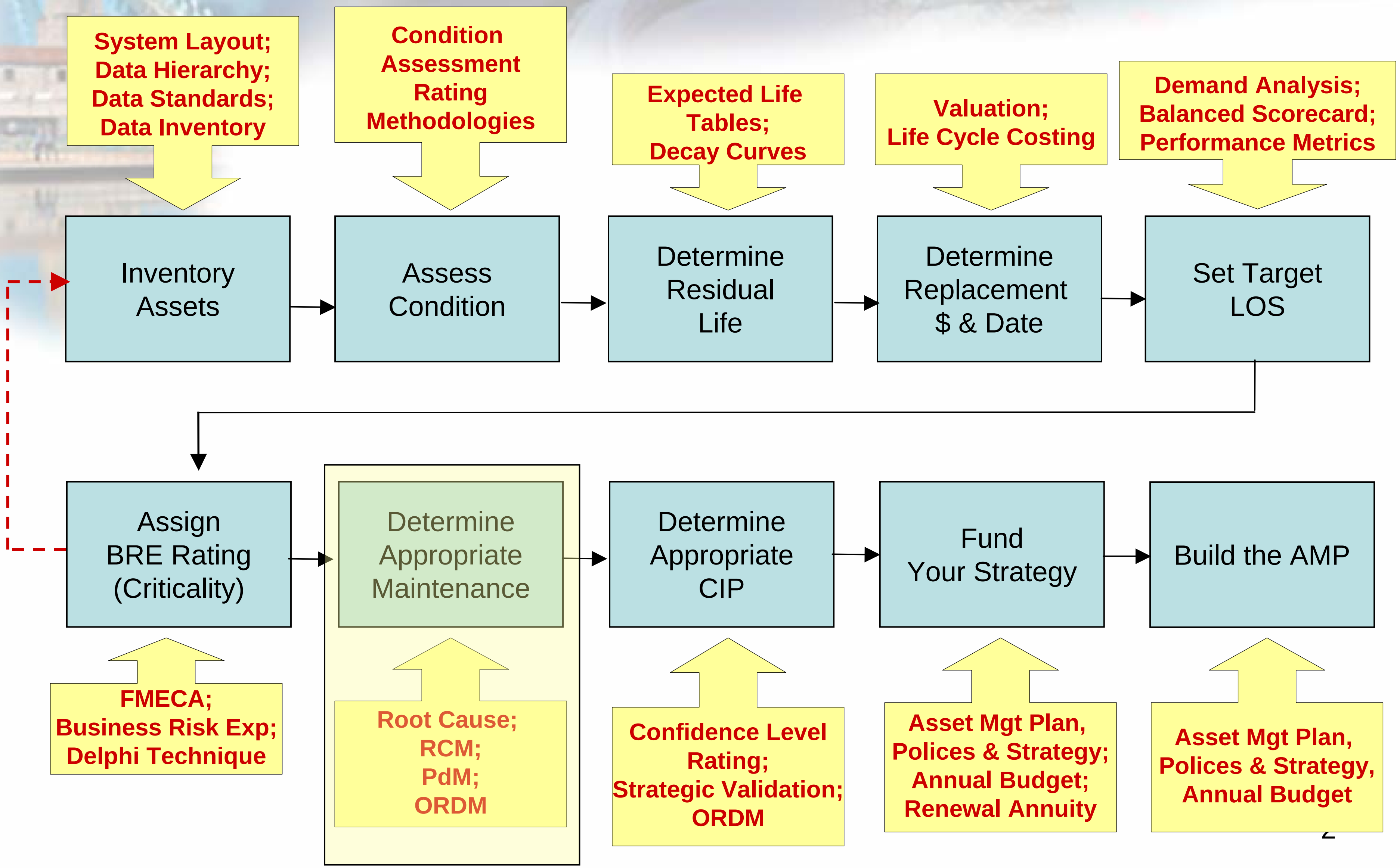
Q4a. Using AAM To Drive O&M Decisions

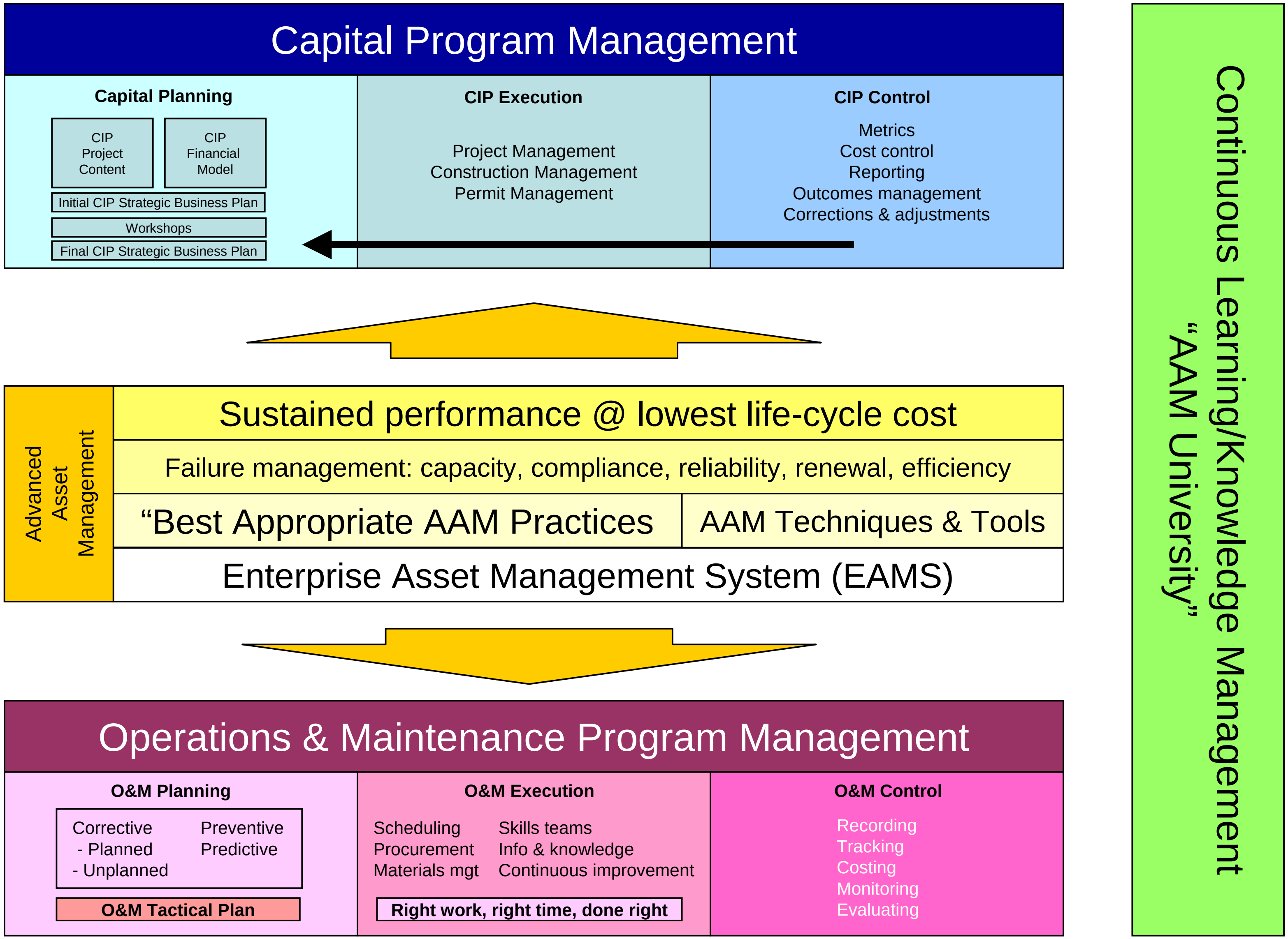
AMPLE

Asset Management Program Learning Environment

Core AAM Program Process Tools



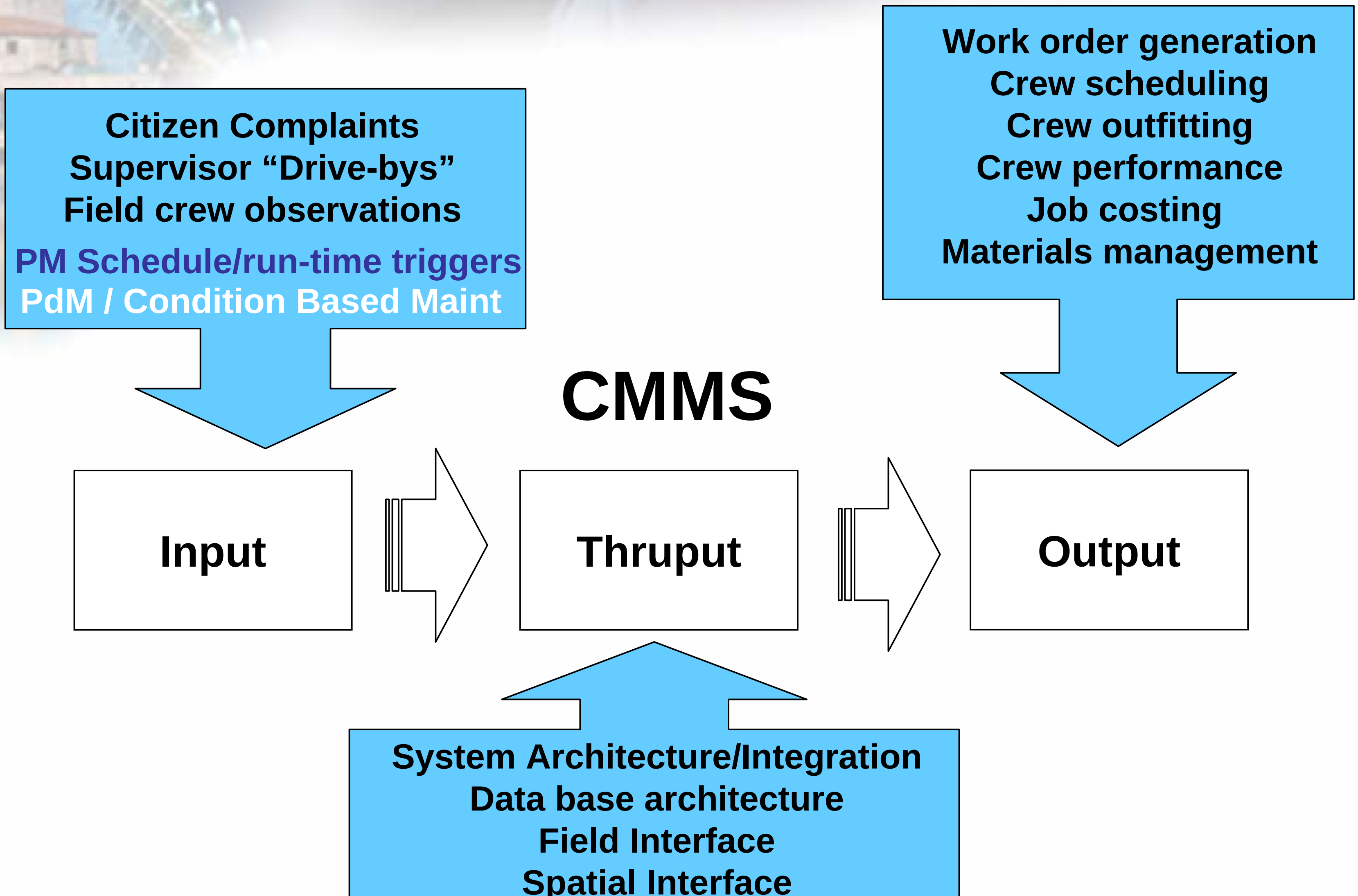
The AAM Model



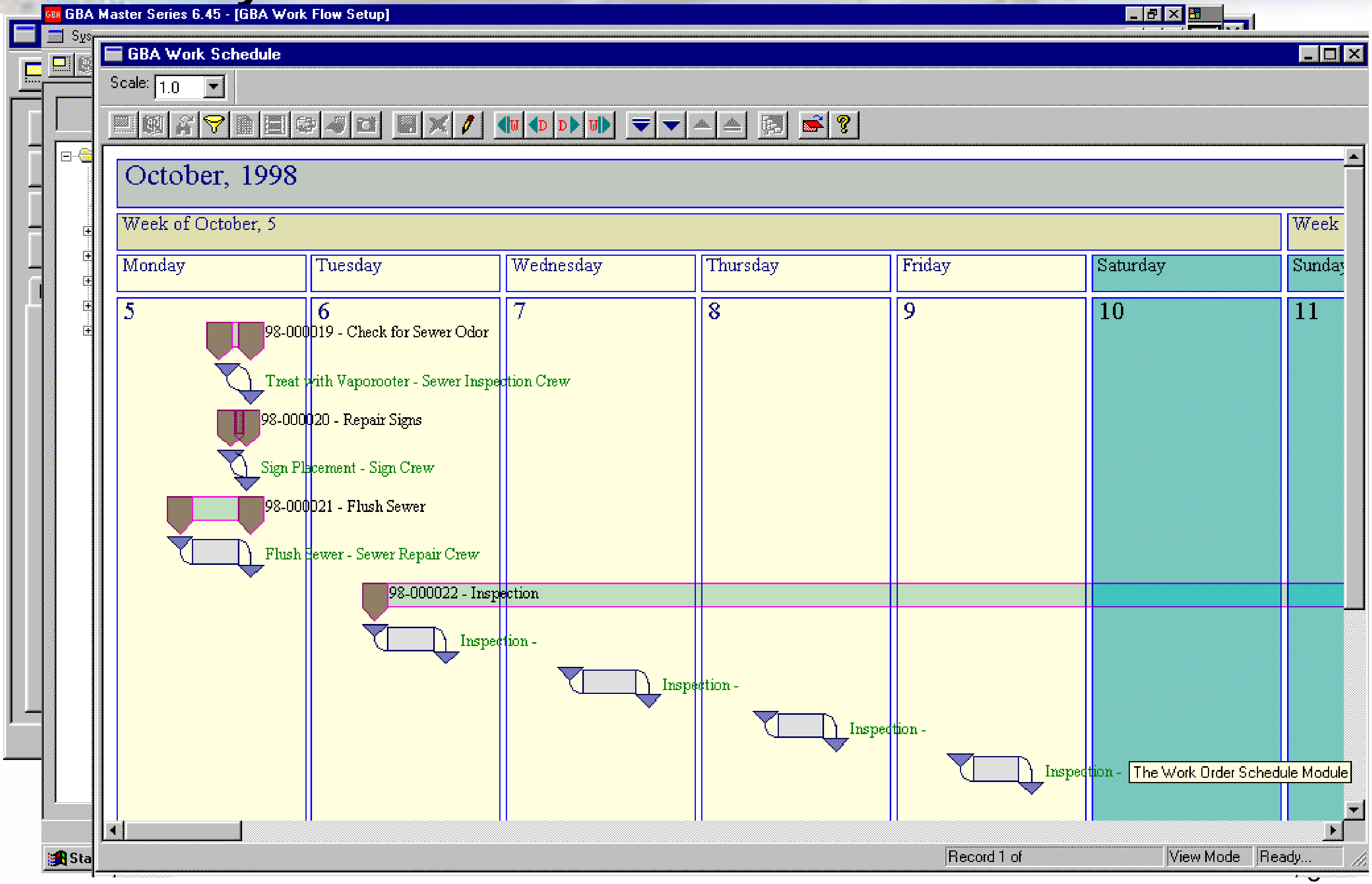
Definitions

- Renewal:
  - Repair – normal periodic maintenance, minor in nature, anticipated in the normal operation of the asset; no enhancement of capabilities; typically funded by operating budget
  - 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

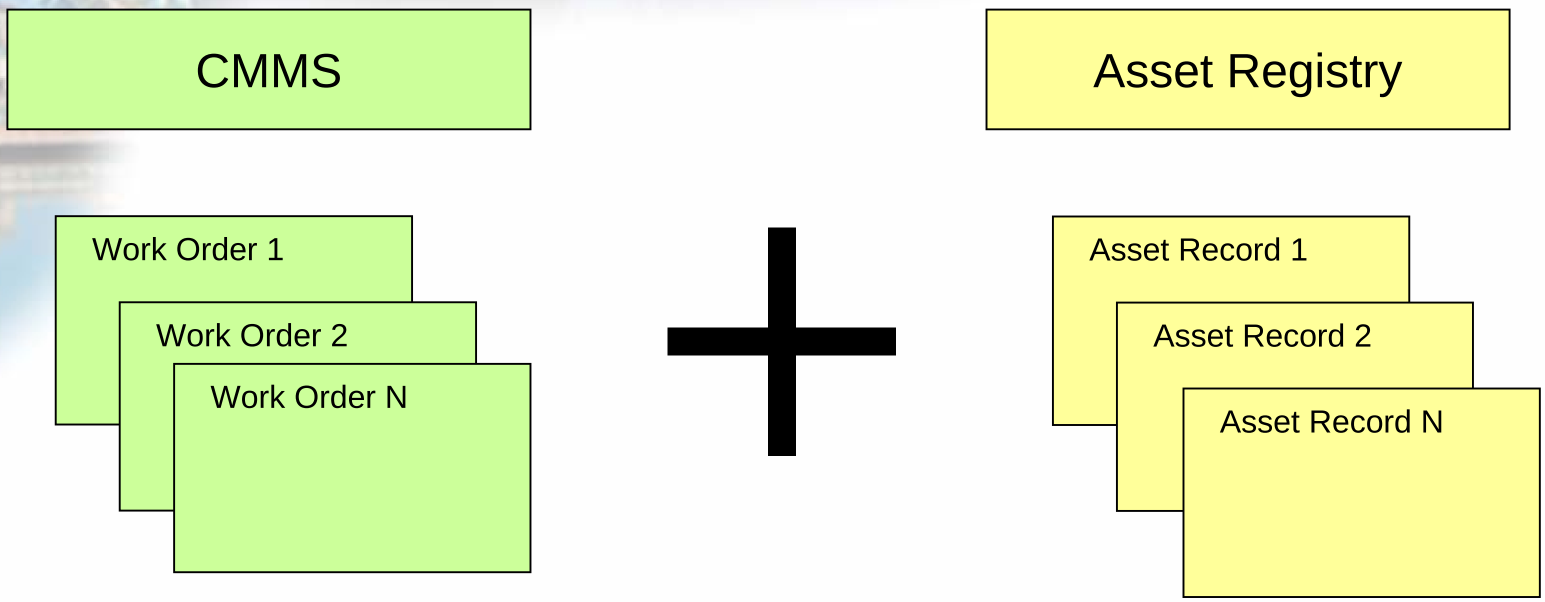
CMMS O&M Triggers



Key to CMMS Is The Work Order



What Distinguishes EAMS from CMMS?



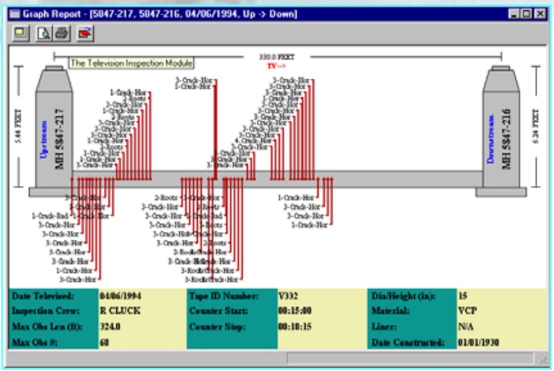
Focus is on the maintenance work order and maintenance performance for a defined period

Focus is on an asset’s performance over its life cycle and on aggregate performance of asset groups

...The Asset View

- 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

Failure Codes



FAILURE MODES IDENTIFIED & ANALYZED

AVAILIBILITY

DEMAND, CAPACITY, QUANTITY

PERFORMANCE LEVEL OF SERVICE

COMPLIANCE

MORTALITY

RELIABILITY, END OF PHYSICAL LIFE

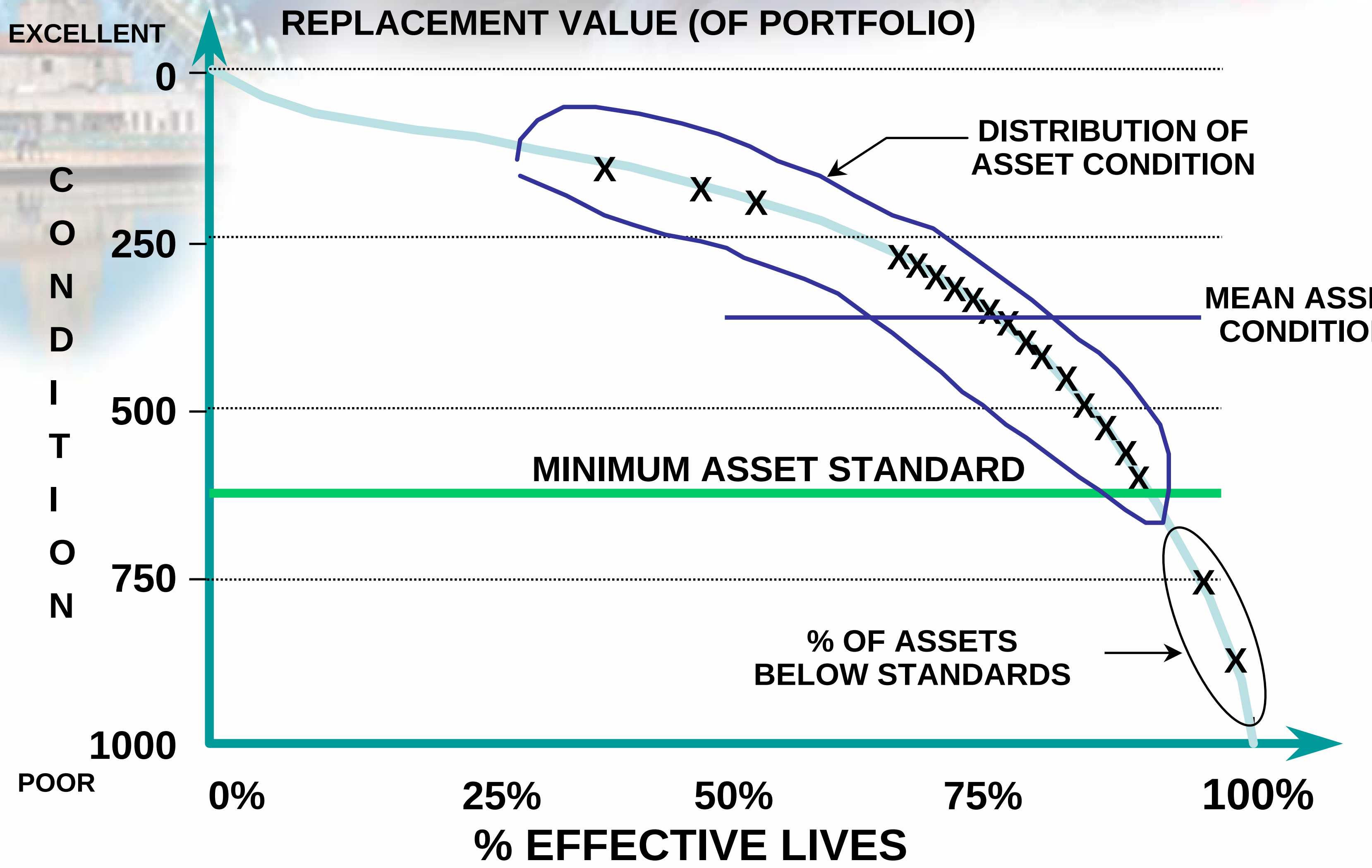
COST

PERFORMS OKAY BUT COSTS TOO MUCH

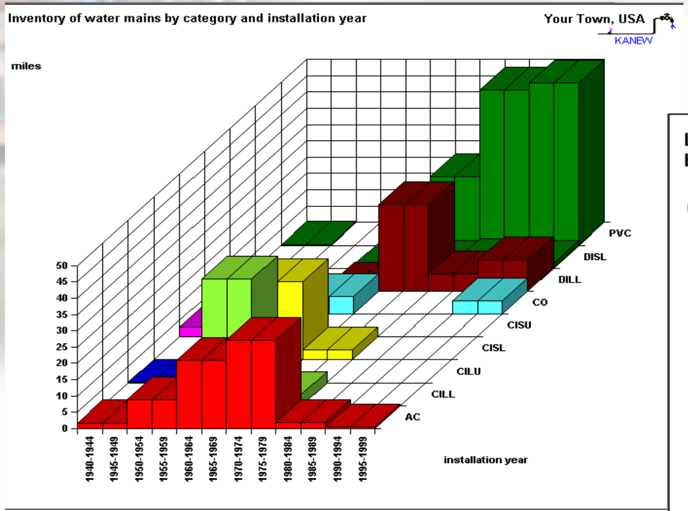
Yields

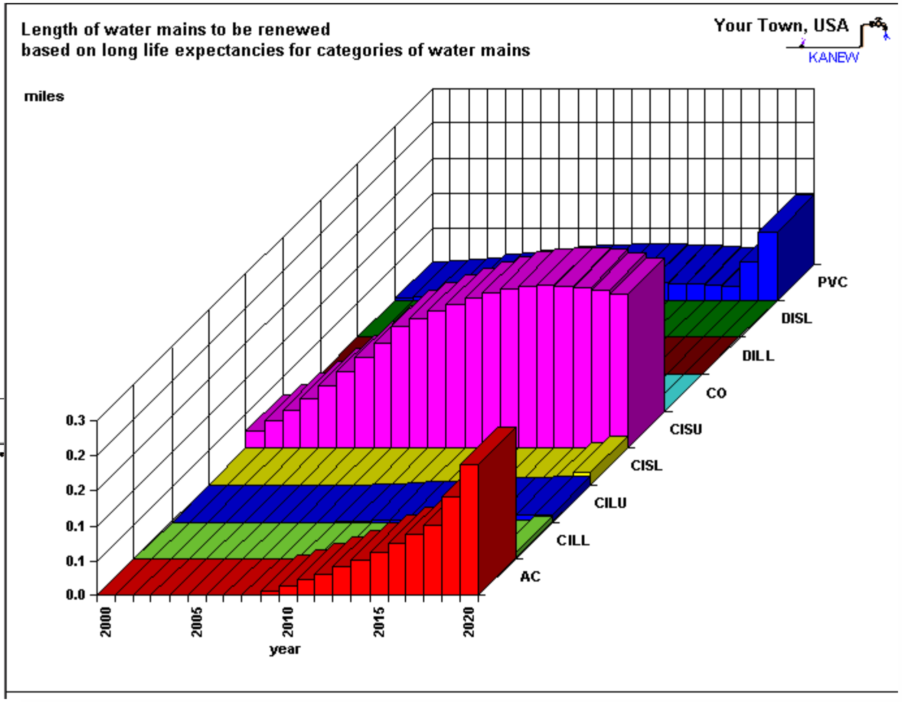
Patterns of Failures Across Assets Over Life Cycle of Each Asset Type

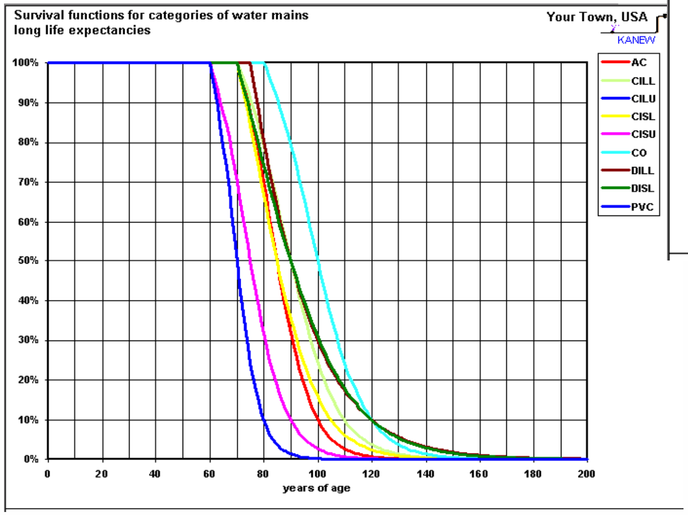
...The Asset Portfolio View



...The Asset Portfolio View



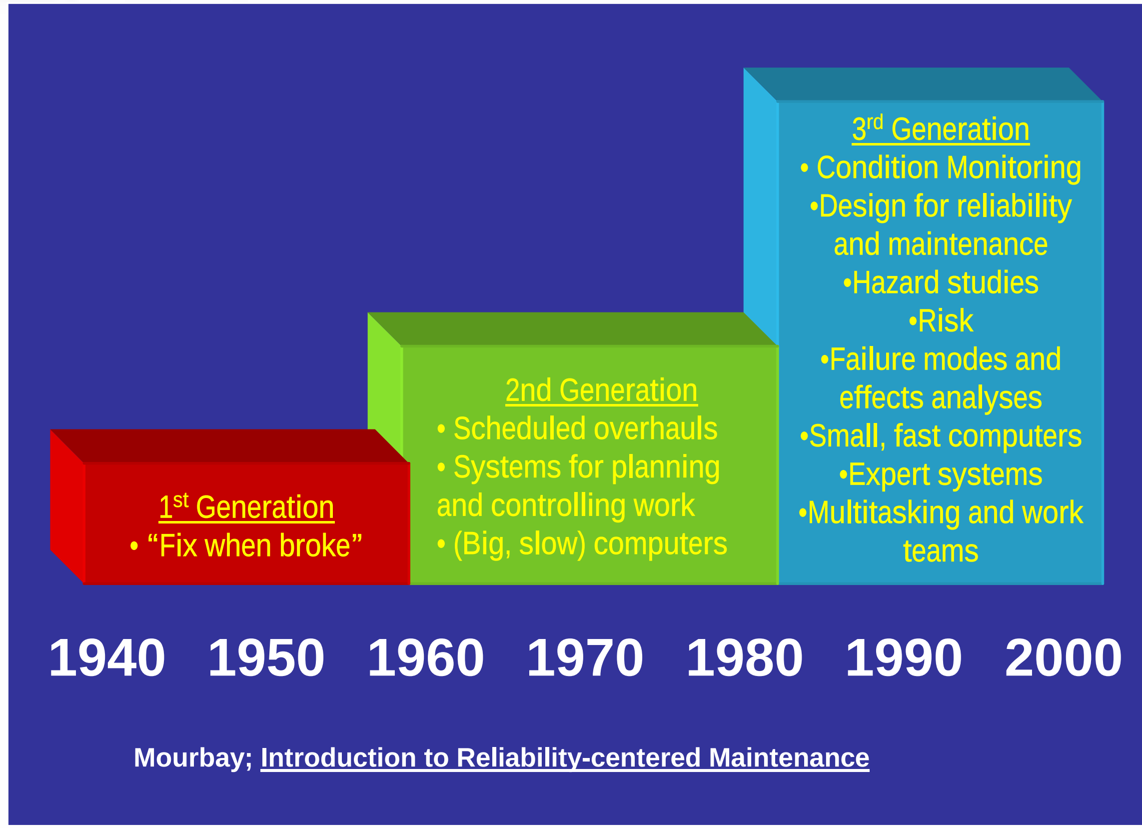




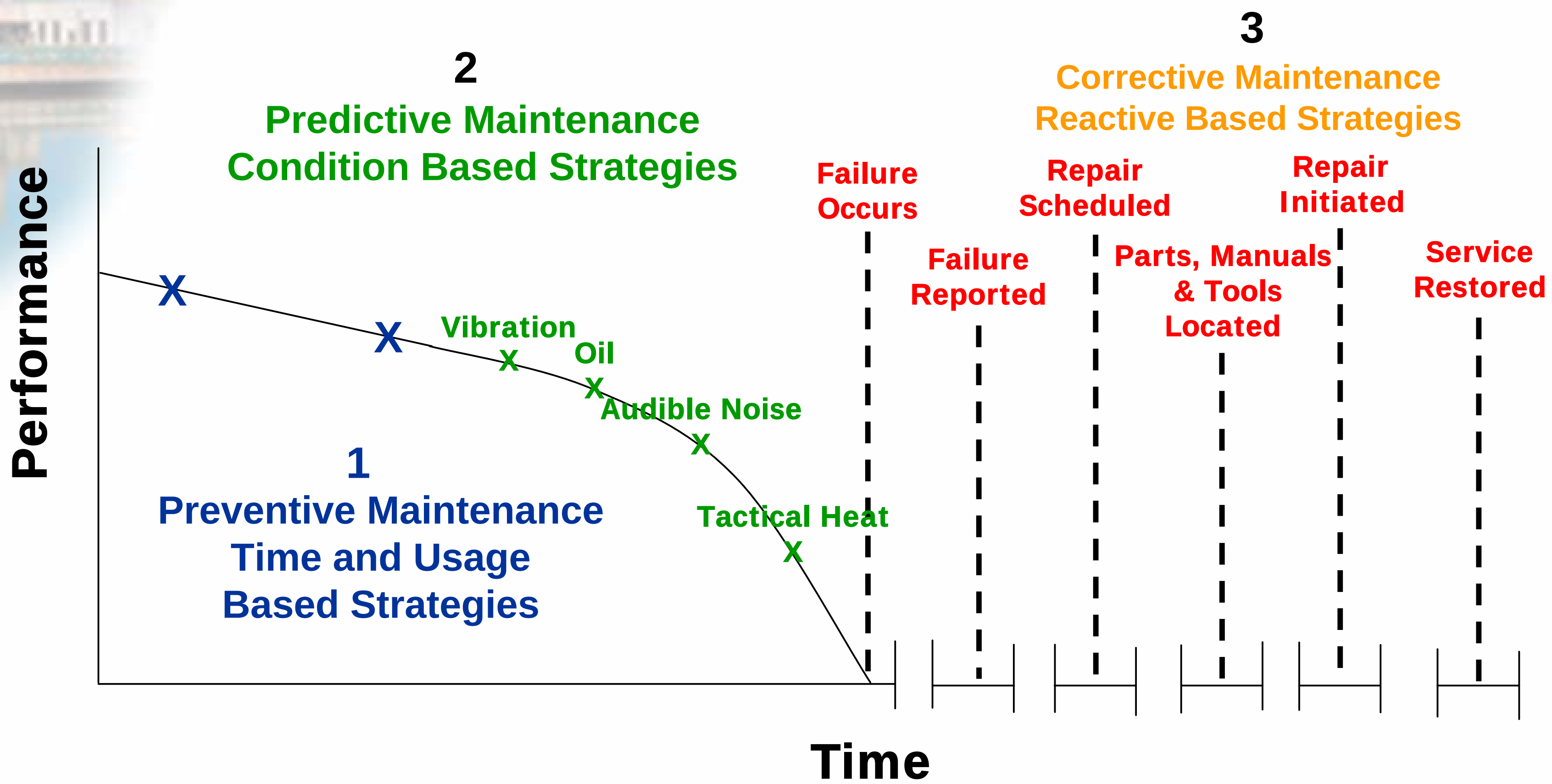
The Evolution of Maintenance Techniques

- **Maintenance:**
  Ensuring that physical assets continue to do what their users want them to do

- **Reliability-centered maintenance:**
  A process used to determine what must be done to ensure that any physical asset continues to do what its users want within its present operating context



“Cost-Compression” Strategies: Asset Life-Cycle Timeline



Cost Compression Strategies & Tactics – The Maintenance Toolbox

Core Strategies		
Total Productive Maintenance	Reliability Centered Maintenance	Zero Breakdown Maintenance

Operational Tactics			
Design Reliability Analysis	Asset Condition Assessment	Early Equipment Management	Maintenance Prevention
Accelerated Deterioration Elimination	Infrastructure, Equipment, & Component Standardization	Commodity Configuration Management	Design For Serviceability
Failure Lead-Time Analysis	Demand Criticality Classification	Location Failure Analysis	Standardized Failure Codes

Total Productive Maintenance

- Embraces both asset design and maintenance
- Goal is to maximize Overall Equipment Effectiveness (OEE), where:

  OEE = availability x performance efficiency x "first-time-through" quality

- Focuses on developing a comprehensive asset management plan for each asset for the life of the asset
- Ties maintenance objectives to the value chain (set-up time, lack of materials, poor quality, equipment functional failures, etc.)

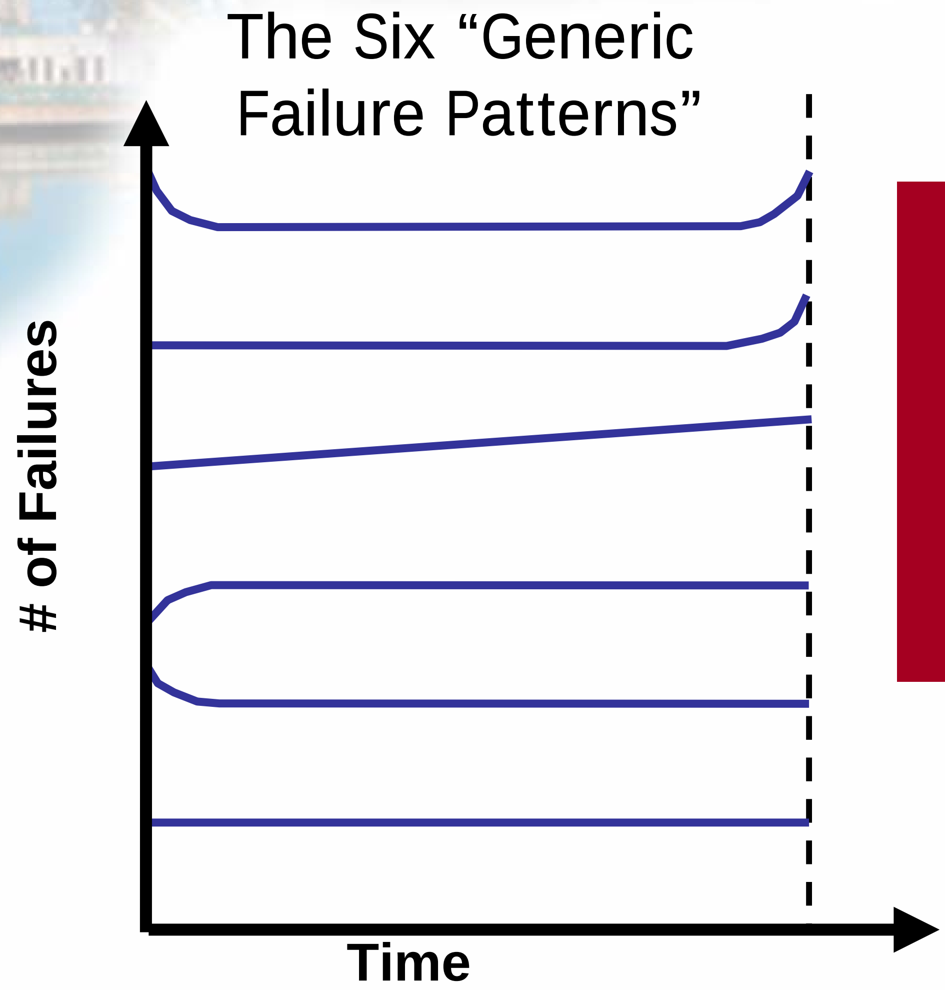
Reliability Centered Maintenance – The Seven Fundamental Questions

1. What are the functions and associated performance standards of the asset in its present operating context?
2. In what ways does it fail to fulfill its functions?
3. What causes each functional failure?
4. What happens *mechanically* when each failure occurs?
5. In what way does each failure matter?
6. What can be done to predict or prevent each failure?
7. What should be done if a suitable proactive task cannot be found?

Techniques:

- Functions and performance standards
- Functional failures
- Failure modes
- Failure effects
- Failure consequences
- Proactive tasks

Reliability Analysis –Failure Curves



<u>Reliability Analysis</u>

"The probability that a component or system will perform its specified function for the specified period under specified operating conditions"

Failure Mode Drives Decision-Making

Identify Failure Modes

Availability/ Capacity

Levels Of Service Quality

Mortality Risk

Cost

Assess Consequence of Failure On Customers / Community

Determine Treatment Options Available To Reduce Consequences Of Failure

Identify Most Appropriate Treatment Option For Business In Total Life Cycle Terms

Making the Business Case Starts With Failure Mode and Risk/Consequence Analysis

FAILURE MODE/S - IDENTIFIED

	AVAILABILITY DEMAND CAPACITY QUANTITY		PERFORMANCE LEVEL OF SERVICE RELIABILITY	MORTALITY END OF PHYSICAL LIFE	COST PERFORMS OKAY BUT COSTS TOO MUCH
MODES	DEMAND EXCEEDS CAPACITY (SUPPLY)	DEMAND INADEQUATE UTILISATION OF ASSET IS POOR	ASSET IS UNRELIABLE AND INTERUPTS SERVICE DELIVERY TO UNACCEPTABLE LEVELS	ASSET STILL PERFORMING ADEQUATELY BUT FAILURE LIKELY	NON PERFORMING FINANCIALLY TECHNICALLY INEFFICIENT OR OBSOLETE.HAS POOR UTILISATION AND DERIVES LOW INCOME / INCOME
EFFECTS	FAILS TO MEET LEVEL OF SERVICE OR STANDARDS REQUIRED	HIGH COST OF SERVICE NON PERFORMING ASSET (FINANCIALLY)	HIGH NUMBER OF FAILURES IMPACTS ON CUSTOMERS. POOR LEVEL OF SERVICE	LOSS OF SERVICE IMPACT DEPENDENT ON DIRECT / INDIRECT CONSEQUENCES OF FAILURE	• HIGH MAINTENANCE AND / OR OPERATING COSTS • HIGH DEPRECIATION • FUTURE LIABILITIES ETC
TREATMENT	ASSET • AUGMENTATION • NEW ASSET • DEMAND • MANAGEMENT	ASSET • DISPOSAL • RATIONALISATION • INCREASE INCOME • CONTINUE SUBSIDY	• IMPROVE MAINTENANCE • REDESIGN • REHABILITATE • REPLACE / DISPOSE • LOWER SERVICE LEVEL	• COMPLETE RISK ASSESSMENT • COMPLETE ORDM • IDENTIFY OPTIMISED RENEWAL	• RATIONALISATION • DISPOSAL • OPTIMISED RENEWAL • LOWER LEVELS OF SERVICE RESPONSE TIMES etc

FILTER ON TOTAL CONSEQUENCES OF FAILURE COSTS TO BUSINESS

Zero-Breakdown Maintenance

Strategies are deployed over four phases:

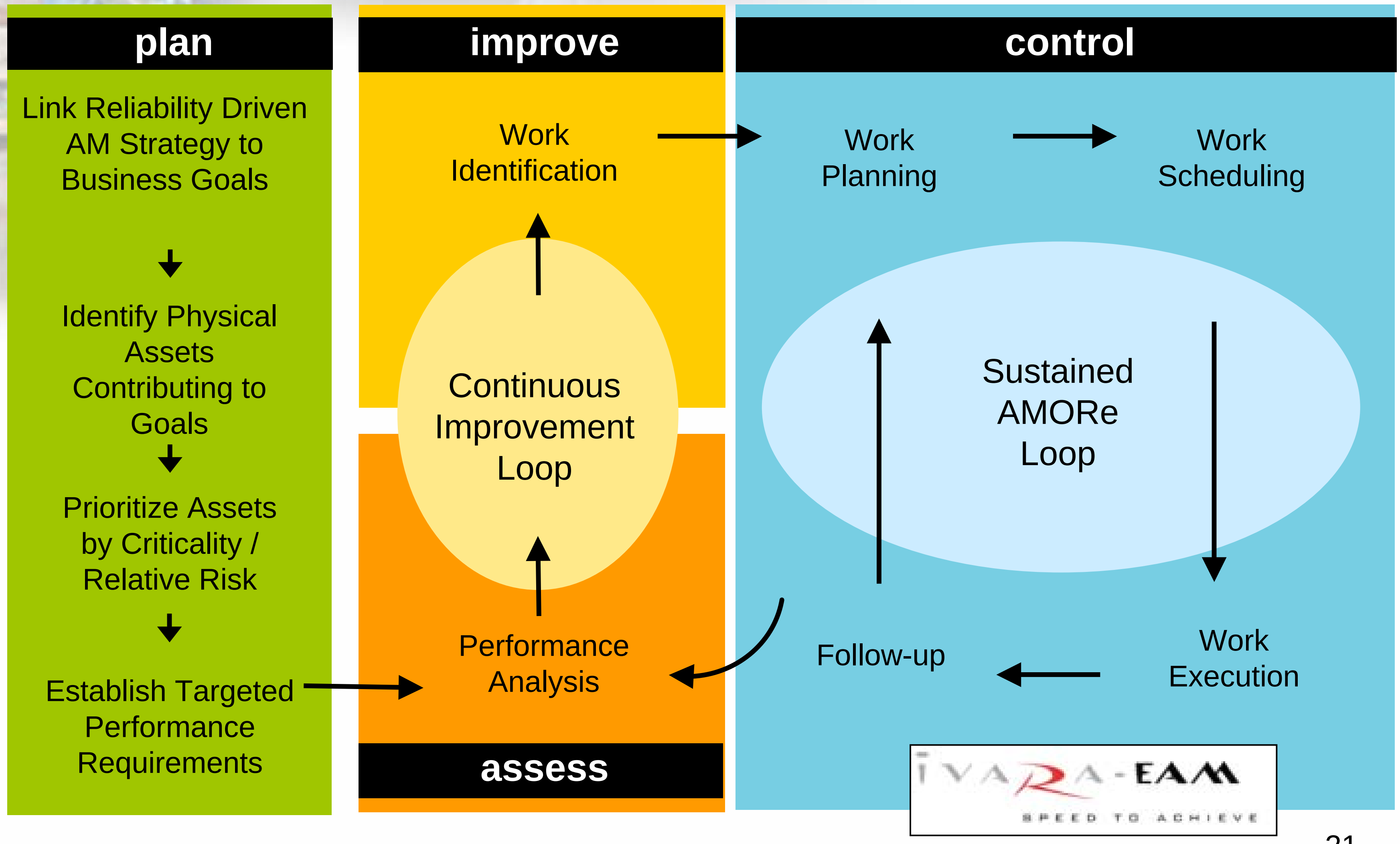
1. Reduce variation in failure intervals
2. Lengthen equipment life
3. Periodically restore deterioration
4. Predict equipment life from its condition

Zero Breakdown Maintenance

Comprised of six core strategies:

1. Eliminate continuing deterioration by establishing basic equipment conditions.
2. Eliminate continuing deterioration by complying with conditions of use.
3. Restore equipment to its optimal condition by restoring deterioration
4. Restore processes to their optimal condition by abolishing conditions that cause accelerated deterioration.
5. Lengthen equipment lifetimes by correcting design weaknesses.
6. Eliminate unexpected failures by improving operating and maintenance skills.

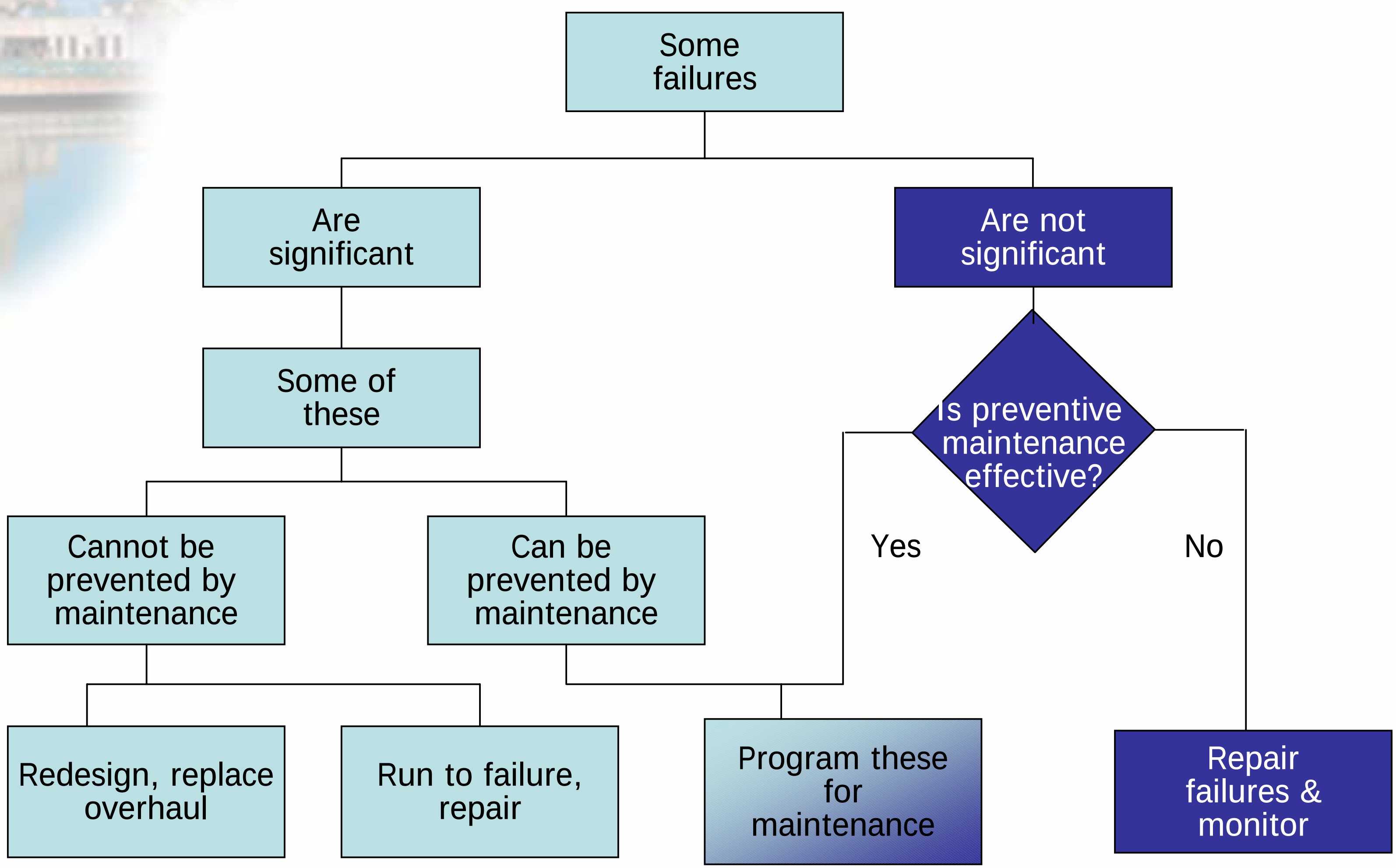
Reliability-Driven AM Process



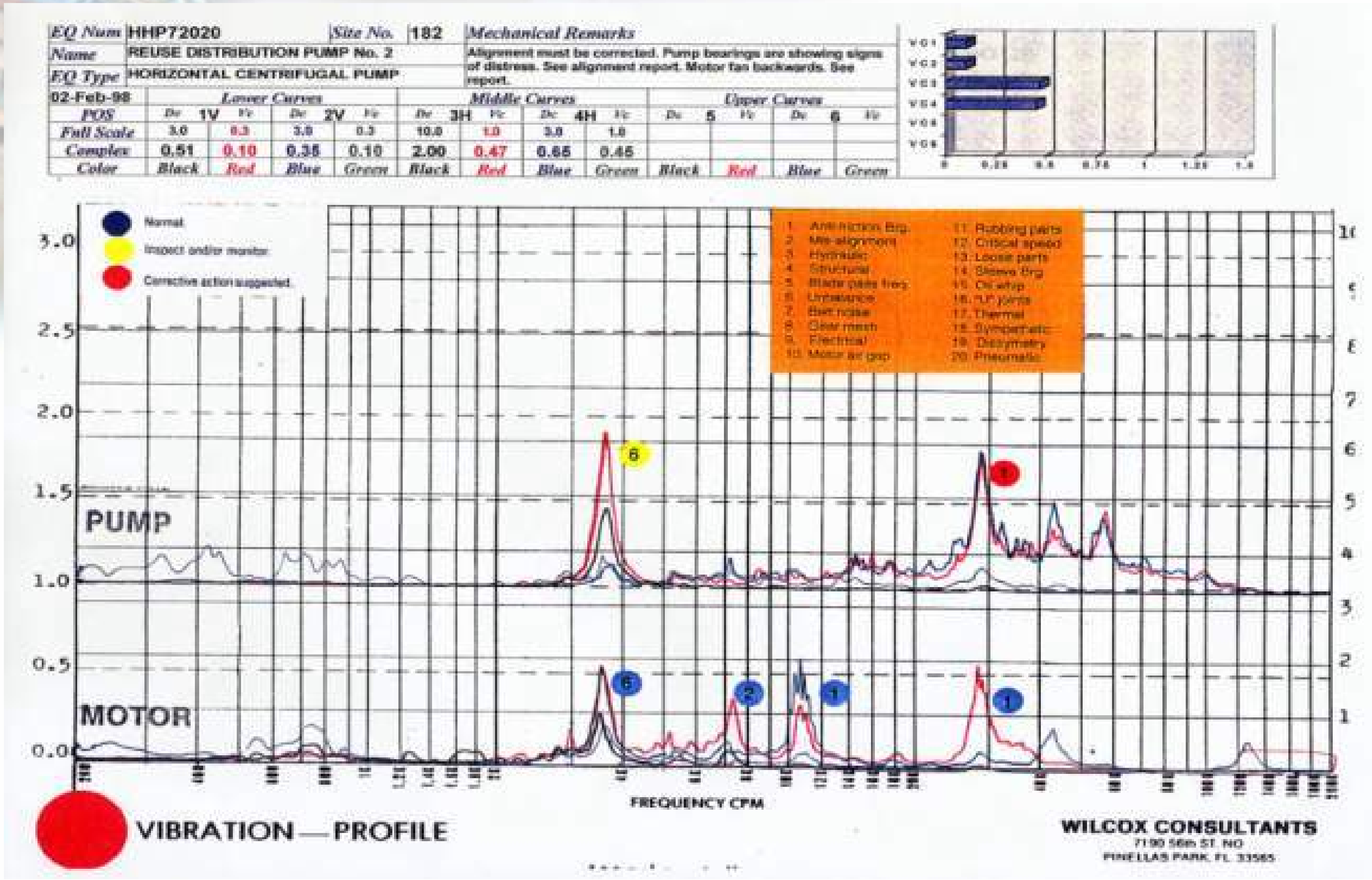
3 Fundamental Maintenance Strategies

1. A zero-based maintenance strategy is one in which no maintenance is undertaken other than statutory or breakdown maintenance. This strategy may be appropriate for assets that are to be replaced, refurbished or disposed (“run to failure”).
2. A preventative maintenance strategy is where maintenance is undertaken at predetermined intervals (based on time or usage) for technical, statutory or reliability considerations.
3. A pro-active maintenance strategy is driven by a systematic inspection process. Maintenance actions are undertaken based on the condition of the asset and on its criticality to sustained performance. Inspection intervals vary with the nature of the decay curve.

Failure-mode Based Management Logic



Vibration Analysis - The Vibration Profile



Power Evaluation

Sample County - Waste Water Utilities Systems

Sewage Lift Stations - Electrical Report - Data as Recorded, June, 1998

	Voltage Line to Line			Amperage			Voltage Drops			Power Data				Horsepower and Load Percent		
Equip. Number	A to B	B to C	C to A	A	B	C	A	B	C	KVA	KVAR	KW	PF	Calc.	Rated	Percent
20LS-RSP-002	244.0	243.0	244.0	24.2	23.7	24.3	0.09	0.08	0.09	9.7	6.9	6.8	90.0	9.1	15.00	60.7
ABLS-RSP-001	474.0	473.0	475.0	24.1	25.1	25.7				17.5	2.8	17.2	98.7	23.1	25.00	92.4
ABLS-RSP-002	474.0	474.0	476.0	27.5	26.7	29.1				18.8	3.2	18.5	98.6	24.8	25.00	99.2
ABLS-RSP-003	474.0	475.0	475.0	25.4	25.8	29.5				17.8	2.9	17.6	98.7	23.6	25.00	94.4
BELS-RSP-001	239.0	240.0	242.0	59.8	52.6	65.7	0.19	0.19	0.18	23.9	12.7	20.3	84.9	27.2	25.00	108.8
BELS-RSP-002	240.0	242.0	240.0	60.5	51.3	55.4	0.16	0.16	0.18	21.5	13.6	16.7	77.6	22.4	25.00	89.6
BGLS-RSP-001	242.0	241.0	242.0	8.5	8.6	8.8	0.30	0.30	0.36	3.6	2.4	2.7	74.5	3.6	3.00	120.0
BGLS-RSP-002	242.0	241.0	242.0	9.4	9.3	9.6	0.24	0.18	0.17	3.9	2.1	3.3	84.2	4.4	3.00	146.7
BLLS-RSP-001	479.0	475.0	468.0	3.9	3.8	3.9	0.08	0.08	0.07	3.0	2.0	2.3	75.3	3.1	2.00	155.0
BLLS-RSP-002	482.0	483.0	485.0	4.0	3.9	4.0	0.08	0.06	0.13	3.1	2.1	2.3	73.8	3.1	2.00	155.0
CMLS-RSP-001	457.0	456.0	456.0	6.6	6.6	7.2	0.40	0.40	0.42	5.1	3.6	3.7	71.3	5.0	7.50	66.7
CMLS-RSP-002	457.0	458.0	458.0	6.0	6.0	6.1	0.27	0.27	0.63	4.7	3.8	2.7	58.0	3.6	7.50	48.0
DWLS-RSP-001	486.0	485.0	486.0	22.1	22.9	24.0	0.14	0.21	0.14	19.0	10.9	15.6	82.0	20.9	20.00	104.5
DWLS-RSP-002	485.0	486.0	485.0	21.3	22.0	22.8	0.16	0.14	0.15	18.3	10.7	14.8	81.1	19.8	20.00	99.0
FDLS-RSP-001	239.0	239.0	239.0	21.1	22.1	22.8	0.21	0.25	0.20	9.0	6.6	6.1	68.2	8.2	10.00	82.0
FDLS-RSP-002	240.0	239.0	240.0	23.9	24.0	25.6	0.26	0.26	0.31	10.0	7.0	7.1	70.9	9.5	10.00	95.0
FRLS-RSP-001	212.0	213.0	215.0	4.9	5.4	5.9	0.23	0.22	0.26	2.0	1.5	1.3	66.5	1.7	2.00	85.0
FRLS-RSP-002	212.0	213.0	215.0	5.2	5.6	6.1	0.25	0.25	0.27	2.1	1.5	1.4	70.0	1.9	2.00	95.0
FSLS-RSP-001	239.0	240.0	240.0	33.7	36.8	42.7	0.14	0.14	0.13	14.8	10.3	10.6	71.7	14.2	15.00	94.7
FSLS-RSP-002	239.0	239.0	240.0	31.4	34.7	39.8	0.17	0.16	0.19	13.9	10.7	8.9	63.9	11.9	15.00	79.3
H6LS-RSP-001	244.0	242.0	242.0	9.2	8.8	9.5	0.62	0.79	0.73	3.8	2.5	2.9	74.7	3.9	3.00	130.0
H6LS-RSP-002	242.0	242.0	241.0	10.2	9.5	10.0	0.49	0.81	0.60	4.1	2.9	2.9	70.6	3.9	3.00	130.0
HCLS-RSP-001	242.0	242.0	243.0	28.4	27.1	26.0	0.12	0.10	0.12	11.2	9.0	6.7	59.3	9.0	15.00	60.0
HCLS-RSP-002	243.0	242.0	243.0	28.3	26.9	25.6	0.12	0.11	0.12	11.2	8.6	7.1	63.6	9.5	15.00	63.3
HKLS-RSP-001	241.0	241.0	242.0	60.3	60.1	38.2	0.45	0.30	0.72	27.1	20.6	17.7	65.1	23.7	40.00	59.3
HKLS-RSP-002	240.0	241.0	241.0	62.4	63.2	66.0	0.23	0.36	0.66	26.6	16.9	21.3	80.2	28.6	40.00	71.5
HSLS-RSP-001	208.0	206.0	208.0	240.3	26.2	28.1	0.19	0.19	0.28	9.0	5.8	6.9	76.5	9.2	10.00	92.0
HSLS-RSP-002	208.0	206.0	208.0	24.1	26.4	27.7	0.17	0.19	0.20	9.0	5.7	6.7	77.4	9.0	10.00	90.0
JHLS-RSP-001	244.0	243.0	243.0	50.9	52.4	51.6	0.21	0.65	0.19	21.4	15.4	14.9	69.6	20.0		
JHLS-RSP-002	245.0	244.0	245.0	44.1	42.8	45.1	0.36	0.54	0.32	18.4	12.7	13.4	72.7	18.0		
MWLS-RSP-001	241.0	240.0	241.0	11.0	11.6	12.4	0.19	0.13	0.14	4.7	2.5	4.0	84.8	5.4	7.50	72.0

Prepared by Wilcox Consulting Inc. - Madeira Beach Office - 11/8/00

Page 1

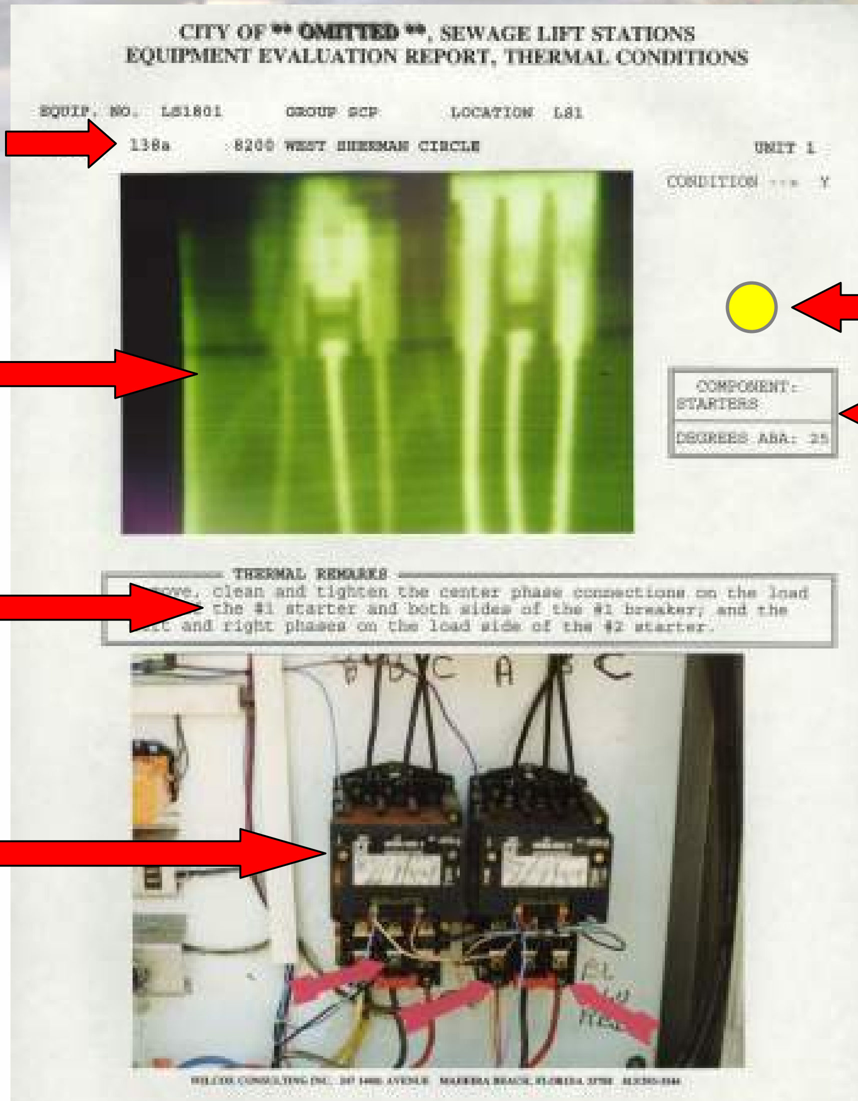
Typical Infrared Report Sheet

Identification

IR View

Remarks

Visual



CITY OF ** OMITTED **, SEWAGE LIFT STATIONS
EQUIPMENT EVALUATION REPORT, THERMAL CONDITIONS

EQUIP. NO. LS1801   GROUP SCP   LOCATION LS1

138a   8200 WEST SHERMAN CIRCLE   UNIT 1

CONDITION --- Y

COMPONENT: STARTERS

DEGREES ABA: 25

THERMAL REMARKS

…ove, clean and tighten the center phase connections on the load … the #1 starter and both sides of the #1 breaker; and the …t and right phases on the load side of the #2 starter.

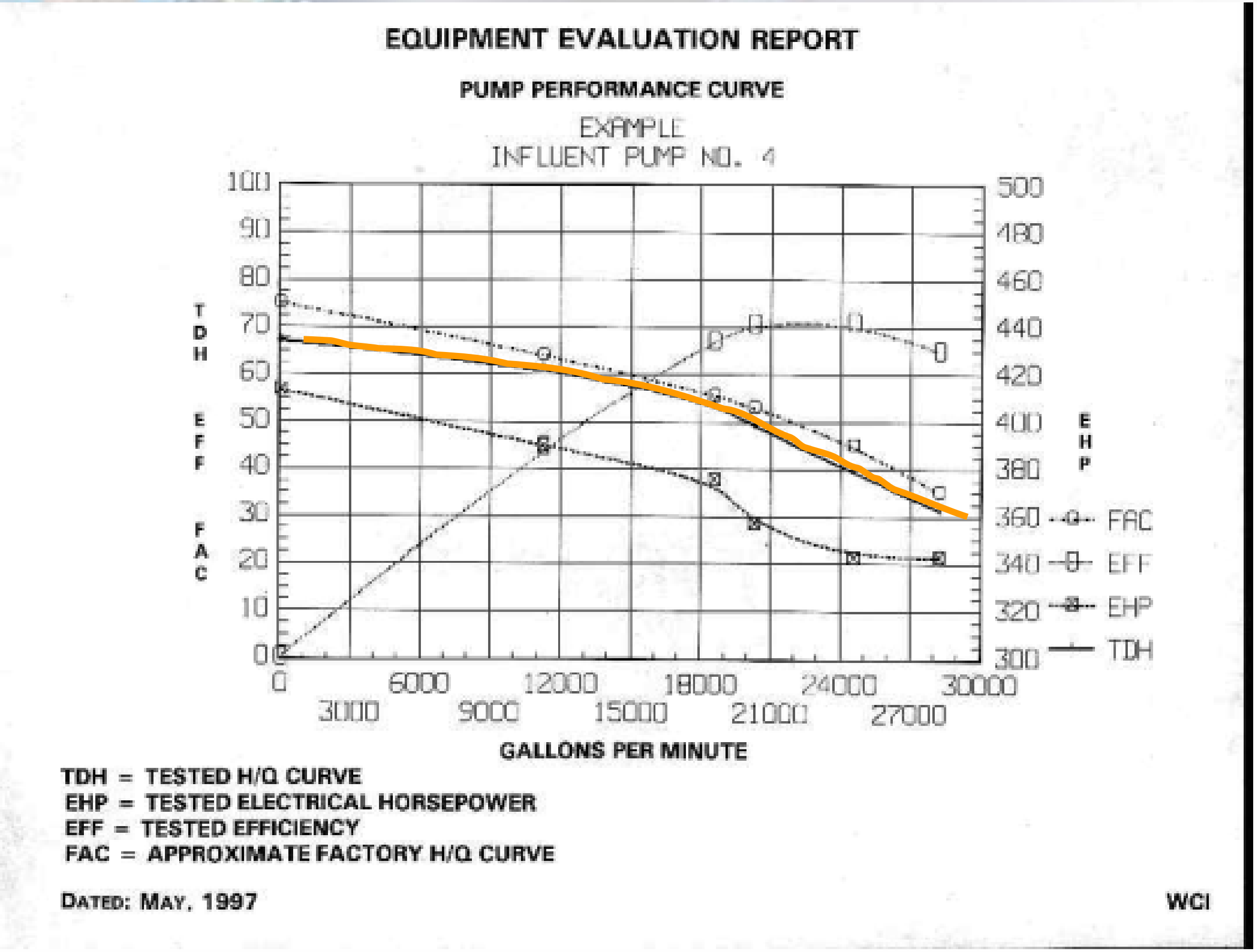
Severity Code

Component Temp

Alignment Inspection and Correction Data

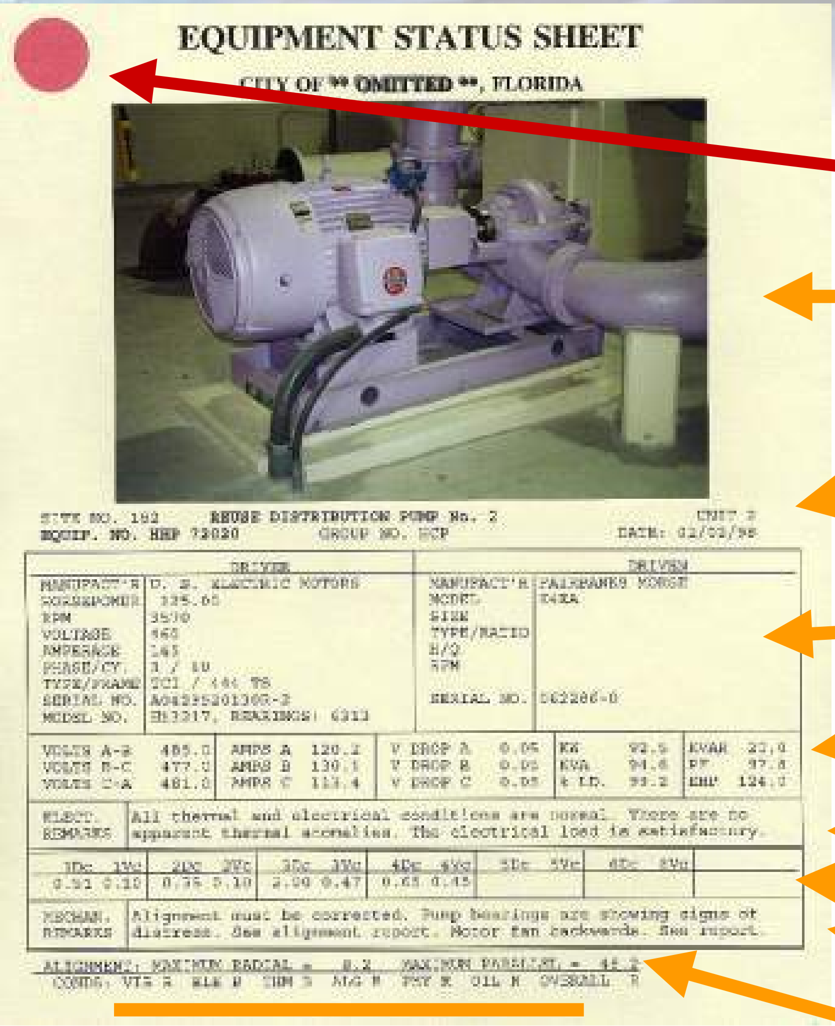
- Coupling Failure
- Bearing Failure

Machine Performance Tests



- Full hydraulic testing of selected machines
- Conforms to factory test curves?

The Status Sheet (Summary)



EQUIPMENT STATUS SHEET

CITY OF ** OMITTED **, FLORIDA

SITE NO. 182 REUSE DISTRIBUTION PUMP No. 2 UNIT 2
EQUIP. NO. HHP 72020 GROUP NO. HCP DATE: 02/03/98

DRIVER		DRIVEN	
MANUFACT'R	U. S. ELECTRIC MOTORS	MANUFACT'R	FAIRBANKS MORSE
HORSEPOWER	125.60	MODEL	5424
RPM	3570	SIZE	
VOLTAGE	460	TYPE/RATIO	
AMPERAGE	145	H/Q	
PHASE/CY.	3 / 60	RPM	
TYPE/FRAME	TCI / 444 TS		
SERIAL NO.	A04295201306-2	SERIAL NO.	062286-0
MODEL NO.	H13217, BEARINGS: 6313		

VOLTS A-B	485.0	AMPS A	120.2	V DROP A	0.06	KW	92.5	KVAR	22.0
VOLTS B-C	477.0	AMPS B	130.1	V DROP B	0.05	KVA	94.6	PF	97.8
VOLTS C-A	481.0	AMPS C	113.4	V DROP C	0.08	% LD.	99.2	EHP	124.0

ELECT. REMARKS: All thermal and electrical conditions are normal. There are no apparent thermal anomalies. The electrical load is satisfactory.

1Dc	1Vc	2Dc	2Vc	3Dc	3Vc	4Dc	4Vc	5Dc	5Vc	6Dc	6Vc
0.51	0.10	0.75	0.10	2.00	0.47	0.65	0.45				

MECHAN. REMARKS: Alignment must be corrected. Pump bearings are showing signs of distress. See alignment report. Motor fan backwards. See report.

ALIGNMENT: MAXIMUM RADIAL = 8.2 MAXIMUM PARALLEL = 46.2
CONDS: VIB R ELE N THM N MAG N PHY N OIL N OVERALL R

Overall condition

Picture of machine

Description

All Nameplate Data

Electrical Data

Elect. And Thermal Remarks

Vibration Data

Mech. and Phys. Remarks

Conditions

Alignment Data

Equipment Status List

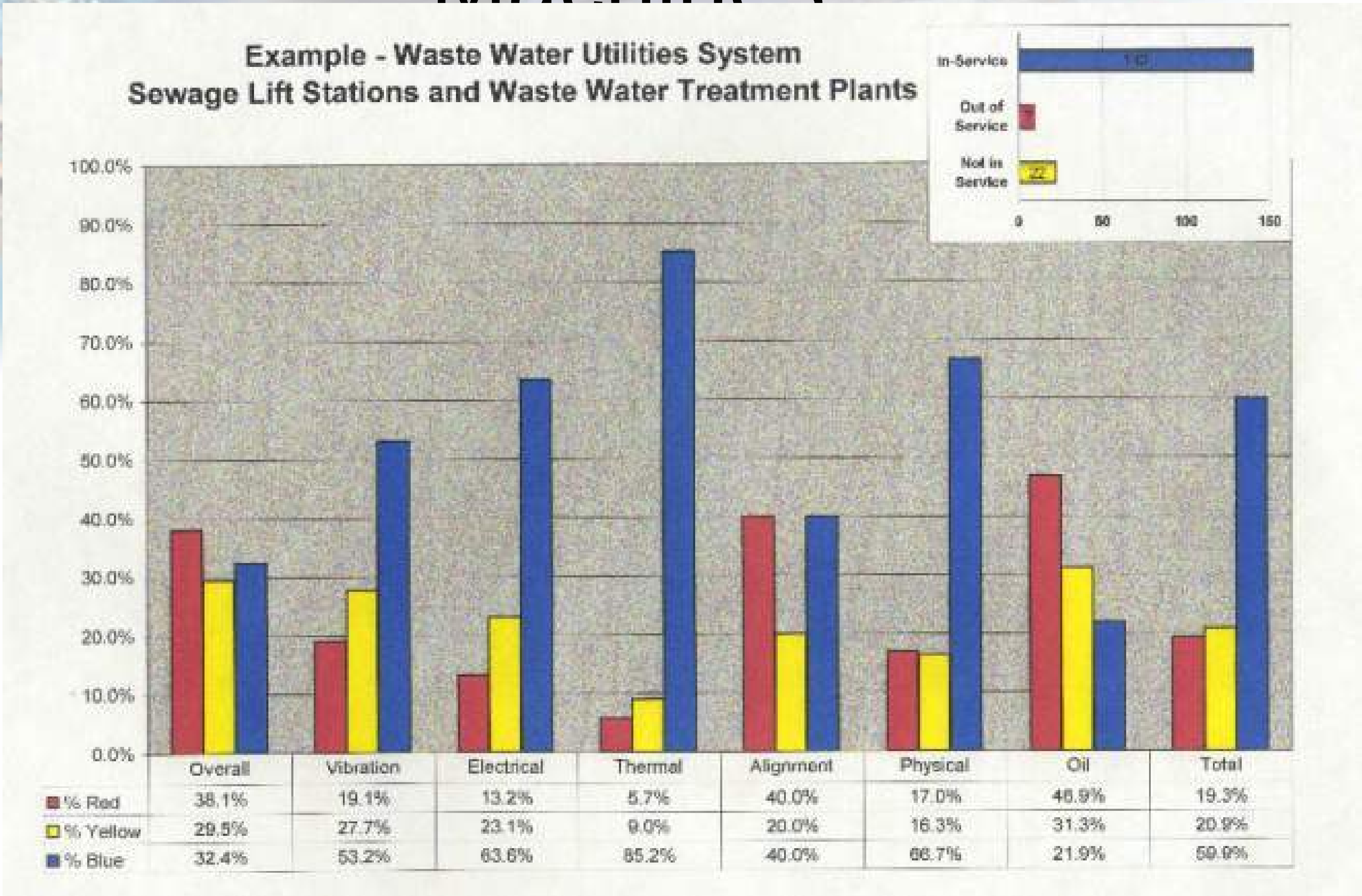
EQUIPMENT SUMMARY REPORT - STATUS LIST

June, 1998

Equipment Number	Site Number	Overall	Vibration	Electrical	Thermo-graphy	Alignment	Physical	Oil
LOCEQ	SITENO	OACC	VIBC	ELEC	THRC	ALGC	PHYC	OILC
20LS-RSP-001	113A	O	N	N	N	N	R	N
20LS-RSP-002	113B	Y	Y	B	B	N	B	N
ABLS-RSP-001	101A	Y	B	B	B	N	B	N
ABLS-RSP-002	101B	Y	Y	B	B	N	B	N
ABLS-RSP-003	101C	Y	B	N	N	N	R	N
ABTP-ADU-001	201	B	B	Y	B	N	B	B
ABTP-ADU-002	202	Y	N	N	N	N	B	B
ABTP-ADU-003	203	B	N	N	N	N	B	B
ABTP-ADU-004	204	R	N	N	N	N	B	B
ABTP-BC1-001	205	R	N	N	N	N	B	R
ABTP-BC1-002	206	R	N	B	B	N	B	R
ABTP-BC1-002	207	R	B	B	B	N	B	R
ABTP-MAC-001	225	N	B	B	B	N	B	N
ABTP-PFP-001	226	N	B	B	B	N	B	N
ABTP-SFP-001	223	N	N	N	N	N	N	N
ABTP-SFP-002	227	N	N	Y	B	N	Y	N
ABTP-SFP-002	224	N	R	R	B	N	R	N
ABTP-TBF-001	211	N	N	B	B	N	B	N
ABTP-TBF-002	212	N	N	B	B	N	B	N
ABTP-TBF-003	213	N	B	B	Y	N	B	N
ABTP-TBF-004	214	N	N	B	B	N	B	N
ABTP-TBF-005	215	N	Y	Y	B	N	Y	N
ABTP-TBF-006	216	N	N	Y	B	N	Y	N
ABTP-THK-001	220	R	N	N	N	N	N	R
ABTP-THK-002	221	B	B	B	B	N	B	N

Severity Color Code

Graphic Summary - All Machines



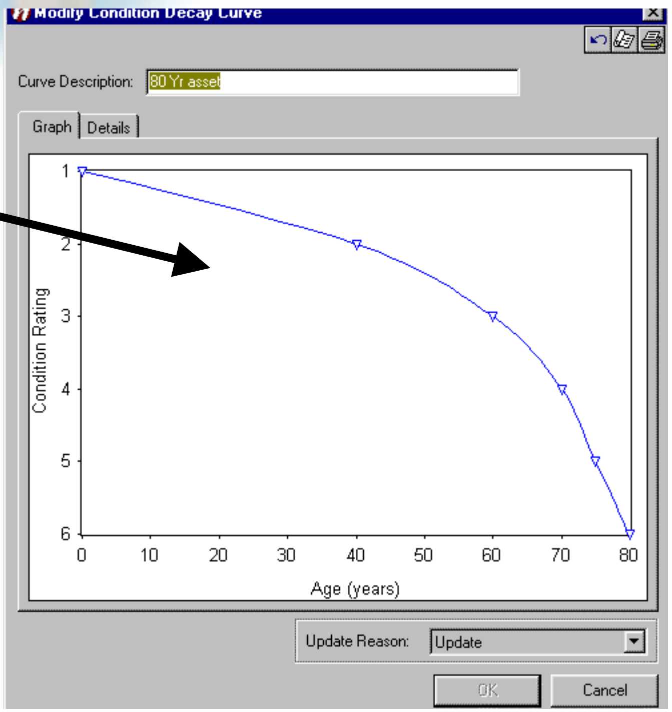
	Overall	Vibration	Electrical	Thermal	Alignment	Physical	Oil	Total
% Red	38.1%	19.1%	13.2%	5.7%	40.0%	17.0%	46.9%	19.3%
% Yellow	29.5%	27.7%	23.1%	9.0%	20.0%	16.3%	31.3%	20.9%
% Blue	32.4%	53.2%	63.6%	85.2%	40.0%	66.7%	21.9%	59.9%

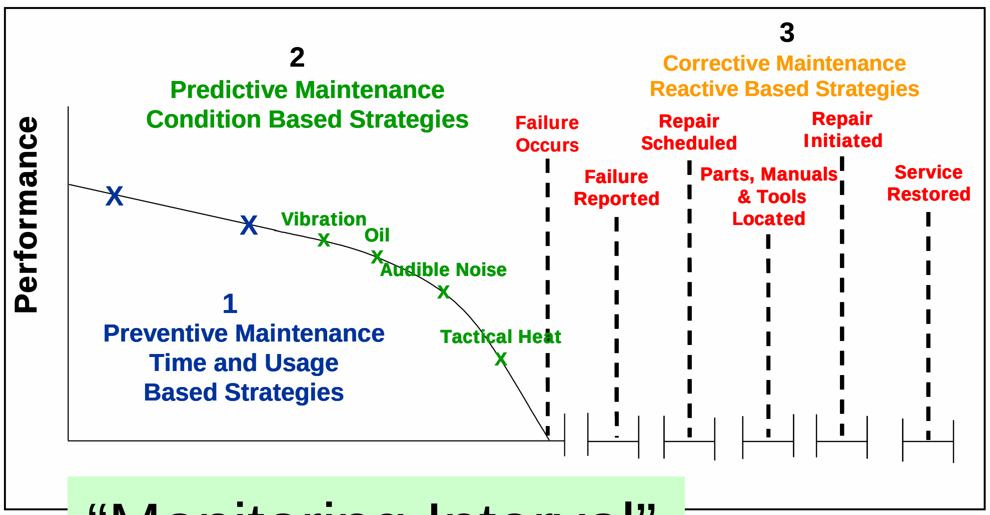
Condition-Based Maintenance

"Nameplate" Data

+

Vibration Signature	Sonic Signature	Thermal Signature	Electrical Signature	Performance Signature	Oil Residue Signature	Electro-magnetic Signature





"Monitoring Interval"

Example RCM Analysis on Headworks Screen

RCM II INFORMATION WORKSHEET © 1994 Aladon Ltd	SYSTEM: *Bull screens*	No. 0	Compiled by	Date 18-Aug-02	Sheet 1
	SUB-SYSTEM	Ref. *Bull screens*	Reviewed by	Date	of 49

FUNCTION		FUNCTIONAL FAILURE		FAILURE MODE (Cause of failure)		FAILURE EFFECT (What happens when it fails)
1	To remove all sedimentary and floating foreign matter greater than 1 inch from the effluent	A	Cannot remove foreign matter from the effluent	1	Bull screen shovel control cable worn	Over time the control cable wears and thins, strands start to break and eventually the cable looses enough tensile strength that it can no longer support the shovel's weight when open. The cable breaks and the shovel closes and cannot be opened. During its decent the shovel catches on the scraper and beaks it off. The shovel continues its cycle but does not open and cannot gather foreign matter. The excess material in front of the screen accumulates and the water level differential across the screen rises. The shovel tries to clean the screen more often and eventually the water level in front of the screen rises enough that the "high level" alarm sounds in the control room. With time the channel overflows. Repair time: 4 hours, Downtime: 5 hours. Special tools: mobile scaffolding and security bar. Spare parts: Wire rope in stock.
1		A		2	Bull screen shovel control cable extension worn	The control cable extension is positioned at the portion of the cable that flexes the most during normal operation. Over time the control cable extension wears and thins, strands start to break and eventually the cable looses enough tensile strength that it can no longer support the shovel's weight when open. The cable breaks and the shovel closes and cannot be opened. During its decent the shovel catches on the scraper and beaks it off. The shovel continues its cycle but does not open and cannot gather foreign matter. The excess material in front of the screen accumulates and the water level differential across the screen rises. The shovel tries to clean the screen more often and eventually the water level in front of the screen rises enough that the "high level" alarm sounds in the control room. With time the channel overflows. Repair time: 4 hours, Downtime: 5 hours. Special tools: mobile scaffolding and security bar. Spare parts: Wire rope in stock from which to make the extension.

IVARA-EAM
SPEED TO ACHIEVE

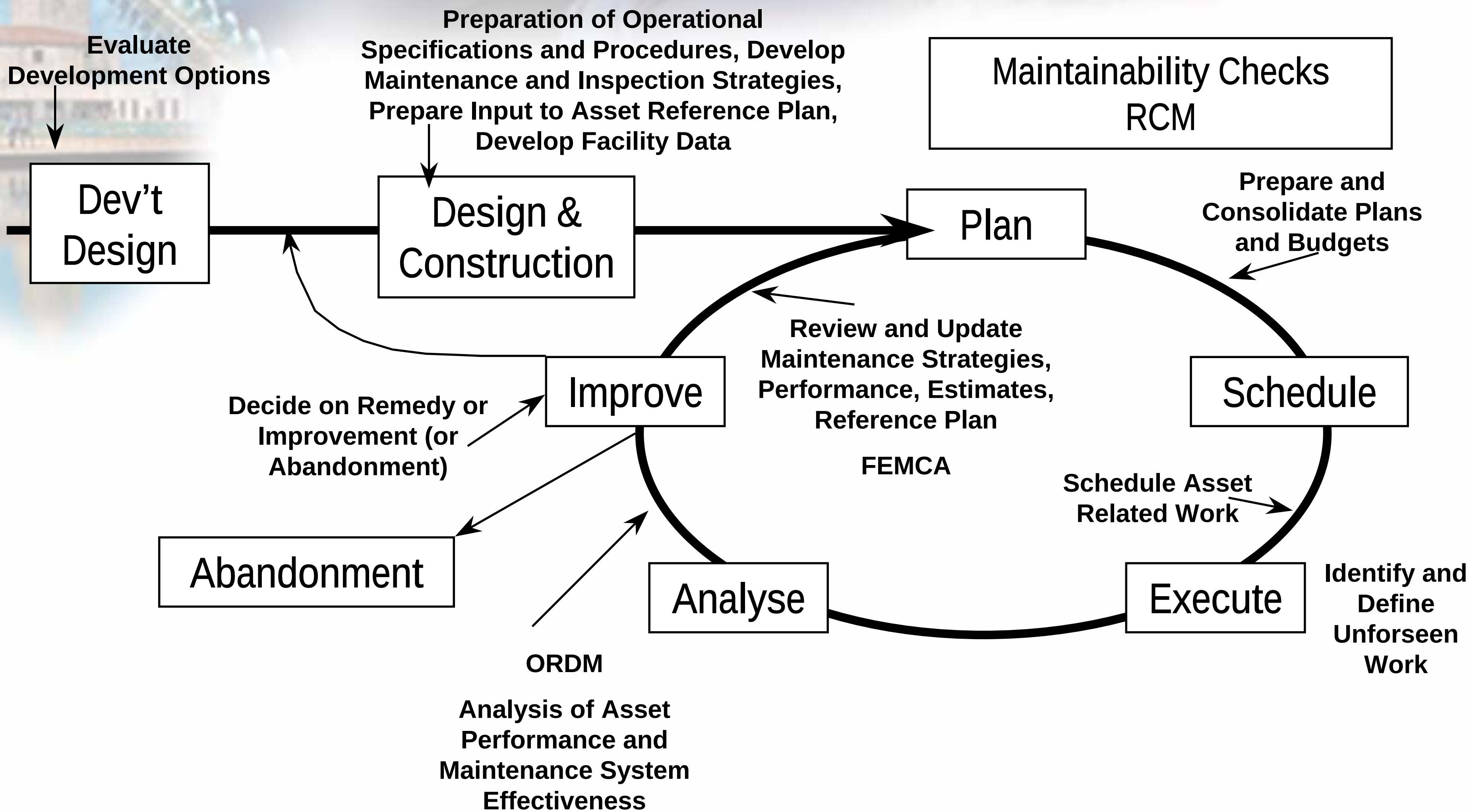
Example RCM Analysis on Headworks Screen

RCM II DECISION WORKSHEET © 1994 Aladon Ltd	SYSTEM *Bull screens*	No. 0	Compiled by	Date 18-Aug-02	Sheet 1
	SUB-SYSTEM	Ref. *Bull screens*	Reviewed by	Date	of 9

Information reference			Consequence evaluation				H1 S1 O1 N1	H2 S2 O2 N2	H3 S3 O3 N3	Default tasks			Proposed Task	Initial Interval	Can be done by
F	FF	FM	H	S	E	O				H4	H5	S4			
1	A	1	Y	N	N	Y	Y						Visual inspection of the shovel control cable for broken strands and reduced cable diameter. Standards to be established. Replace cable as needed.	5000 cycles	Mechanic
1	A	2	Y	N	N	Y	N	N	Y				Replace the bull screen shovel control cable extension	3500 cycles	Mechanic
1	A	3	Y	N	N	Y	N	Y					Shorten the bull screen shovel lift cable to eliminate the worn section, from the connector to the curvature. Ensure that both lift cables are the same length. The cable can be shortened twice before a new cable must be installed.	3500 cycles	Mechanic
1	A	4	Y	N	N	Y	Y						Visual inspection of the bull screen shovel lift cables for broken strands and reduced cable diameter. Standards to be established. Replace cable as needed. When replacing the cable, ensure that both lift cables are the same length.	5000 cycles	Mechanic
1	A	5	Y	N	N	Y	N	N	N				No scheduled maintenance		
1	A	6	Y	N	N	Y	Y						Visual inspection of the bull screen shovel's lift wench's drums for accumulation of foreign matter. Have the drum's surface cleaned when the accumulation affects cable seating.	Mensuel	Operator
1	A	7	Y	N	N	Y	Y						Visual inspection of the bull screen shovel's control wench's drum for accumulation of foreign matter. Have the drum's surface cleaned when the accumulation affects cable seating.	Mensuel	Operator
1	A	8	Y	N	N	Y	N	Y					Lubricate the bull screen shovel wench's bearings. Norms to be established.	Annuel	Mechanic

IVARA-EAM
SPEED TO ACHIEVE

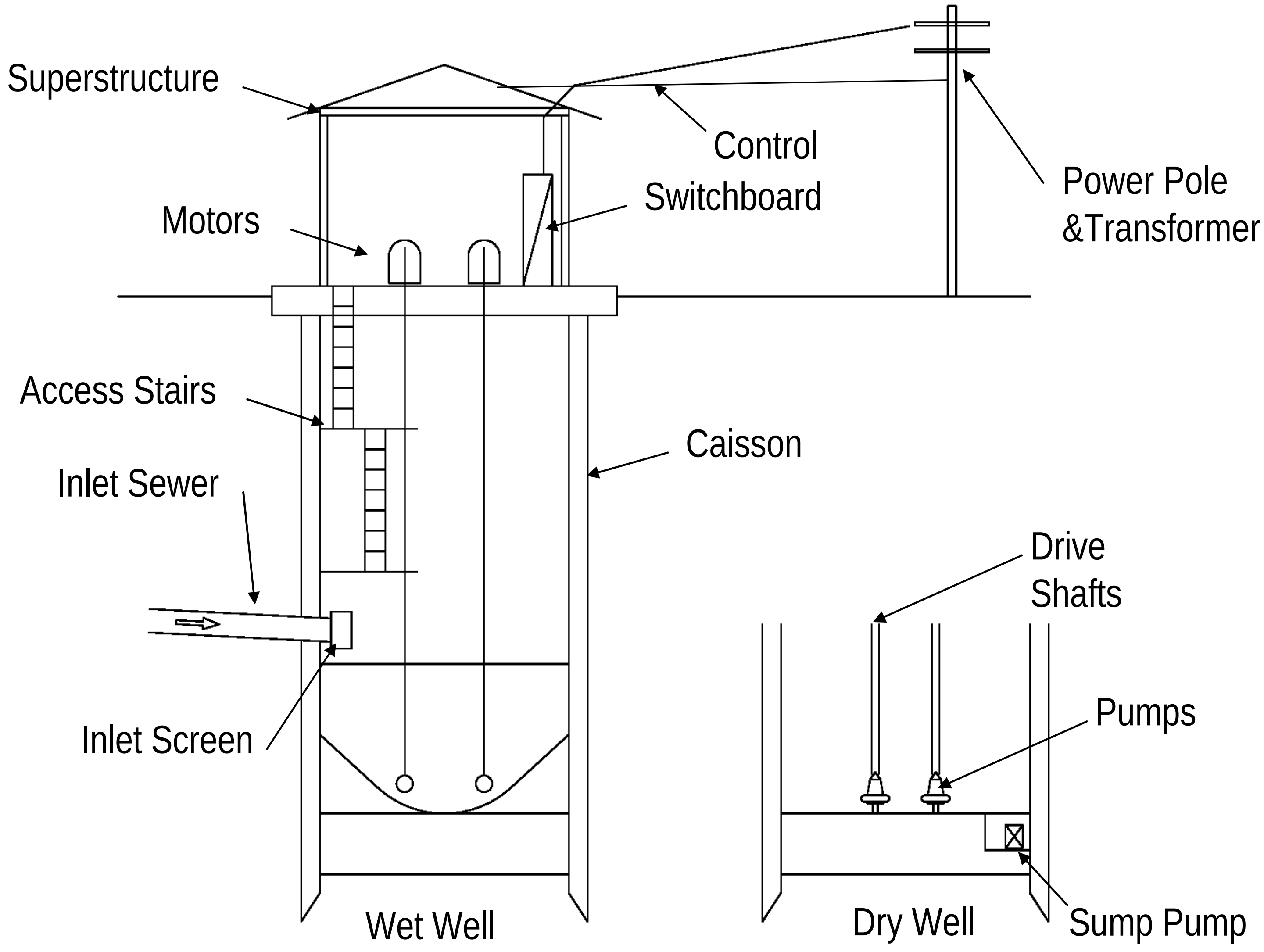
Maintenance - Contribution to LCAM



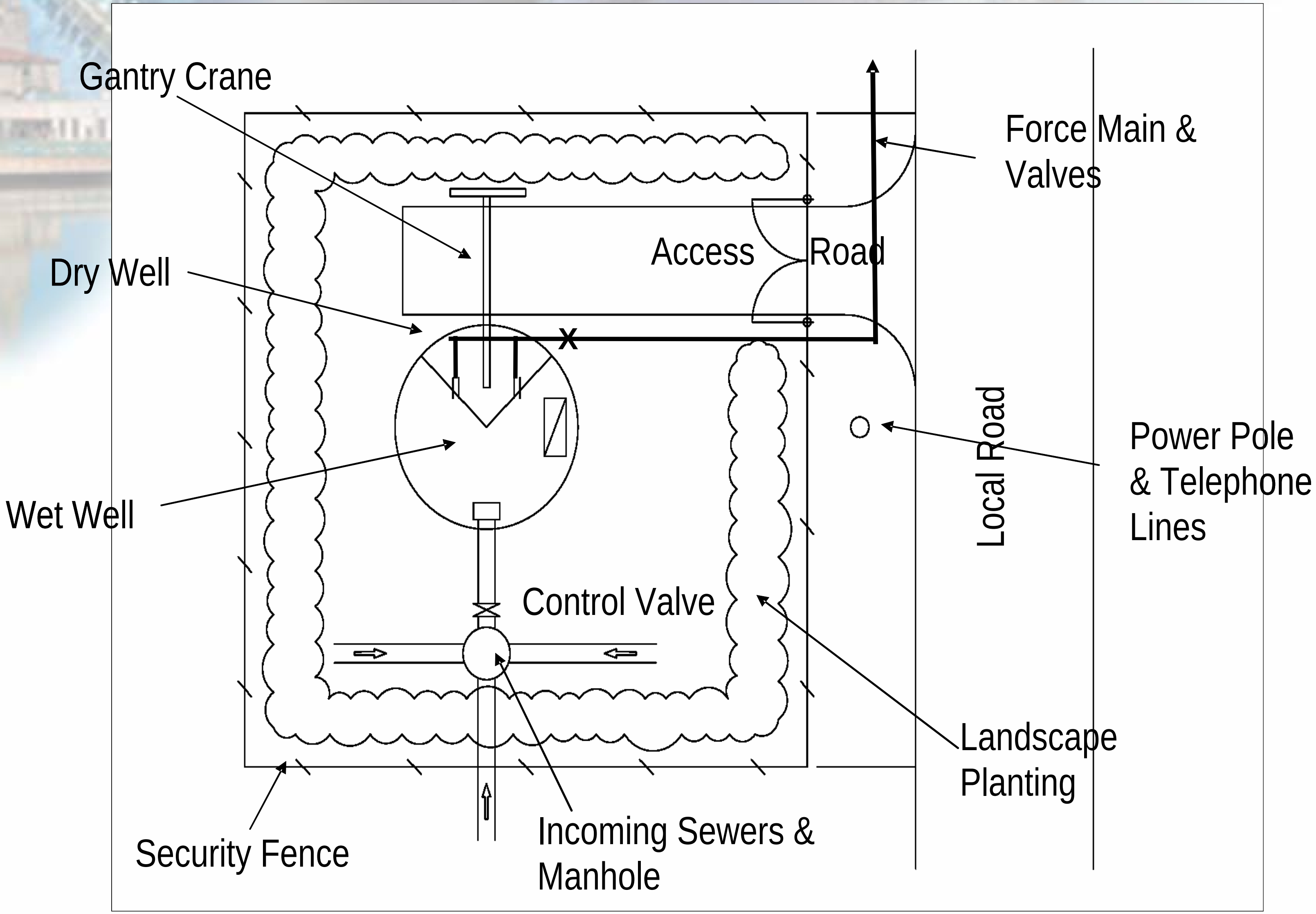
Q4: Given the above, what are the likely changes you would make to your present maintenance program?

Work through spreadsheet …

The Pump Station



The Layout View



Exercise Number 4

Help Tom develop an understanding of the future costs of the pump station ..

Using the data provided, :

- Assess the future maintenance impacts in column S and apply the change you expect..using % shown in column S
- If you believe they will rise, then reassess the residual physical life and give the component a new residual economic life…in column T of the spread sheet

Exercise Number 4 Cont.

Using the data provided, :

- Adopt a renewal strategy based on your best judgment using sheet F on the spreadsheet.
- Estimate the cost of this renewal strategy based on your best estimate …(in dollars)
- The spreadsheet will calculate the date required using the shortest of the physical or economic lives ..

Key Lessons Learned

- There are lots of ways to renew (extend the economic life) of an asset
- We need to think differently …outside our normal box - our normal culture
- We need good technical and cost data to understand the best time to renew
- Our CMMS and Work Orders are the heart of any good data flow

CMMS – Computer-based Maintenance Management System

Take home messages

- Get ‘cracking’ ….(aussie for started)
- Develop a simple approach like this example and get started
- You don’t have to be perfect to be much better …(focus on process – data comes later ..)
- We must realize that capital is not free and that sometimes more maintenance will be cheaper
- Encourage others to do it …but
  - Don’t try and change the world over night…
  - Change your world …