Production Wells

Strategies for Effective Operation

Using Continuous Monitoring to Circumvent Catastrophic Failure

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Public Service Message:

Please,

BACK UP YOUR PLC PROGRAMS!

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Opening Questions:

How many people in this room:

1) "are the licensed operators for public or private water supply?
2) "use a third party maintenance company that has a fixed maintenance schedule?
3) " have remote monitoring systems for their wells?
4) "have a fixed inspection and maintenance schedule?
5) "have a control system that collects data on the wells?
6) " uses the data to predict well performance?
7) " uses the data as an instructional instrument for less experienced operators?

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The primary purpose of a monitoring system is to provide a window into your operating equipment to allow:

1. A certain amount of peace of mind because you know the state of your equipment.
2. Timely execution of maintenance to circumvent catastrophic failure and/or more costly response repair.
3. Avoidance of unnecessary maintenance.

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The business of predictive monitoring as opposed to reactive monitoring is the use of trending, which requires the use of transmitters not switches.

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Take Away:

1. The process data and trend tracking **cannot replace the experience of a seasoned operator.**
2. When the **correct data** is collected and co-related trigger points are **used effectively**, major **catastrophic repairs** and **unnecessary maintenance may be prevented** .
3. **The predictive process starts with cataloging your base line variable magnitudes.**

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Take Away:

4. If the **correct process variables** are collected, their **trends** can be used to **predict the future** if experience offers the "if-then" hindsight. (The experienced operator)
5. The **correctly collected data**, with the help of an experienced operator's eye, can be **used as a powerful training tool**, especially if the data can be injected into a process modeling equation.
6. Remote **monitoring technology** is now **easily available** to the smallest of water utilities.

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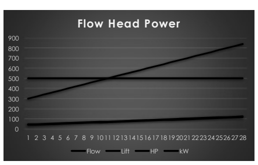
Let's start with the most basic hydraulic concept:
Work Performed in Pumping: Horsepower

$$Brake\ Horsepower = (GPMxH(feet)x\ sp\ gr)/(3960x\ Pump\ Efficiency)$$

What are the variables?
In this case we can say 3: Flow, Lift and Power



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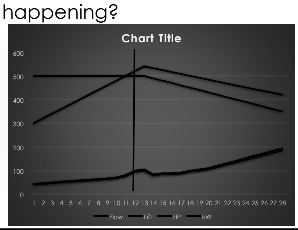
Let's start with the most basic hydraulic concept:
Work Performed in Pumping: Horsepower

$$Brake\ Horsepower = (GPMxH(feet)x\ sp\ gr)/(3960x\ Pump\ Efficiency)$$

Now what is happening?



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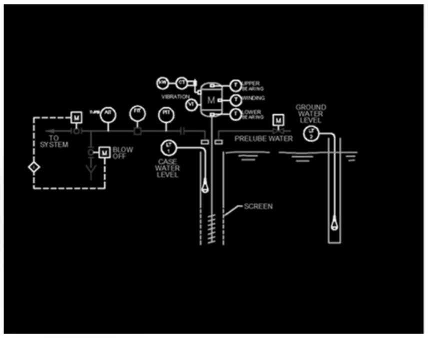

In this scheme we need a monitoring system able to take in 10 analog signal inputs.

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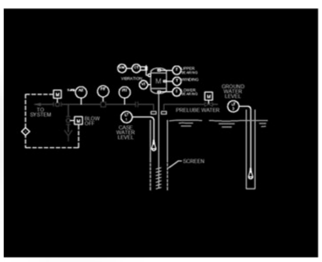
Step 1: Measure and Document Your Baseline Variables:



What are the baseline variables?

1) Static ground water level
2) Operating kW
3) Motor Temperature and Vibration
4) Discharge Pressure
5) Flow in GPM (Q)
6) Turbidity
7) Operating drawdown in Feet (S)
8) 30 minute Q/S

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Baseline Readings

Variable	Value
Static GW Depth (Ft)	50'
Operating kW	71kW
Motor Temp Upper Bearing	180F
Motor Temp Winding	190F
Motor Temp Lower Bearing	145F
Motor Vibration, in/sec vertical	0.04
Discharge Pressure (PSI)	165
Flow (GPM)	470
Turbidity (NTU)	0.2
Draw Down (Feet)	43
30 minute Q/S	10.9

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Step 2: Set Watch Values

Variable	Value	Watch Values
Static GW Depth (Ft)	50	100
Operating kW	71	80
Motor Temp Upper Bearing	180F	210
Motor Temp Winding	190F	250
Motor Temp Lower Bearing	145F	195
Motor Vibration, in/sec vertical	0.04	0.049
Discharge Pressure (PSI)	165	115
Flow (GPM)	470	300
Turbidity (NTU)	0.2	0.53
Draw Down (Feet)	43	75
30 minute Q/S	10.9	4

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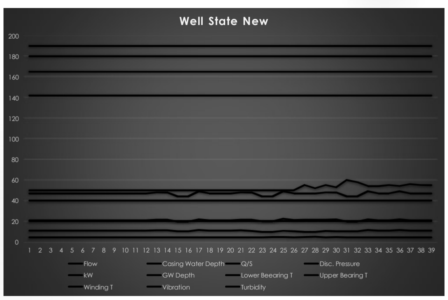

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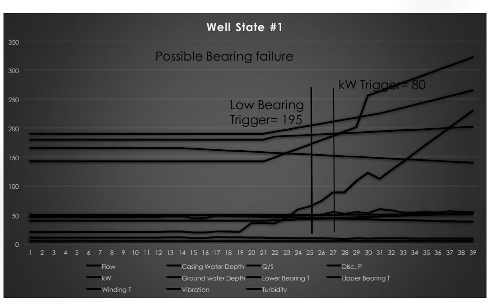

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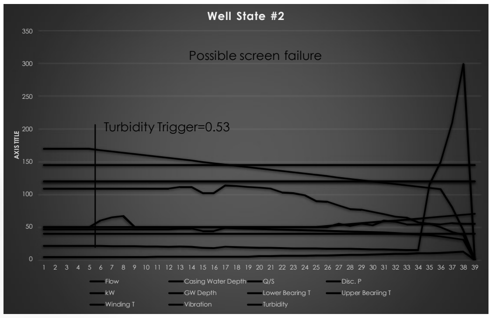

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Specific Capacity as a Diagnostic Tool

As a Diagnostic Tool for Boreholes in Service				
Well	**Original Q/s [A]**	**After 3 Years [B]**	**Change in Q/s [A-B]**	**Recommendation Efficiency = [A-B]/A*100**
PW-1	50 gpm/ft	48 gpm/ft	2 gpm/ft	4% loss in efficiency. Rehabilitation not required.
PW-2	50 gpm/ft	40 gpm/ft	10 gpm/ft	20 % drop in efficiency. Rehabilitation recommended now.
PW-3	50 gpm/ft	20 gpm/ft	30 gpm/ft	60 % drop in efficiency. Cost assessment on rehabilitation or replacement?

As a Diagnostic Tool While Redeveloping a Boreholes			
Baseline Q/s	**Procedure**	**Incremental Increase**	**Improved Q/s**
12 gpm/ft	Surging + Airlifting	3 gpm/ft	15 gpm/ft
	Acid Treatment + Surging + Airlifting	5 gpm/ft	20 gpm/ft
	Hypochlorite Treatment + Surging + Airlifting	8 gpm/ft	28 gpm/ft

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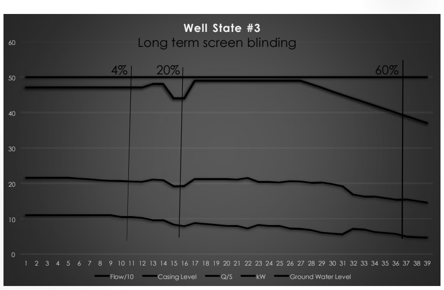

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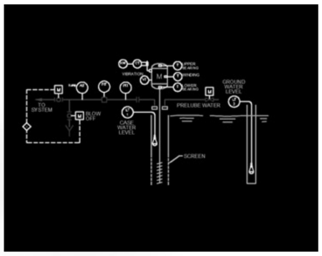
Monitoring System Capital Cost:



Device	Cost
AIT Turbidity	$2,800
FIT (8")	$3,200
PIT	$500
LIT	$900
VT	$350
kW Meter	$1,200
RTD Signal Converter	$900
Telemetry Unit	$3,200
Installation	$12,000
Total	$25,050

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Well Service Cost:

Well Service	Cost
Pump Pull with Video	$5k-$10k
Well Rehab Minor	$20k-$40k
Well Rehab Major	$40k-$80k
Pump Replacement	$100k
Motor Replacement	$5k-$40k
Well Replacement	$1 million

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The primary purpose of utilizing continuous monitoring with real time trending is to save money.

This is done by either foregoing maintenance action because you don't need it

Or

By heading off major well degradation or failure by using deflections in the monitored variables to act in advice to a catastrophe.

The other side benefit is that you have a feel for the condition of your well(s) and are not running blind, which offers some peace of mind.

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Thank you

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