



**Ontario Water Works
Association**

A Section of AWWA

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**Basic Municipal Well Performance Monitoring,
Recognizing Potential Problems and What to Do**

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Presentation Overview

- **Typical characteristics of municipal wells**
- **Simple well performance measurements that all operators should be collecting**
- **How to use this data to identify an issue before it becomes a problem**
- **What to do if you do identify an issue/problem**

Municipal Water Well System Typical Line Shaft Pump



Municipal Water Well System

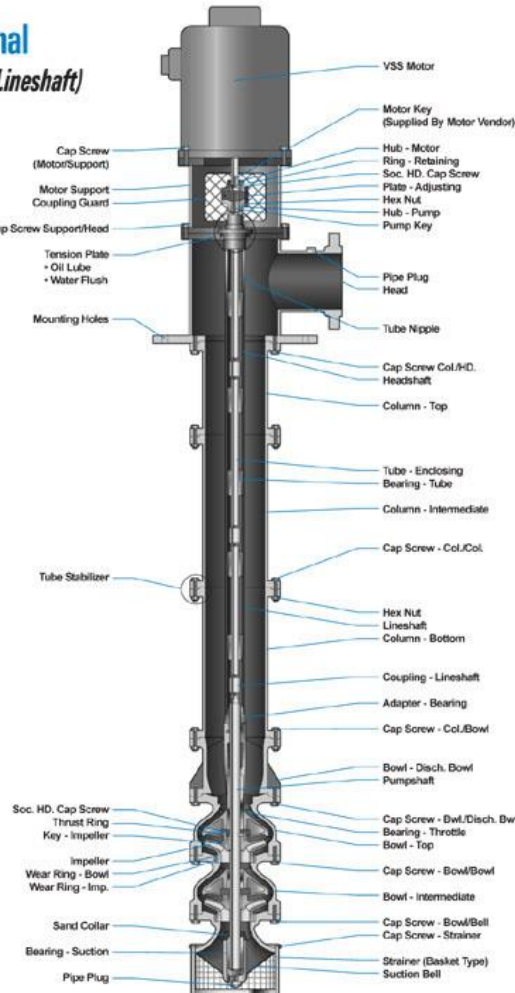
Typical Line shaft Pump

Cross Sectional

VIT-FF (Enclosed Lineshaft)

Typical Markets Served

- Mining
- Municipal
- Power Generation
- General Industry
- Chemical

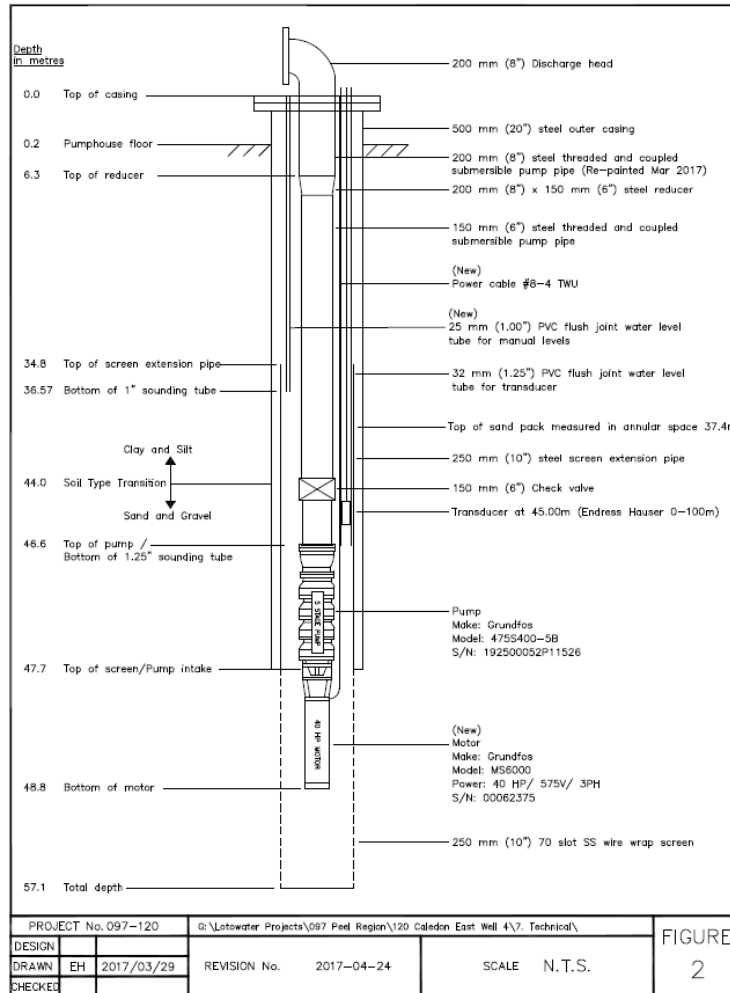


- Solid drive shaft from motor at surface to pump
- Shafts must be straightened and bushings fit to tolerance to minimize vibration
- Well must be plumb
- Lineshaft pumps are always located in a pump house
- Usually found on higher flow wells (20hp and larger)

Municipal Water Well System Typical Submersible Pump



Municipal Water Well System Typical Submersible Pump



- Submersible motor is mounted under pump
- Power cable runs to surface
- Generally found on smaller wells (<20hp)
- Easier to remove and reinstall
- Can be setup outside with a pitless adapter
- Can be set in wells that are slightly out of plumb

Pitless Adapters

What is a pitless adapter? It is a device that allows an underground connection to a well can have a frost free connection to piping underground.



So you have a well

Are you confident that everything is OK?

Can you prove it and back this up with data?

Having some data can provide assurances and give you confidence that things are OK.

Basic Well Performance Measurements That Well Owners and Operators Can Collect Themselves

1. Flow Rate
2. Well Water Level in Well
3. Pump Discharge Pressure

Supplementary:

Pump speed (if VFD equipped)

Motor Current or Amps

Vibration



Regularly collecting and recording these basic measurements allows us to assess the following:

- 1. Pump and Motor**
- 2. Well screen or borehole flow (plugging)**
- 3. Aquifer Performance**



Flow Rate

Flow rates are critical but fortunately nearly all systems are equipped with an accurate flow meter



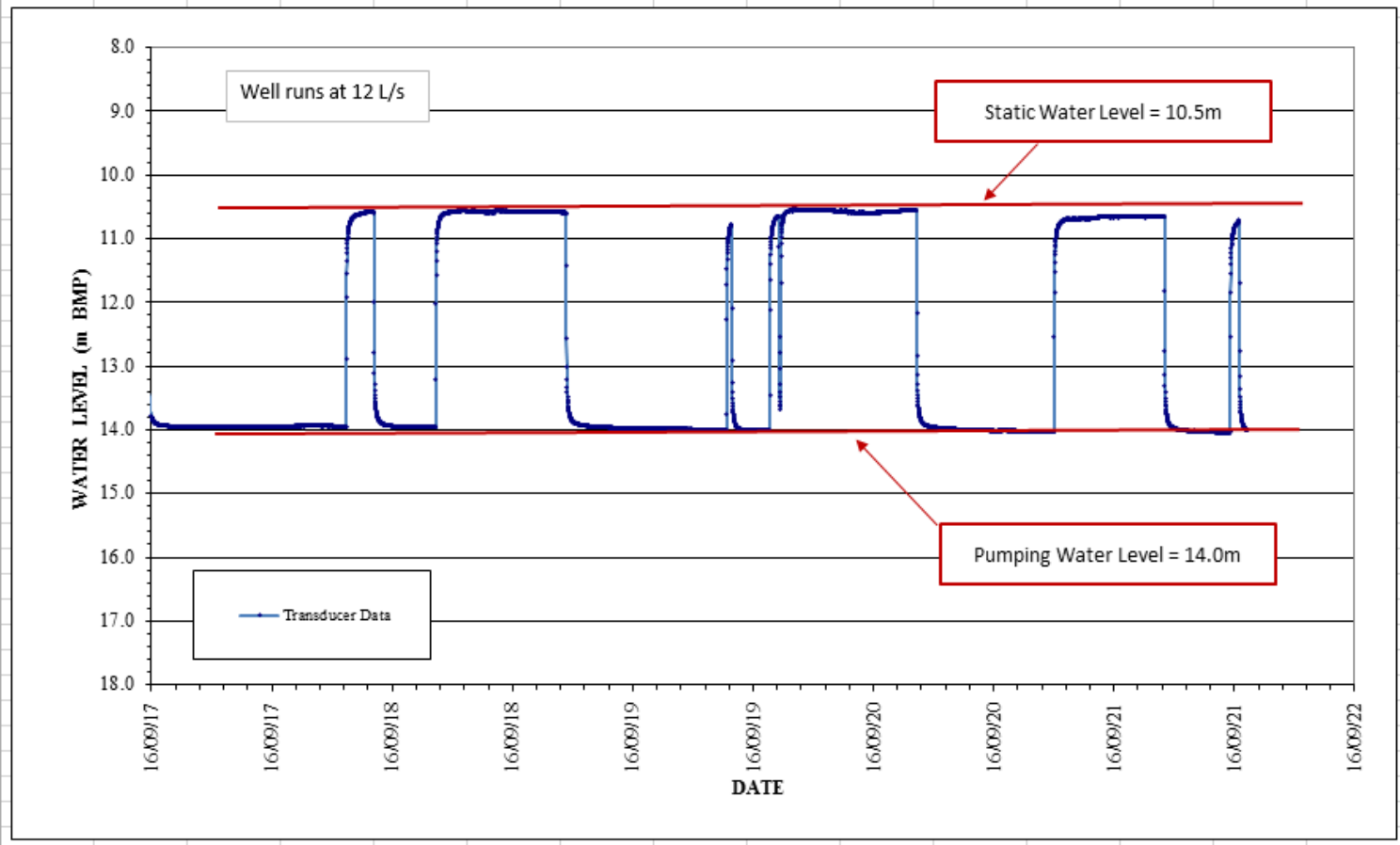
Well Water Level

We need to regularly check the level under two separate operating conditions

Static Water Level (SWL) = Level after the pump has been off for an extended period of time and has “stabilized”

Pumping Water Level (PWL) = Level after the pump has been on for an extended period of time and has “stabilized”

Hydrograph Comparing Static and Pumping Conditions



Tips On Collecting Water Levels

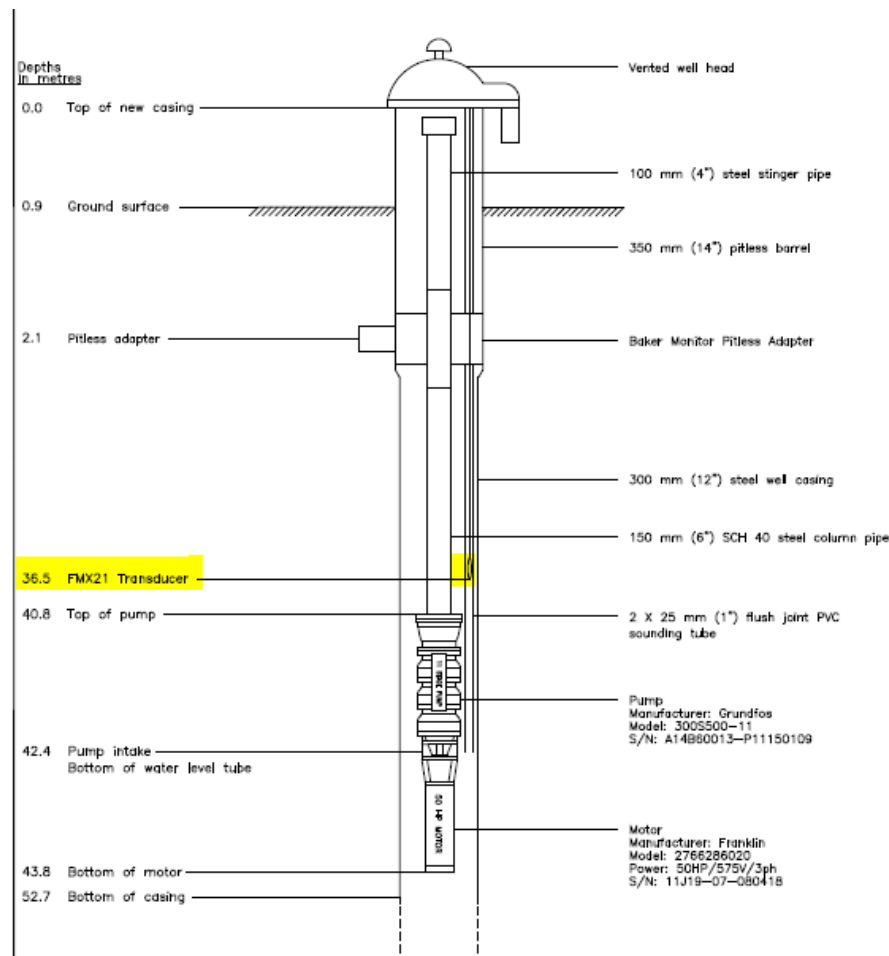
- Have a dedicated sounding tube in the well with an easily accessible port to facilitate manual measurements



Tips On Collecting Water Levels

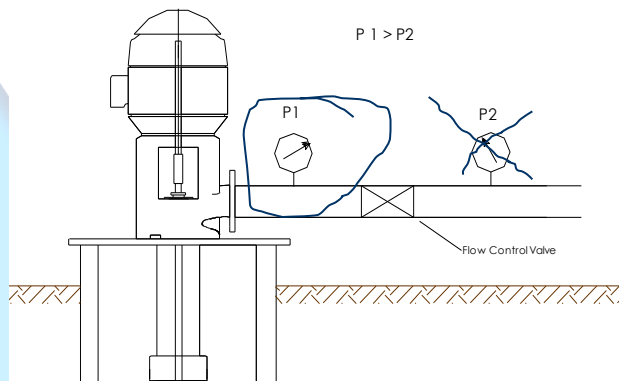


- If the well is equipped with a transducer that is great but make sure to know the transducer setting depth and the units the transducer is reporting in (m or feet of water?). Periodically check/calibrate transducer readings with a manual measurement.



Pump Pressure Measurements

- Record incoming pressure as close to the well as possible.
- Make sure to record pressure on the high side of any flow control valve



- Note that many systems don't have such a pressure gauge. If you don't have one its a good idea to get one installed

Speed and Vibration

For VFD Equipped Wells Only

- Record the pump speed (in % or Hz)

For Lineshaft Pumps Only

- Note obvious increases in vibration. Measure with a simple vibration pen or hire a company that can measure vibration. A major vibration issue is obvious and can easily be felt and observed.

One last note on collecting measurements



- All measurements need to be taken at the same time or at least under stable operating conditions

OK, we have our flow rates, water levels and pressure measurements. How do we use this to assess our wells condition?



Do Obvious Checks First

Has flow decreased, pressure dropped or water levels declined?

If no then likely no problem

*this doesn't mean there won't be a problem just there is no data suggesting there will be

If yes then you can try to diagnose the problems yourself or contact your water well professional/contractor for help

Check Pump First

If your pressure and/or flow has dropped and the well pumping levels haven't changed then you probably have a pump or leak problem



To Determine for sure if it is a pump problem plot the Total Dynamic Head (TDH) on the Pump Performance Curve

TDH = Pumping Level (ft) +
Pressure (psi x 2.31) + piping
friction loss (often negligible)

If it is a pump problem you will
have to pull and repair or
replace

PERFORMANCE CURVES

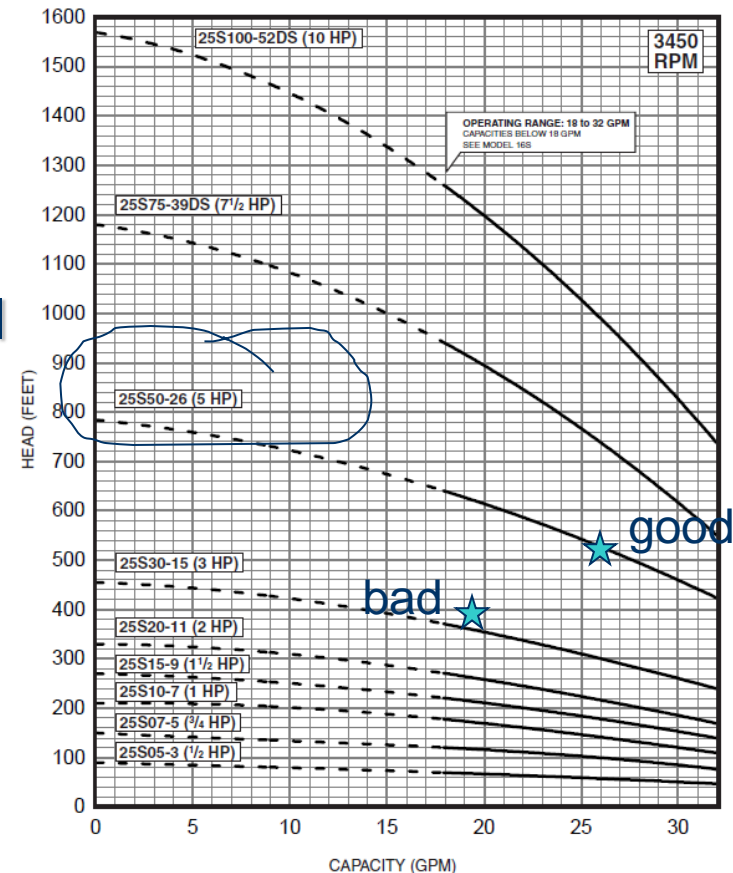
25 GPM

MODEL 25S

FLOW RANGE: 18 -32 GPM

OUTLET SIZE: 1½" NPT

NOMINAL DIA. 4"



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 5-5 HP/3450 RPM.
6" MOTOR STANDARD, 7.5-10 HP/3450 RPM.

Performance conforms to ISO 9906, 1999 (E) Annex A
Minimum submergence is 2 feet.

Note on Well Pumps & Motors (Wells < 10 L/s)

- For most small systems where well flows are 10 L/s or less it doesn't make much sense to disassemble and repair the pump. In nearly all cases replace a poorly performing pump.
- Plan on a 10 year life for small system pumps and motors
- Submersible pump wire gets brittle with time. Plan on replacing when you replace pump and motor



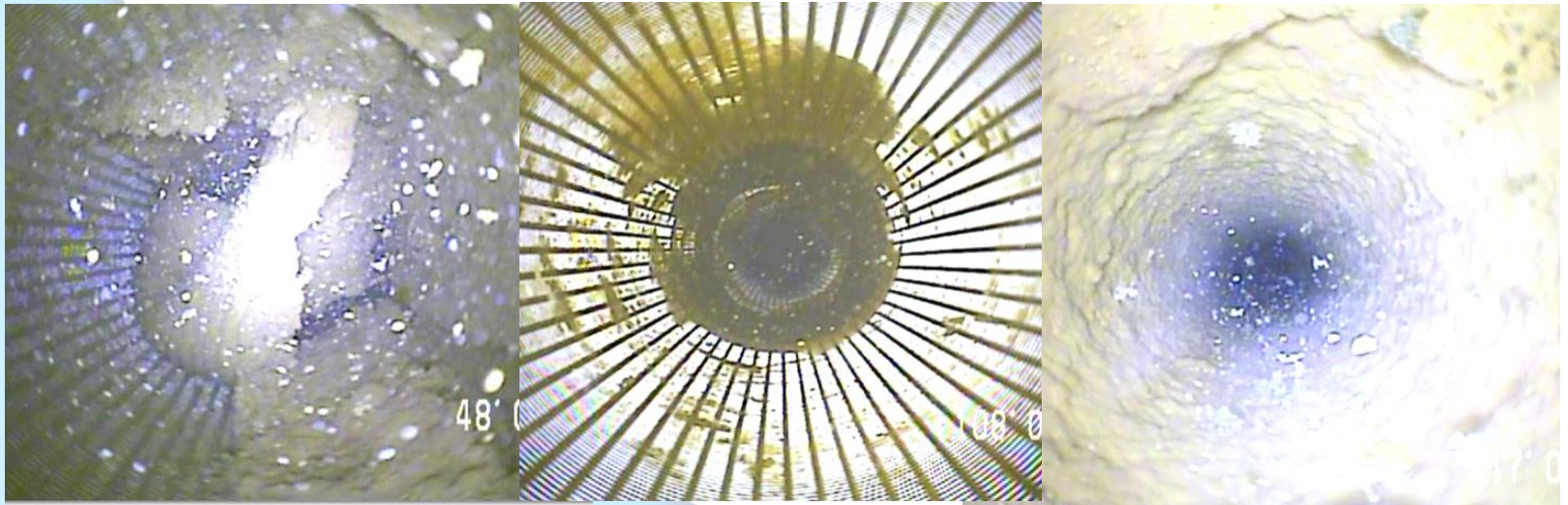
Note on Well Pumps & Motors (Wells > 20 L/s)

- For larger wells that have a high duty (>75%) plan on servicing the well and pump every 7 years.
- Larger pumps and motors are often economical to rebuild.
- You will need time to rebuild a pump so plan replacement accordingly.

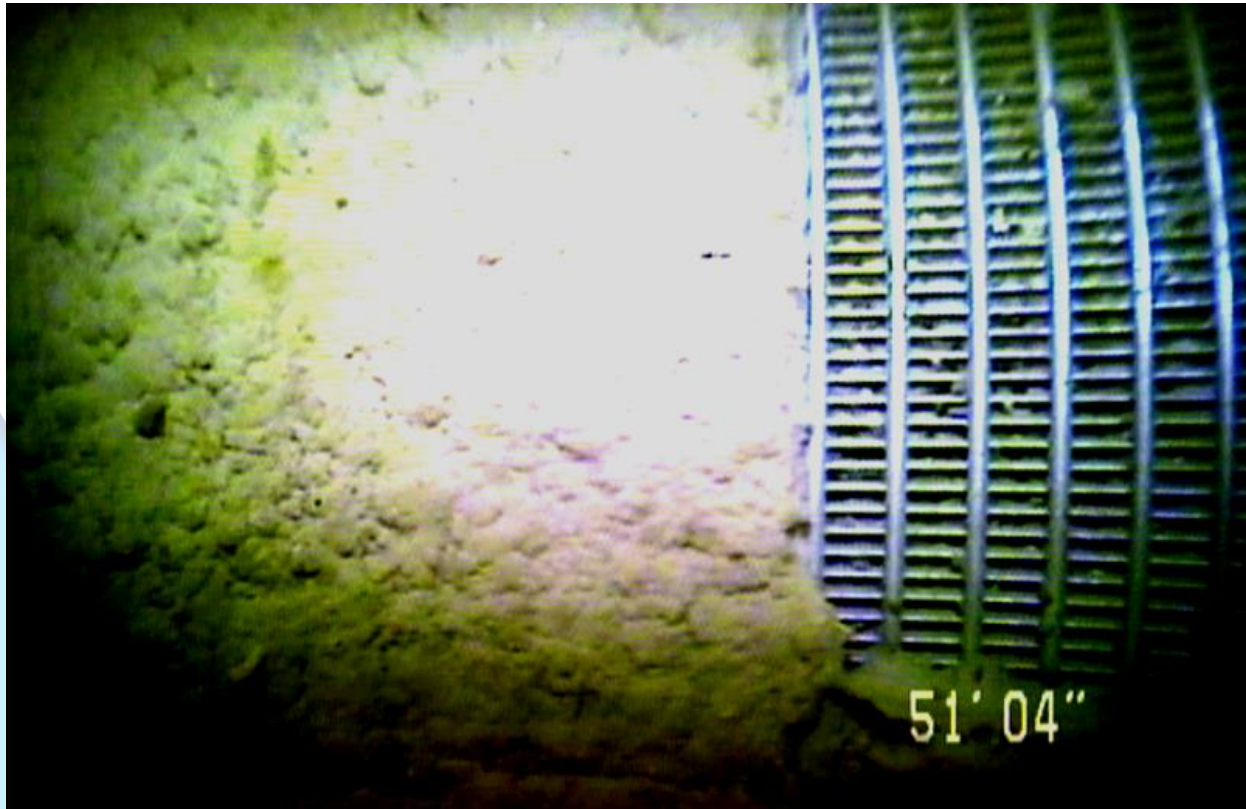


Check for Well Plugging

You probably have a plugged well if the flow is the same or less, pumping levels are down and static level is the same.



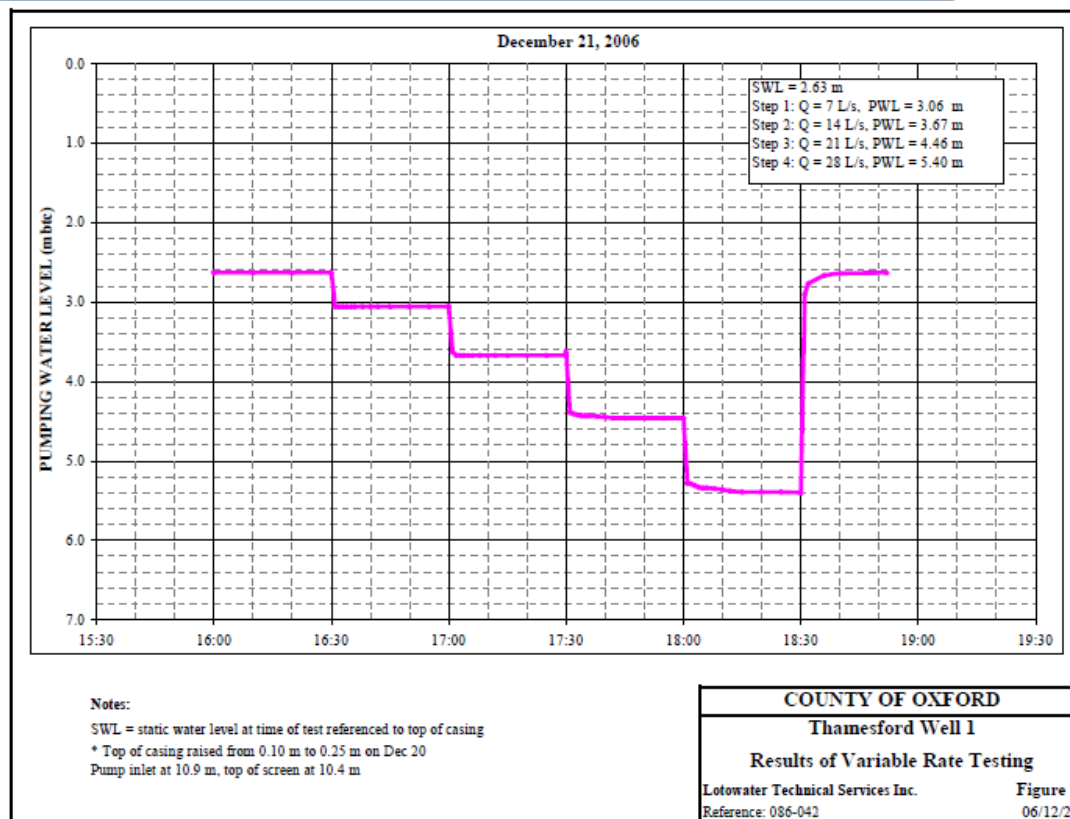
Plugged Well Screen



Note: there may be significant buildup on well screens but such buildup has not yet impacted well flows and vice versa

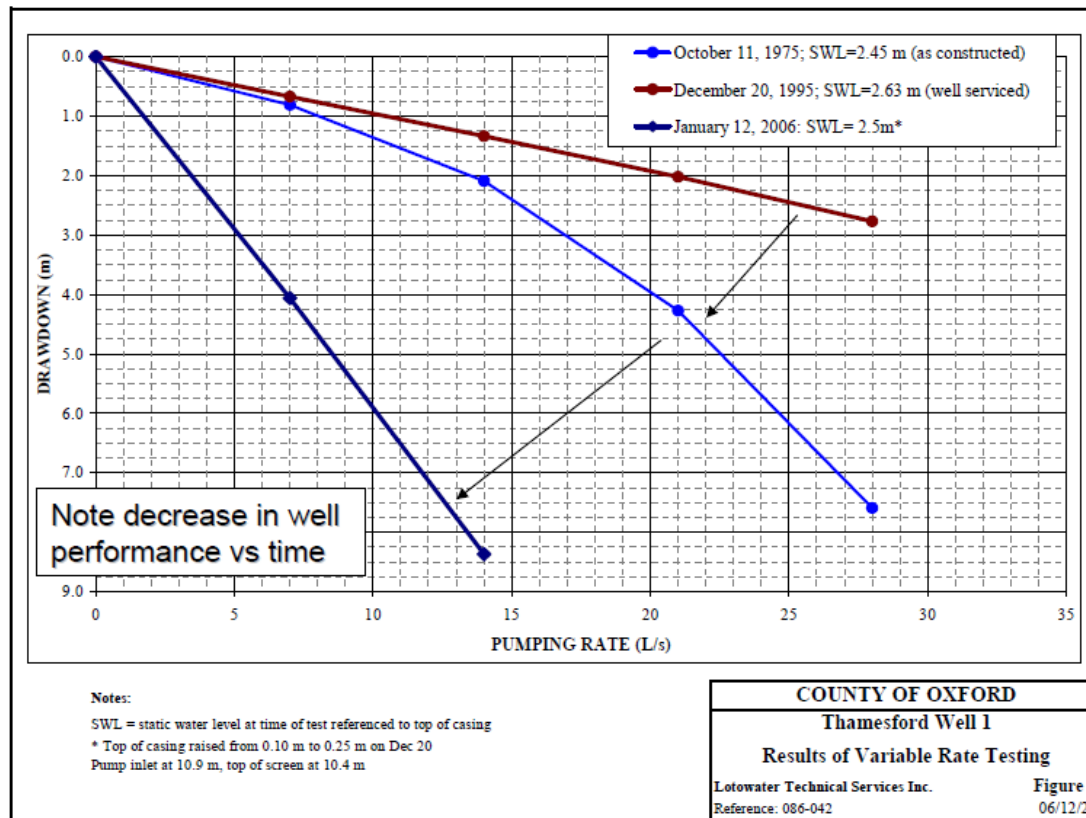
Perform a Step Test to Test for Plugging

Step Test Data: Pumping Water Level vs Time

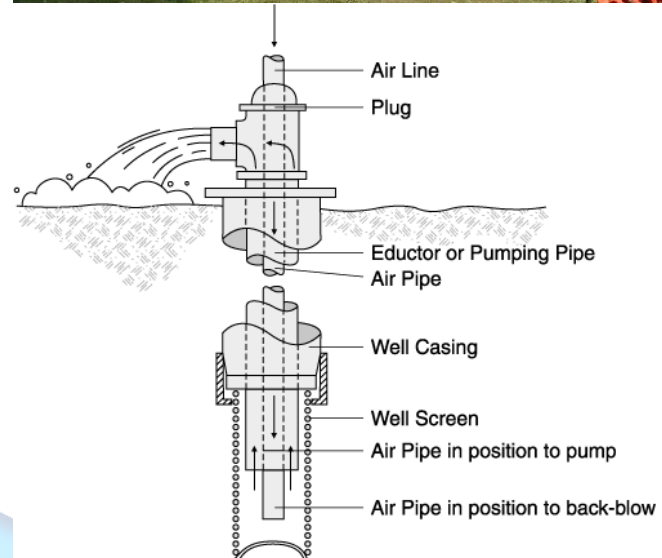
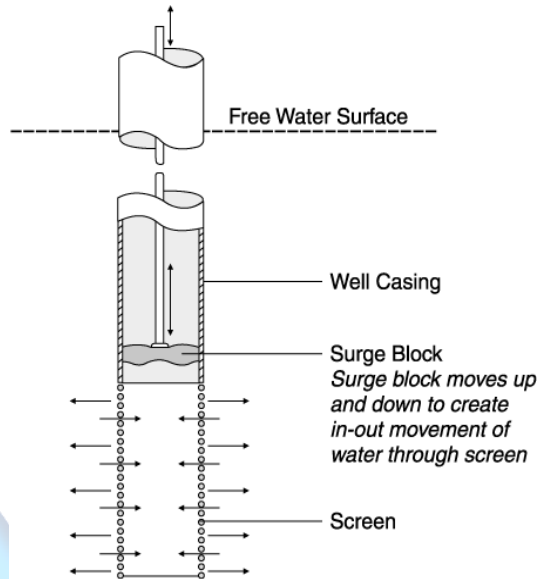


Compare With Historical Test Data

Well Showing Dramatic Loss in Performance Over Time



If your well is plugged you will need to rehabilitate your well

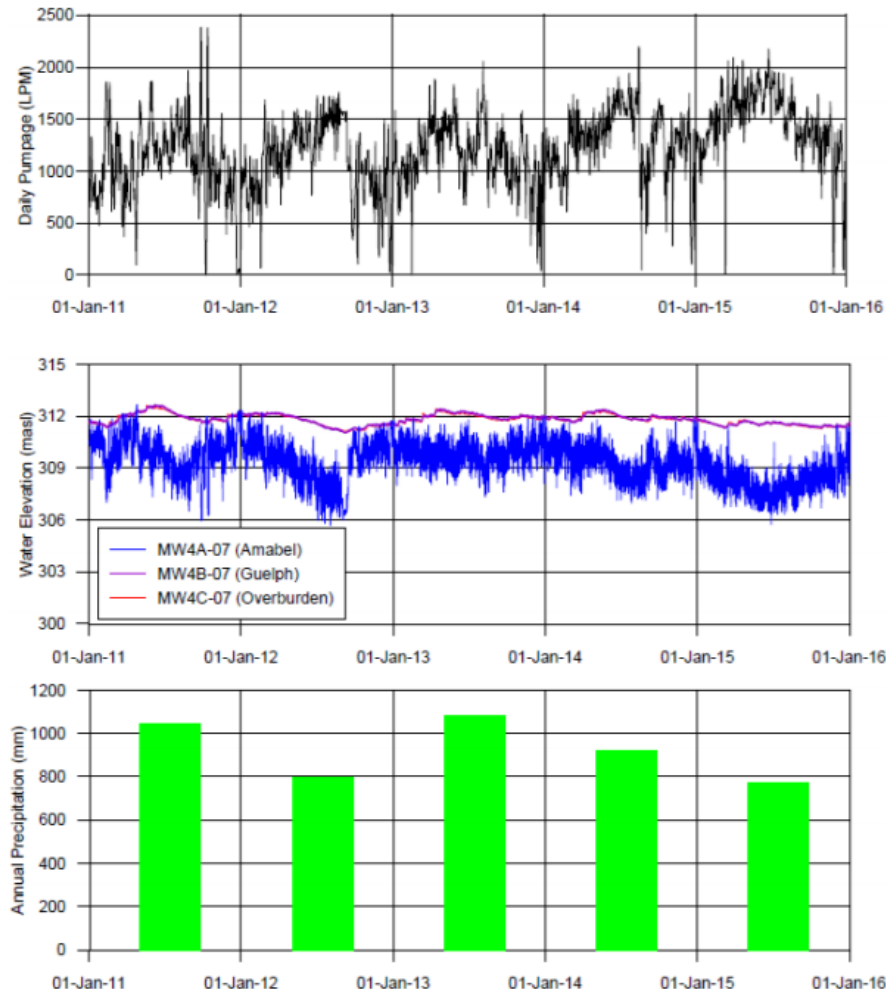


Declining Aquifer Yield

If you have a low static and pumping level you could have a low aquifer level

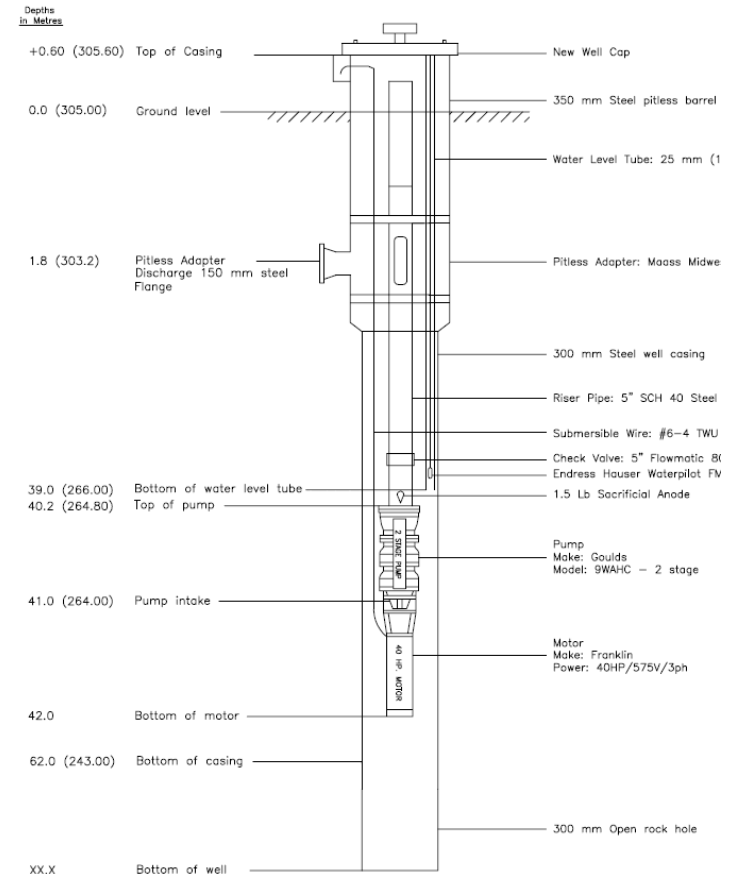
- There could be competing influences from nearby wells or there could be a low water condition due to a seasonal environmental condition
- Look at hydrographs and pumping history. If you have a decreasing trend make plans in advance
- This can often be more difficult to determine. Consult a hydrogeologist if you suspect this condition

Well Hydrograph and Pumping History



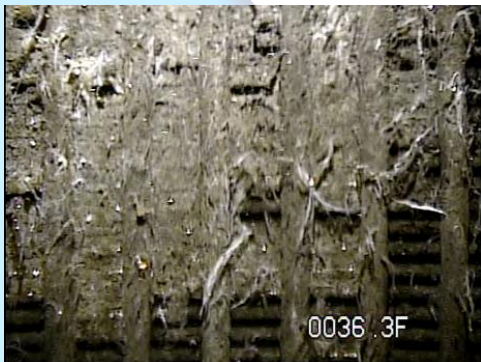
If you do notice a decreasing groundwater trend there may be some things you can do

- You may be able to lower your pump
- Maybe it's a seasonal trend and the well will come back at a later date. Look at historical data and compare
- You may be forced to reduce pumping and/or find another source



Your Well May be Under Performing for Multiple Reasons

- You could have an underperforming pump, low aquifer levels or a plugged well screen. Keep in mind that all could be occurring simultaneously



Ok, So I am pretty sure I have a problem with my well or Pump. What do I do?

You will need to contact a well professional/contractor to pull your pump with a crane and inspect and service your well and/or pump.

You will need to provide your well contractor information on what the problem is as well as background information on the well if he doesn't already have it.



What Info Should I Provide my Well Contractor

The more information you have on the well the better. At bare minimum you should be able to provide the following:

- Well diameter
- Well normal operating flow rate and duty (how much does it run)
- Well motor horsepower
- Accessibility to the well (photos are great)
- How long can you have the well out of service.

Even to just do a quick pump change the well could be down for a total of 3 days, 1 day to fix the pump and disinfect, the next day to collect a water sample for bacteria analysis and a third day to wait for results. If there are any problems, or if its over a weekend it will be longer. What are you going to do when the well is out of service?

* These are absolute basics you can provide no matter what.

Hopefully You Have More Info Though

Other important information that you may be able to provide:

- **A Previous Well Service Report**

- Pump model & serial numbers and install date
- Pump depth setting
- Riser pipe diameter
- Step test data
- Well construction details
- Other important and relevant history on the well

- **Original Well Construction Report**

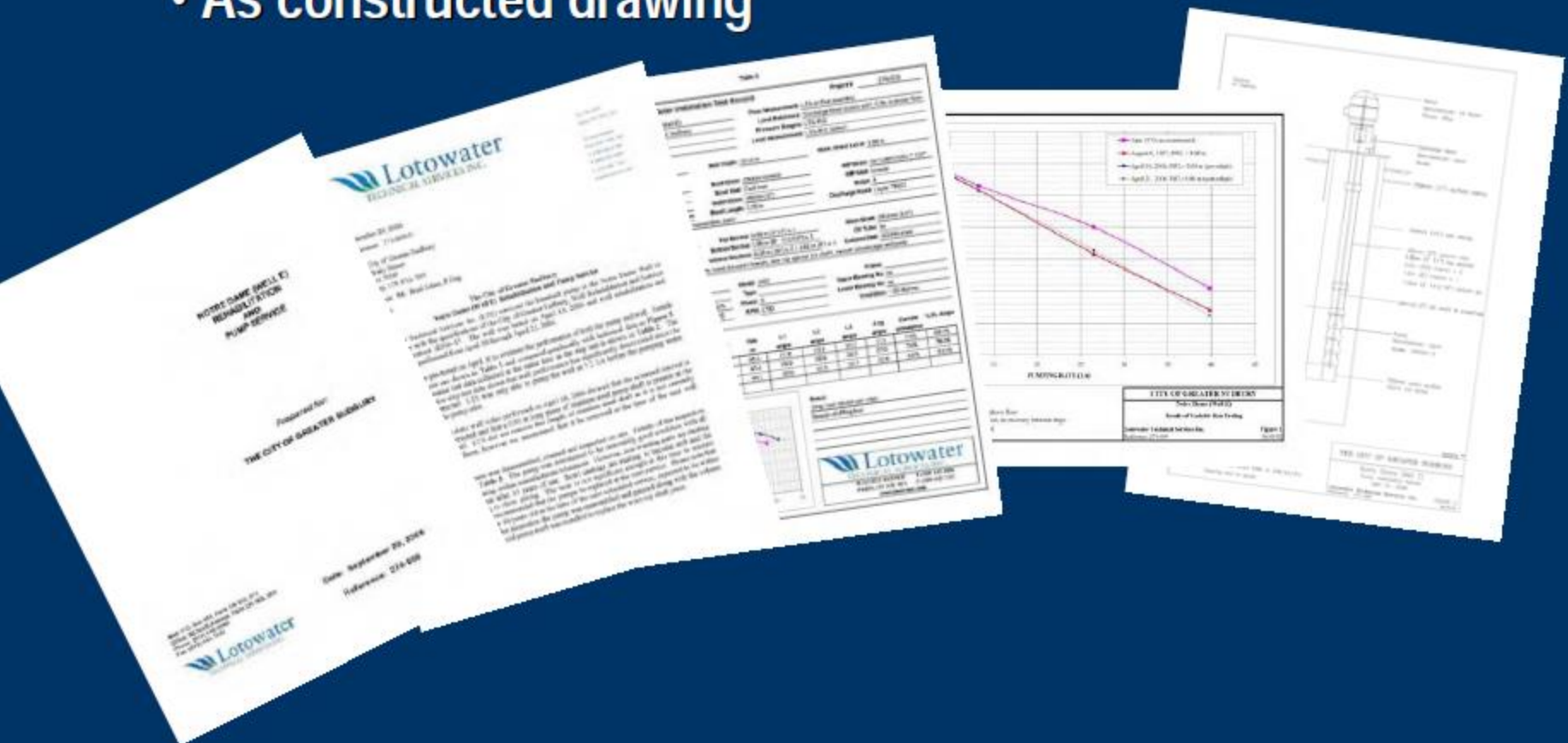
- Year constructed
- Well depth
- Screen or casing depths
- Original MOE well record

The Basics of a good Well Service Program

- Review of historical records
- Pre service program step and performance test
- Remove and physically inspect pump, recommendation for repair and or replacement as necessary
- Diagnostic Well Video
- Recommendation for rehab if there is reduced performance and plugging
 - Physical surging and airlifting
 - Acidification or other treatment if appropriate and necessary
- Post rehabilitation well video
- Pump reinstallation, disinfection and step/performance test
- Detailed report documenting work performed with as constructed drawings, graphs, and tables of data

A good installation report will include:

- A brief summary of the well's history
- A brief narrative of what work was done
- Results of tests performed in tables and graphs
- As constructed drawing



The Well Guy Says “Record this Basic Info and you will be LAPFing

- Flow Rate
- Pumping and Static Water Levels
- Pump Pressure
- Motor Load (Amps)
- Pump Speed

Remember:

LAPFS

Level, Amps, Pressure, Flow, Speed

You got this and your LAPF_{ing}

In Summary

- Review your L_{level} A_{mps} P_{ressure} F_{low} data and look for changes, if there is a change determine what the cause is. Contact a well professional if your not sure or you suspect a problem.
- If you have an issue then address on your terms before it leads to a bigger problem.
- *Ask your self right now, what do you do if your biggest well goes down. Do you have a plan?*

Thank You

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