

Milk Ranch Well

A Deep Groundwater Source in Pine, AZ

Presented May 17th, 2008

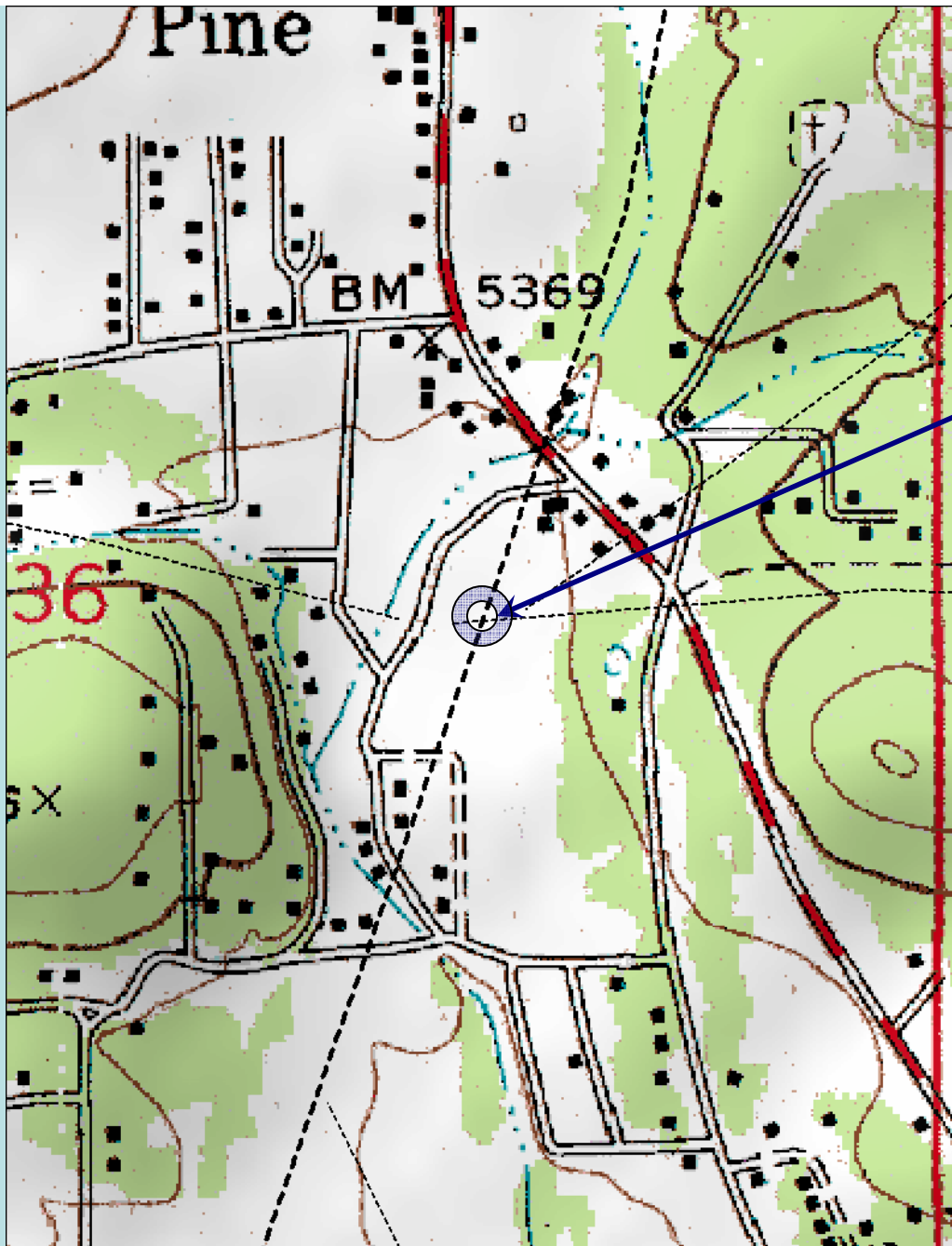
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HIGHLAND WATER
RESOURCES CONSULTING Inc.

Background

- 2003 - Milk Ranch LLC. first contract HWRC to identify an optimum well site on a 10 acre property located in central Pine.
- A Geological and Structural investigation of the area was conducted.
- The effort focused on the identification of surface expressions of fracture and fault systems.
- A nexus of fault and/or fracture traces was identified within the property and the well site selected.



Faults and/or Fracture Lineaments Came Together Here, on the Milk Ranch Property.

This Location is Where the Well was Drilled.

Drilling Begins.....

- Following reviews of drilling contractor proposals and technologies, ADT Drilling was selected to drill the well.
- Because of the extreme variability in geology anticipated, ADT's air rotary casing advance system was selected.
- ADT's technology uses traditional air rotary drilling in combination with an extremely powerful casing advance system and specialized drilling bit.

March-April 2005 Drilling

Drilling began in late March 05 with good progress...



That was.. until mid April when the drill string was severed and the tools and well were lost.

After a second failed attempt, ADT pulled off.

The Milk Ranch Well - Success Winter 2006

- With lessons learned, ADT and HWRC were able to give tooling Engineers the data needed to modify the bit and drilling system to succeed.
- In February 2006 drilling again commenced with a slow but steady progress.
- By mid March 2006, nearly a year following the first attempts, the well was installed and reached a total depth of approximately 1,050ft..

What was found?



Well Drilling was Monitored and Drill Cuttings Collected

In order to keep track of the Geology that makes up the Aquifer drill cuttings were collected at 10 foot intervals.



The well was found to penetrate:

- 20 ft. of alluvial fill (dry)
- 140ft. of Naco lime/shale (dry)
- 120ft. of Redwall Limestone (dry)
- 380ft. of Martin dolomite (lower-Saturated)
- 70ft. of Tapeats sandstone (Saturated)
- 320ft. of fractured Precambrian bedrock "silty-quartzite and slates" (Saturated)

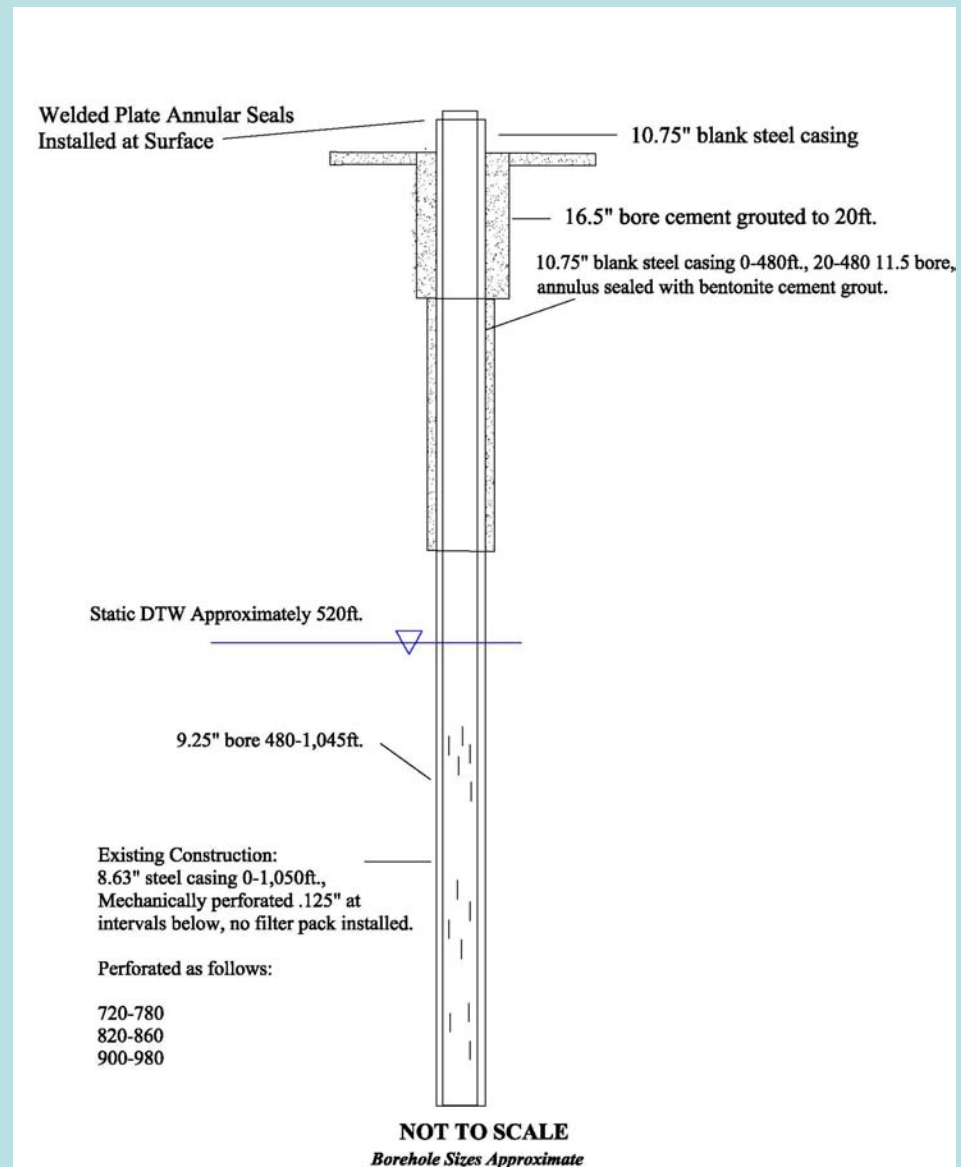
Aquifer

Milk Ranch Well Construction

The well was constructed with an outer cement seal to 480ft. In order to ensure isolation of the deep aquifer.

The 8 inch casing that was advanced to 1,045ft. Was perforated in places below 720ft. to allow groundwater to enter the well.

The resulting depth to water was a surprising 520ft.



Well Development, Pumping, and Water Quality Sampling Completed by November 2006

- Following the application of well development “cleaning” efforts, the well was outfitted with a test pumping system that included a down hole sand separator to protect the pump from sediment.
 - Prior to the installation of the Milk Ranch Well, fine sand and silt were thought to be a localized condition. We now know that sand/silt are going to be a common challenge for all deep wells constructed in this aquifer system. Thankfully it can be dealt with, as this is not a new problem.
- From September thru November 2006 the well was put through multiple pumping tests.
- During the testing, water quality samples were collected.

Pine's Deep Aquifer and Sediment -- Why?

Sediment in Groundwater is a normal occurrence.

In Pine's deep aquifer, the sand and silt are primarily from sandy layers in the "Martin" dolomite and silt from the Precambrian basement.

- Sand/silt can also be related to water passing through caverns or voids in the aquifer which contain some of the finest material.

- Typically, As a new well is used the sand problem diminishes and can be minimized through operation techniques.

- If necessary, filtration can be added at the surface.

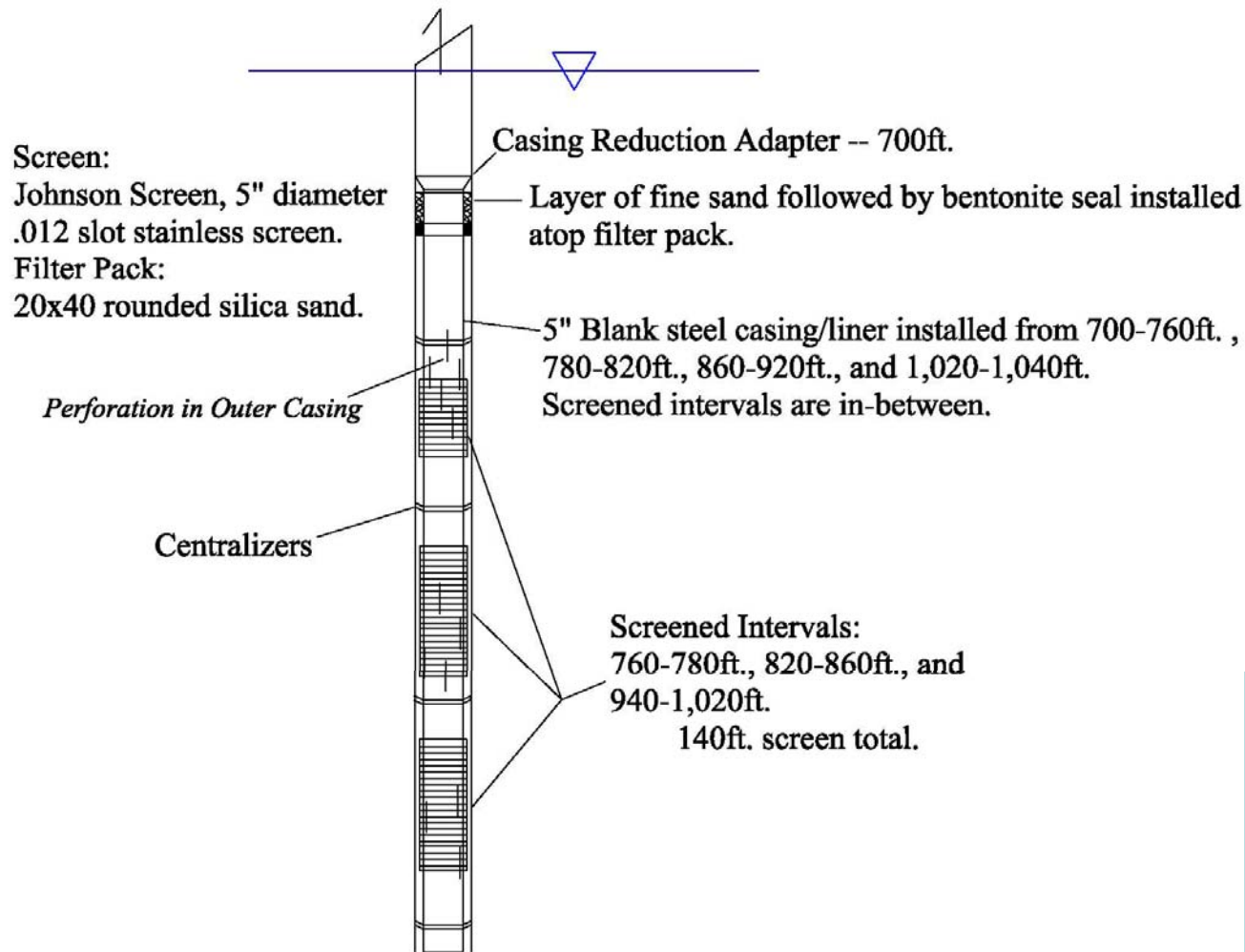
- Alternative well completion methods can help minimize sediment through the use of "filter packs and screen". This can be a challenge in cavernous aquifers.







Proposed Liner / Screen Installation Detail
Milk Ranch LLC Well #55-210454



NOT TO SCALE
Approximate for Discussion Purposes Only

Modification Options to Stop Sediment

Liner/screen to pre-filter sediment from groundwater.

Pro:

Keeps sediment out of well and pump and lets water in.

Con:

Potential for plugging and loss of yield cannot be ruled out. (However, this can be mitigated through a regular maintenance schedule once silting rates are known)

Other similar options exist such as pre-pack screen and pump screens but at higher costs and risk.

➤ A full suite of sediment removal strategies are currently under consideration.

➤ Assuming the existing pump is not significantly worn, HWRC is recommending the well be used "as is" with the following topics in mind:

a) Surface filtration / screen will be required.

b) A standard start-up and operation strategy should be developed to minimize sanding.

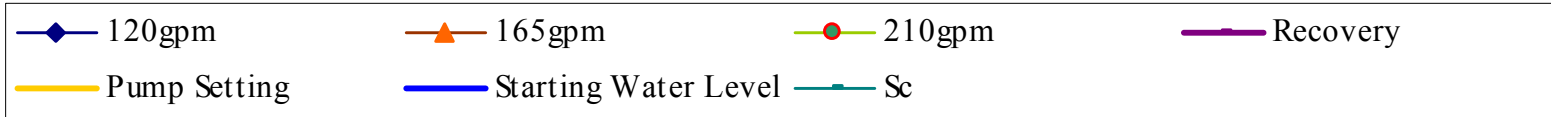
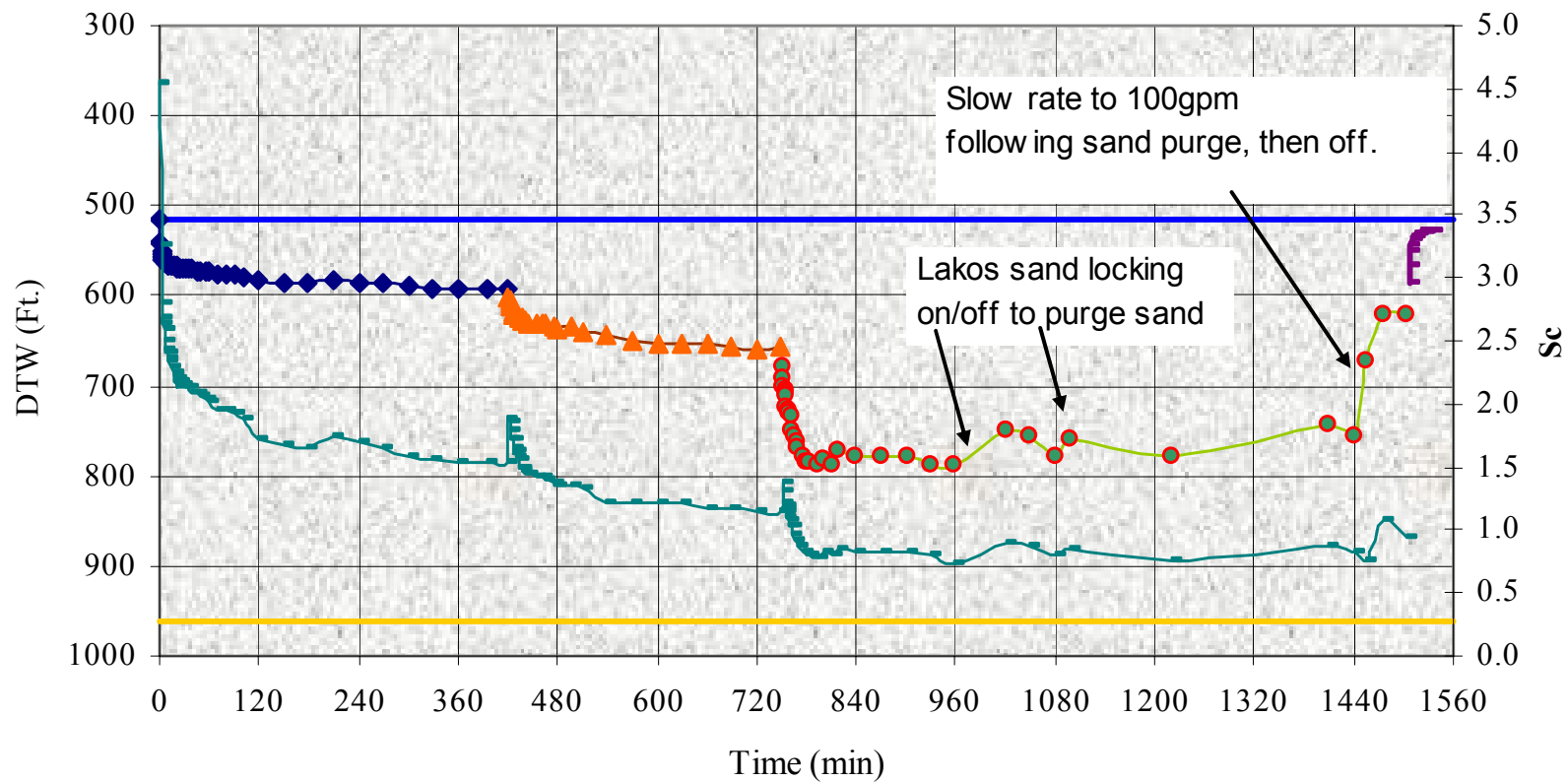
c) A well development (cleaning) and/or modification plan should be ready for implementation once pump failure occurs.

OR

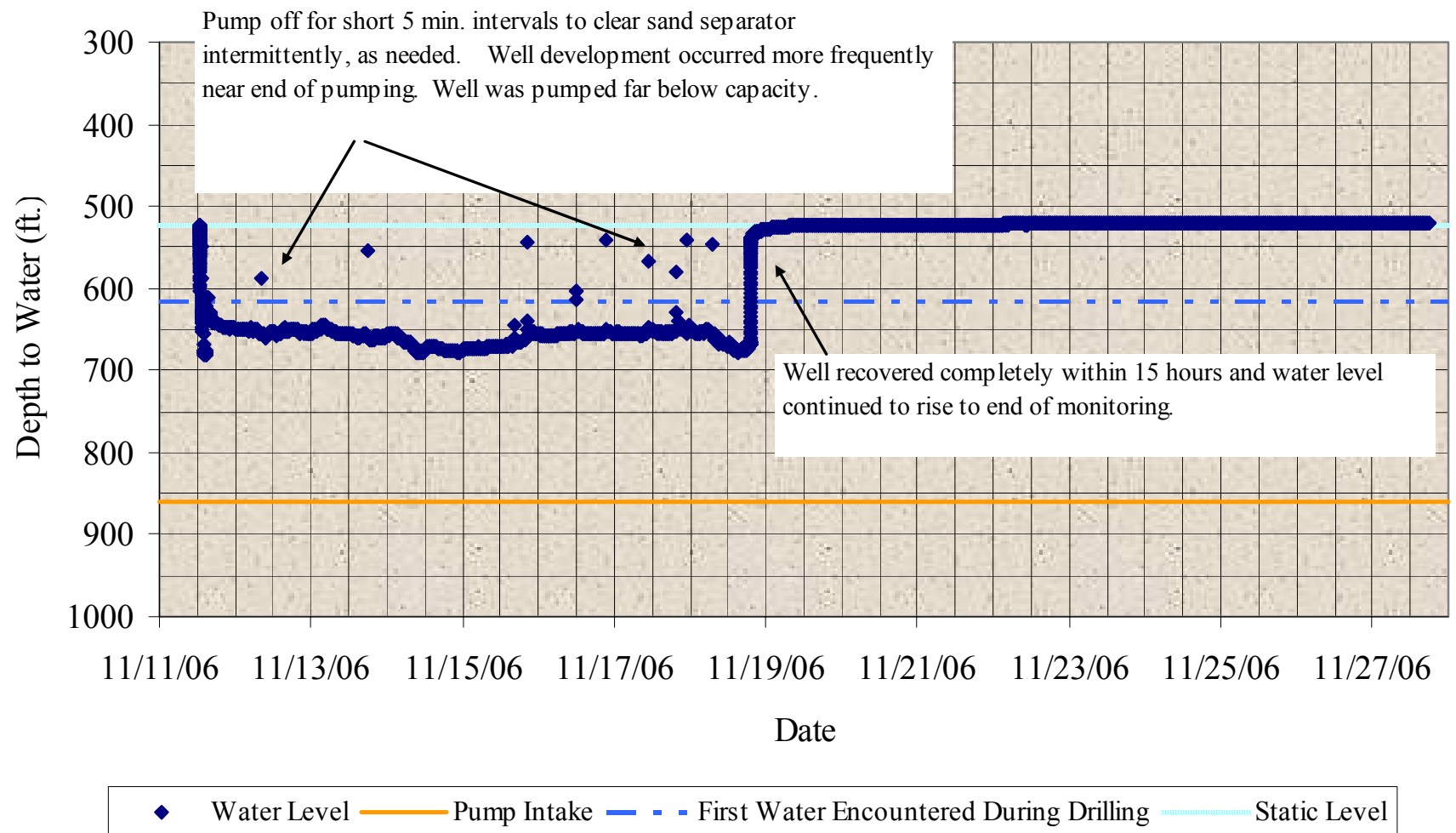
d) Well development (cleaning) and/or modification should be scheduled in prevention of failure. -- low demand period.

So, How much water are we talking about??

Milk Ranch Well #55-210454 Step Testing
September 9th-10th, 2006



Milk Ranch Well 7 Day 140gpm Constant Rate Test with 7 Day Recovery Water Levels vs. Time



Water Quality Results

- The well was sampled and screened for all ADEQ required -- "new source approval" potential contaminants.
- The Milk Ranch Well water quality met all ADEQ and EPA water quality standards.

Some values:

Ph = 7.2 normal

Hardness (Ca) = 160 mg/l (average for region)

Temperature = 56 degrees Fahrenheit (colder than most)

Total Dissolved Solids (TDS) = 230 (average for region)

In Summary

The Milk Ranch Well:

- ✓ Has a demonstrated capability to provide as much as 250,000 gallons of water per day to the community.
- ✓ Only needs the installation of sand filter system to be ready to provide silt free water on a regular basis. In the meantime, other more long-term solutions for dealing with sediment are under investigation.
- ✓ Is a source of high quality groundwater that can be made available to the community in relatively short order.
- ✓ Findings reinforce the fact that there is a deep groundwater aquifer in Pine that has been historically ignored.

With proper management of this new resource alongside existing sources, the era of water shortages and conflict in Pine and Strawberry can be over.

