

# Listening to the Noise

What's in Your Data Besides Data?

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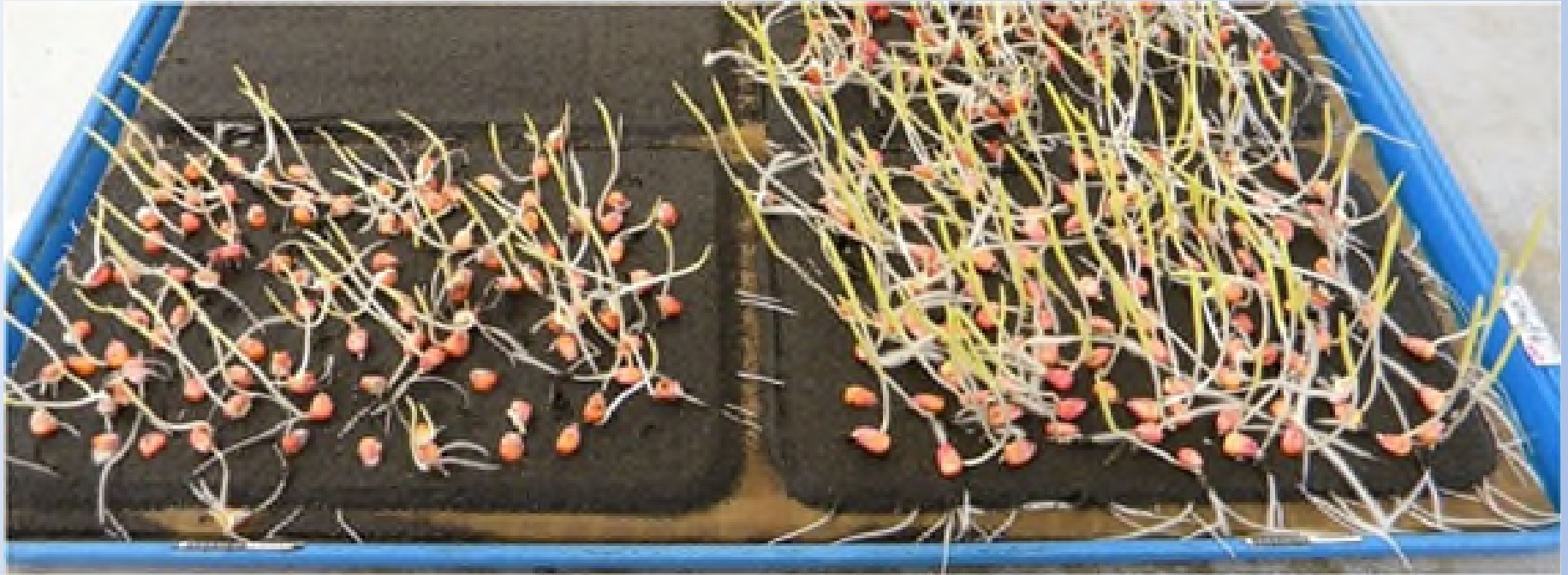


Presentation

# Introduction

- We all need data to do our jobs, whether we are students, vendors, operators, regulators, or consultants.
- All data is inferred, estimated, extrapolated, and statistically massaged.
- We need data treatments to make collecting, analyzing, and applying information manageable.
- Inaccuracies can result not only from human error, but also from equipment and environmental factors.
- Poor data management can make even the best dataset useless.
- Assumptions are inevitable, but making unwarranted assumptions can be dangerous.
- Careful examination can sometimes reveal useful data even in the shakiest datasets; but always keep it in context.

















# Data- Facts?

- The data we work with represents natural systems. Natural systems vary.
- Much of our data is not directly measured. Quite often, we are actually measuring tiny changes in electrical current.
- Data is collected, organized, and analyzed by people. People make mistakes.
- Instruments have a margin of error. Calibration is important.
- Variation can come from unexpected sources. It may not be a mistake; you may not be measuring exactly what you think you are.
- Results can be changed or biased by the act of measurement itself.
- Careful statistical processing can remove or control uncertainty in a dataset.



# The Human Element

- Well Drillers

# Drillers' Logs

**95 40 E 05 ABC**  
**MONITORING**  
**WELL LOG REPORT**

File No. 105378

State law requires that the Bureau's copy be filed by the water well driller within 60 days after completion of the well.

Hardin 1244-93 Big Horn

Form No. 43 (Rev. 8-88)

1. WEI \_\_\_\_\_  
 2. DU \_\_\_\_\_

3. WELL LOCATION  
 SW  
 Township \_\_\_\_\_  
 Section \_\_\_\_\_  
 or Lot \_\_\_\_\_ Block \_\_\_\_\_  
 or \_\_\_\_\_  
 or \_\_\_\_\_

4. PI  
 Other: Scientific observation

5. TYPE OF WORK:  
 New well  Method: Dig  Bored   
 Deepened  Cable  Driven   
 Reconditioned  Rotary  Jetted

6. DIMENSIONS: Diameter of hole  
 Dia. 8.75 in. 0.0 ft. to 275.0 ft.  
 Dia. \_\_\_\_\_ in. from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
 Dia. \_\_\_\_\_ in. from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

7. CONSTRUCTION DETAILS:  
 Casing: Stuc \_\_\_\_\_ Dia. \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
 Threaded  Welded  Dia. \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
 Type \_\_\_\_\_ Well thickness \_\_\_\_\_  
 Casing (Depth) \_\_\_\_\_ Dia. \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
 Weight 24.40 lb. Dia. 8.75 from 0 ft. to 275.0 ft.  
 PERFORATIONS: Yes  No   
 Type of perforator used Sigs slotted - factory  
 Size of perforations 0.25 in. by 3.0 in.  
700 perforations from 245.0 ft. to 275.0 ft.  
 \_\_\_\_\_ perforations from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
 \_\_\_\_\_ perforations from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

SCREENS: Yes  No   
 Manufacturer's Name \_\_\_\_\_  
 Type \_\_\_\_\_ Model No. \_\_\_\_\_  
 Dia. \_\_\_\_\_ Slot size \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
 Dia. \_\_\_\_\_ Slot size \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

GRAVEL PACKED: Yes  No  Size of gravel No. 8 sand  
 Gravel placed from 240.0 ft. to 275.0 ft.

GROUTED: To what depth 240.0 ft.  
 Material used in grouting Benbowite chips

8. WELL HEAD COMPLETION:  
 Pitless Adapter  Yes  No

9. PUMP (if installed)  
 Manufacturer's name \_\_\_\_\_  
 Type \_\_\_\_\_ Model No. \_\_\_\_\_ HP \_\_\_\_\_

10. WELL TEST DATA See 12  
 The information requested in this section is required for all wells. All depth measurements shall be from the top of the well casing.  
 All wells under 100 gpm must be tested for a minimum of one hour and provide the following information:  
 a) A \_\_\_\_\_ Pump \_\_\_\_\_  
 b) Static water level immediately before testing \_\_\_\_\_ ft. FFOW \_\_\_\_\_  
 c) Closest pressure \_\_\_\_\_ ps \_\_\_\_\_ value \_\_\_\_\_ gpm.  
 d) Filter corrected by \_\_\_\_\_ valve \_\_\_\_\_ rec. corr. \_\_\_\_\_  
 e) other (specify) \_\_\_\_\_  
 f) Depth of well pump is set for \_\_\_\_\_ ft. at \_\_\_\_\_ hrs. after pump was begun.

11. WAS WELL PLUGGED OR ABANDONED? Yes  No   
 If yes, how? \_\_\_\_\_

12. WELL LOG  
 Form \_\_\_\_\_ To \_\_\_\_\_ Formation \_\_\_\_\_  
 0.0 1.0 Topsoil; silt  
 1.0 45.0 Shale; hard  
 45.0 140.0 Shale  
 140.0 157.5 Sand  
 157.5 240.0 Shale  
 240.0 275.0 Sand  
 275.0 \_\_\_\_\_ TRD

Washed and blown  
 jetted clean to  
 develop - Blows  
 5 gpm.

ATTACH ADDITIONAL SHEETS IF NECESSARY

13. DATE COMPLETED 12-15-93

14. DRILLER/CONTRACTOR'S CERTIFICATION  
 This well was drilled under my jurisdiction and this report is true to the best of my knowledge.  
1-24-94  
 Drw  
Kiewit Mining Group  
 P.O. Box 3049 Sheridan, WY 82801  
Ken C. Allen MNC-190  
 License No. \_\_\_\_\_

MONTANA DEPARTMENT OF NATURAL RESOURCES  
 1620 EAST SIXTH AVENUE HELENA, MONTANA 59602

DEPARTMENT - BUREAU COPY  
 M: 144 097









# The Human Element

- Well Drillers
- Field Personnel

# The Human Element

- Well Drillers
- Field Personnel
- Effort



# Effort

- We need to make sure we are always checking units on our field equipment.
- Be careful not to fall into bad habits in field notes. “Ditto” is not data. Significant figures cannot be replaced. “16” is not the same as “16.000”. Once the value is recorded without the trailing zeroes, that precision is gone forever.
- You can never have too many water level readings.
- A water level reading without a date and time is worthless.
- GPS everything, and take lots of photos.
- If you work in the field, it is worth the time to bone up on statistics.

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 151049  
GoA Well Tag No.  
Drilling Company Well ID  
Date Report Received 1990/05/07

1. Well Identification and Location										Measurement in Metric	
										Postal Code	
Town _____ Province _____											
<b>Location</b>	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description		
	SW	12	092	10	4						
Measured from Boundary of				GPS Coordinates in Decimal Degrees (NAD 83)				Elevation _____ m			
_____ m from _____				Latitude <u>56.962619</u> Longitude <u>-111.474410</u>				How Elevation Obtained _____			
_____ m from _____				How Location Obtained _____				How Elevation Obtained _____			
				Not Verified				Not Obtained			

Additional Information										Measurement in Metric
Distance From Top of Casing to Ground Level _____ cm										
Is Artesian Flow _____					Is Flow Control Installed _____					
Rate _____ L/min					Describe _____					
Recommended Pump Rate _____ 254.58 L/min					Pump Installed <u>Yes</u> Depth _____ m					
Recommended Pump Intake Depth (From TOC) _____ 20.12 m					Type <u>SUB</u> Make _____ H.P. _____					
					Model (Output Rating) _____					
Did you Encounter Saline Water (>4000 ppm TDS) _____					Depth _____ m Well Disinfected Upon Completion _____					
Gas _____					Depth _____ m Geophysical Log Taken _____					
					Submitted to GIC <u>Electric</u>					
					Gamma _____					
					Sample Collected for Potability _____ Result Attached _____					
Additional Comments on Well										
<b>DRAWDOWN CALCULATED FROM T VALUE.</b>										

5. Yield Test			Measurement in Metric	Taken From Ground Level
			Depth to water level	
Test Date	Start Time	Static Water Level		
1990/03/31	12:00 AM	20.70 m		
<b>Method of Water Removal</b>				
Type <u>Pump</u>				
Removal Rate <u>254.58 L/min</u>				
Depth Withdrawn From <u>20.12 m</u>				
If water removal period was < 2 hours, explain why				
Drawdown (m)	Elapsed Time	Recovery (m)		
	Minutes:Sec			
6.27	0:00	0.00		
7.16	1:00	0.00		
7.26	2:00	0.00		
7.30	3:00	0.00		
7.33	4:00	0.00		
7.34	5:00	0.00		
7.35	6:00	0.00		
7.36	7:00	0.00		
7.36	8:00	0.00		
7.38	9:00	0.00		
7.39	12:00	0.00		
7.39	18:00	0.00		
7.46	30:00	0.00		
7.72	50:00	0.00		
7.78	60:00	0.00		
7.84	75:00	0.00		
7.85	90:00	0.00		
7.87	105:00	0.00		
7.88	120:00	0.00		

6. Water Diverted for Drilling		
Water Source	Amount Taken	Diversion Date & Time
	L	

7. Contractor Certification	
Name of Journeyman responsible for drilling/construction of well	Certification No
UNKNOWN NA DRILLER	1
Copy of Well report provided to owner	Date approval holder signed



# The Human Element

- Well Drillers
- Field Personnel
- Effort
- Measurement Errors

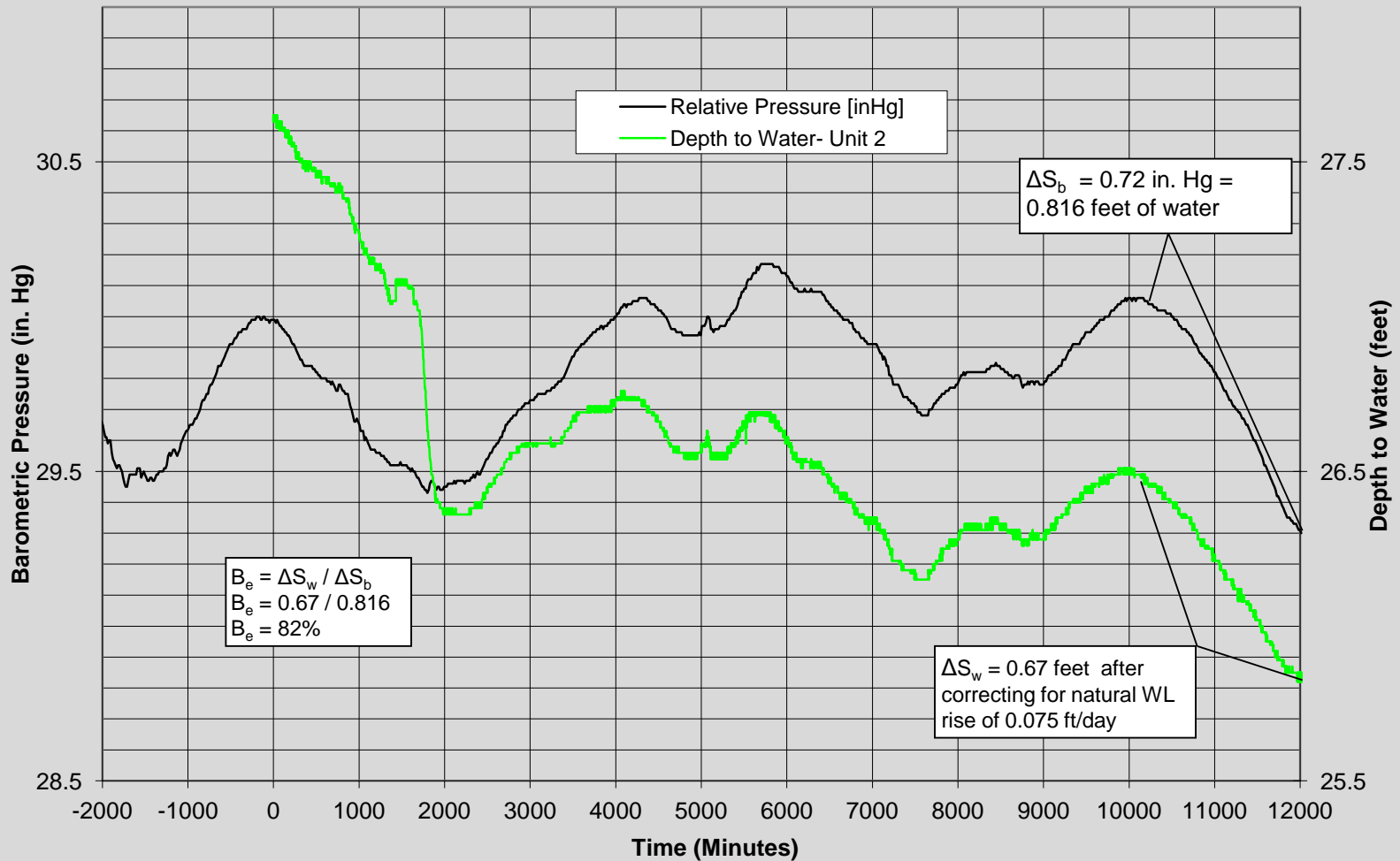
# Measurement Errors

- Have a working knowledge of what the data ought to look like. You don't usually need to know whether the pH ought to be 7.2 or 8.1 at a particular well, but -3.5 or 13.7 ought to raise alarm flags anywhere.
- It only takes a few minutes to round up a table of unit conversions, and carry it with you. Or download an app.
- On shift changes, make sure your relief knows where and how you have been measuring, and what units you have been using.

# Environmental Factors

- Climate

# Barometric Effects

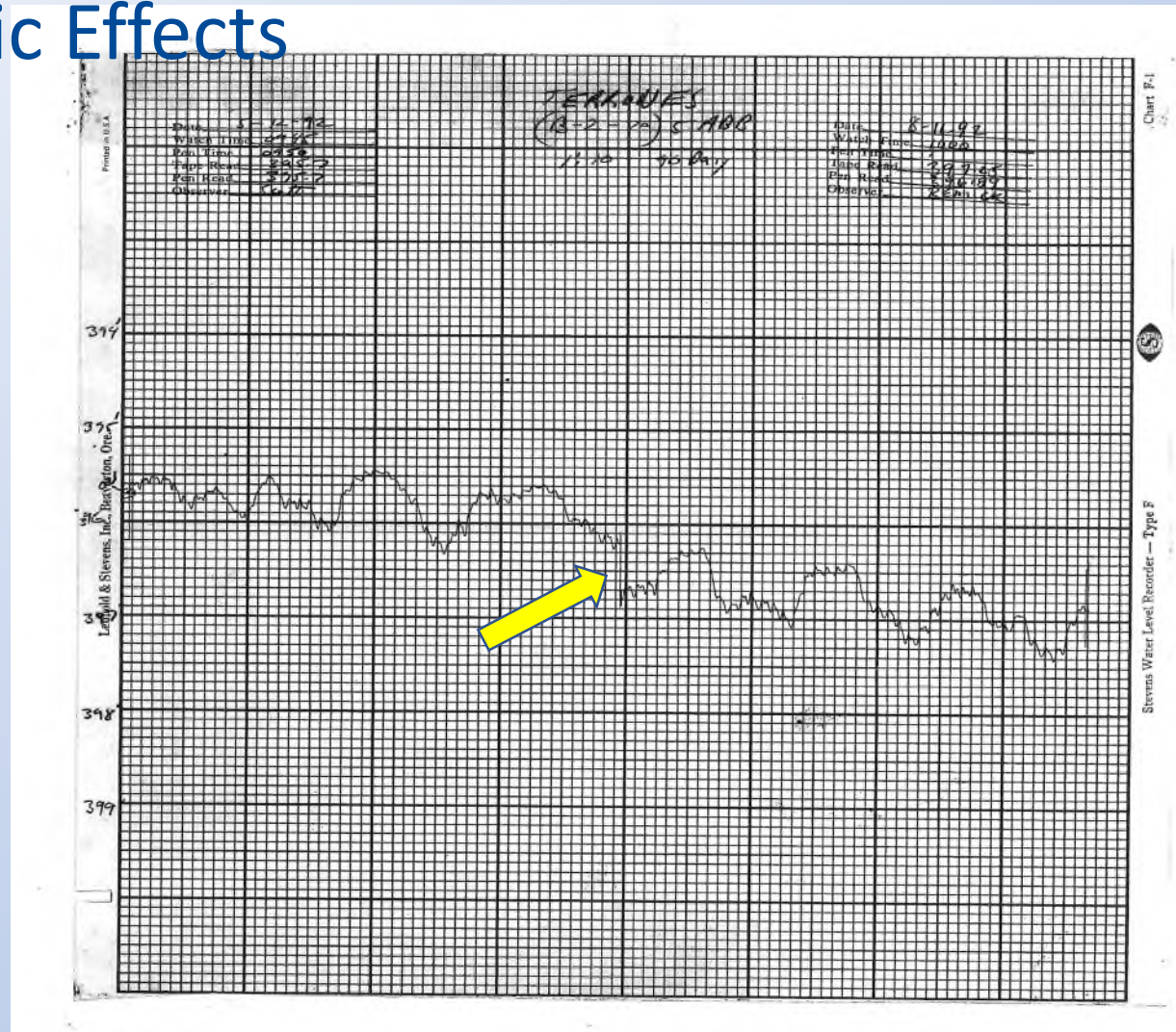




# Environmental Factors

- Climate
- Seismic Effects

# Seismic Effects



# Seismic Effects, Continued.



# Environmental Factors

- Climate
- Seismic Effects
- Tidal Forces



# Tidal Effects

50 GEOLOGY AND GROUND WATER, NORTHWESTERN KING CO., WASH.

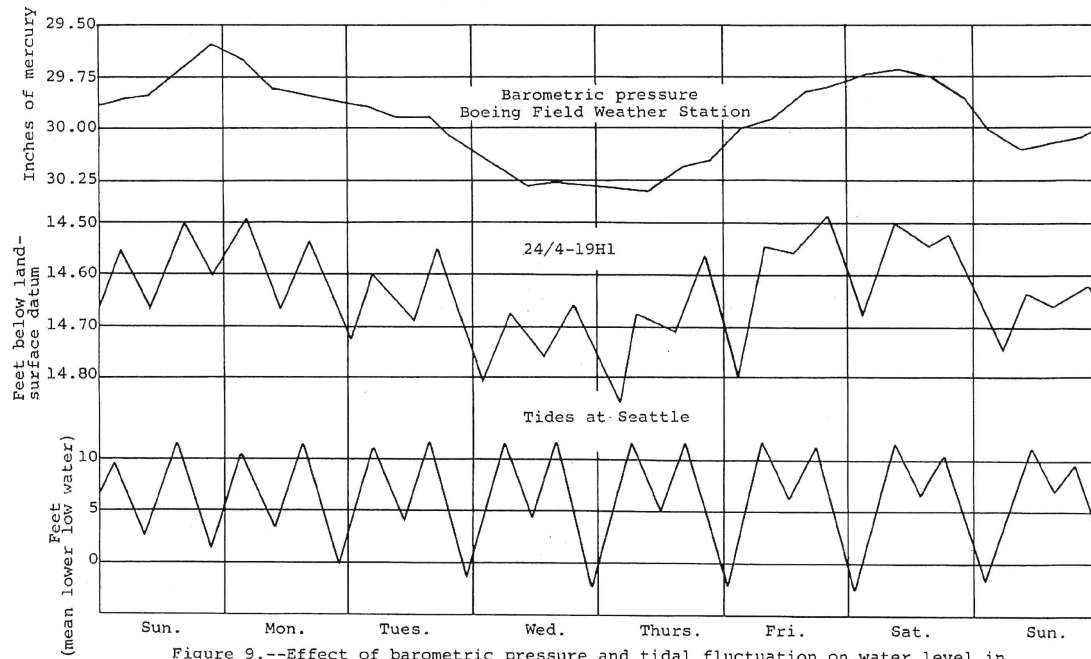
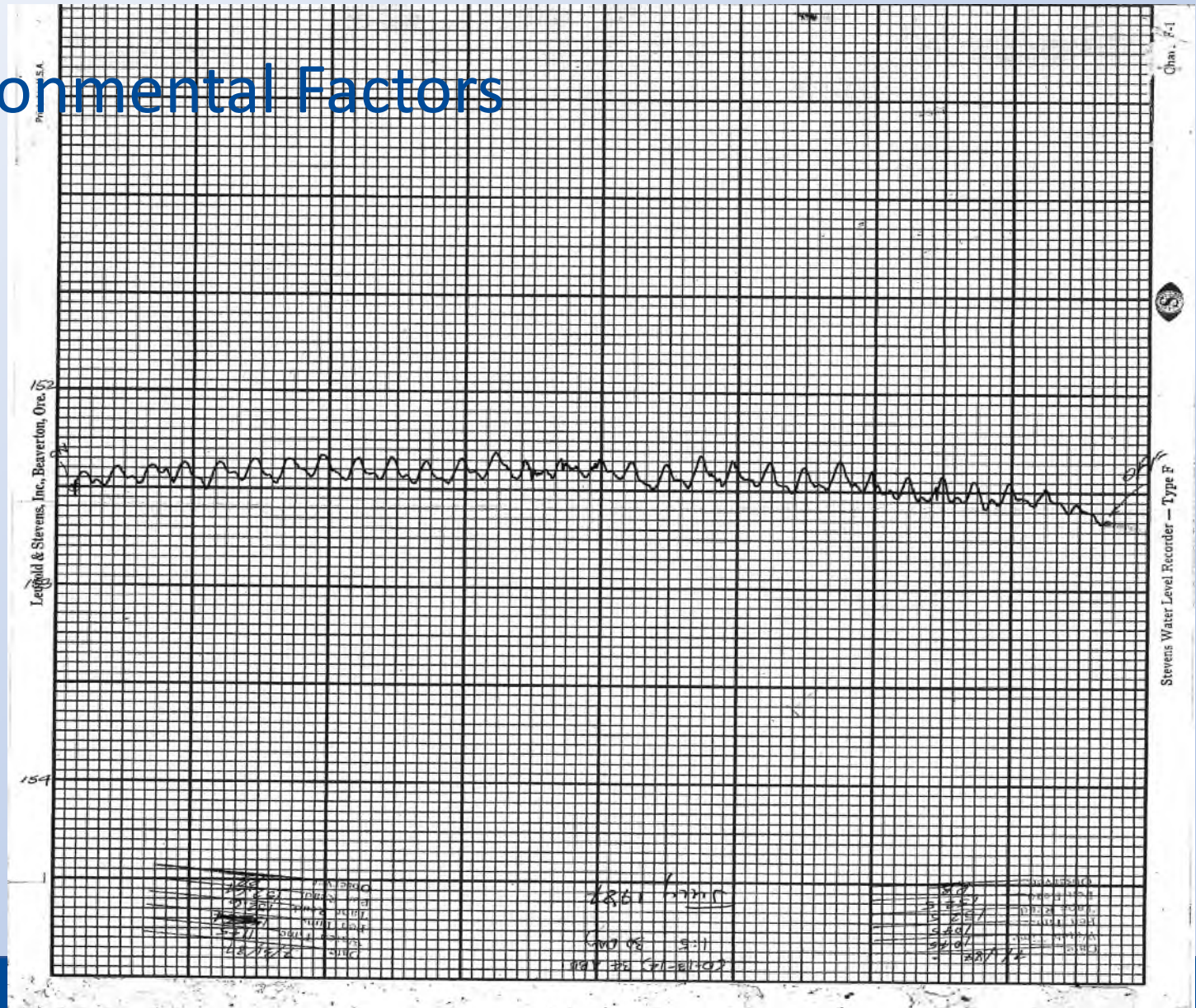


Figure 9.--Effect of barometric pressure and tidal fluctuation on water level in well 24/4-19H1, October 10-17, 1954.

# Environmental Factors

- Climate
- Seismic Effects
- Tidal Forces
- **Biologicals**

# Environmental Factors



# Equipment Factors

- Calibration
- Drift



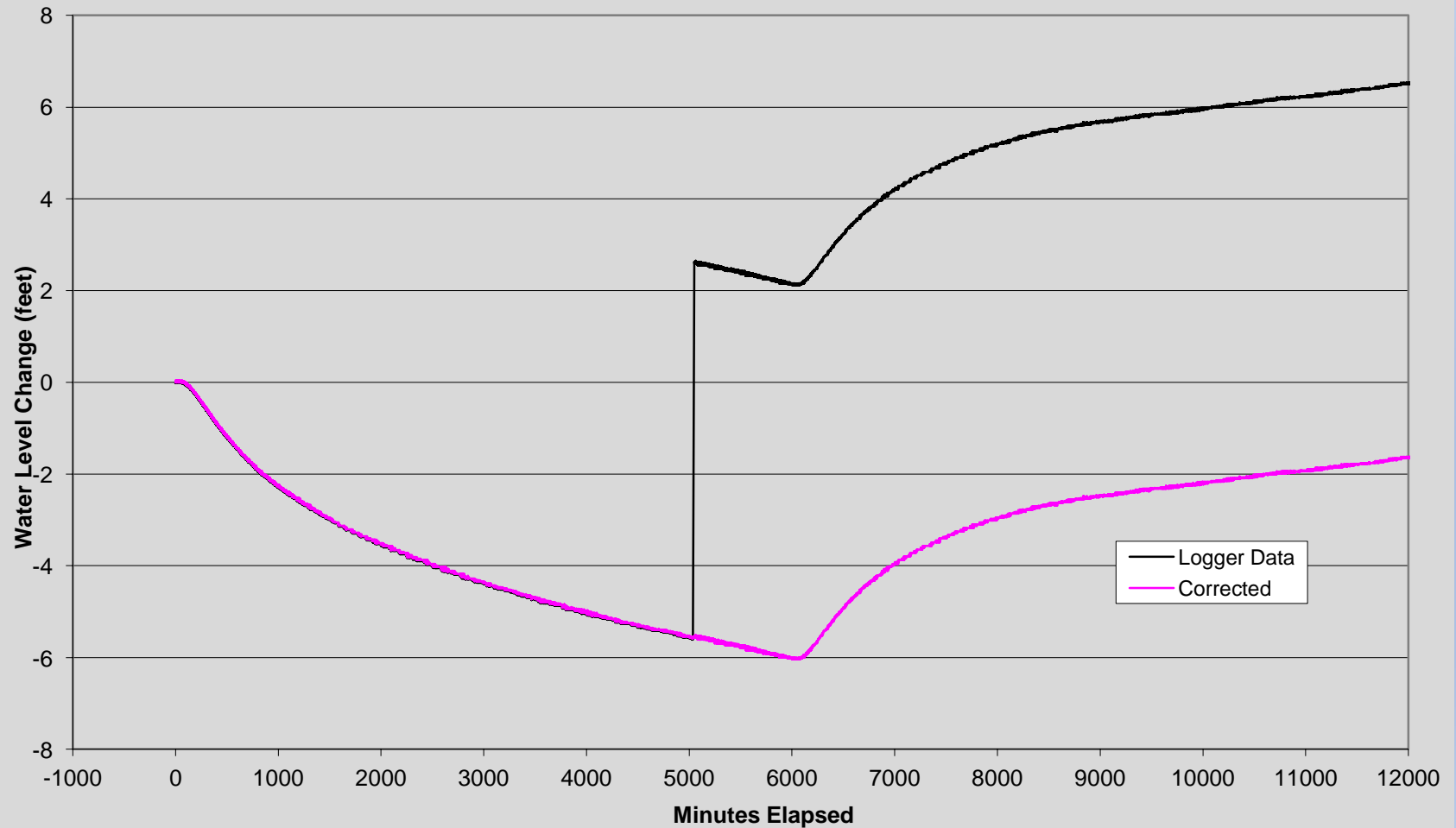
# Calibration and Drift

- Always calibrate electronic equipment every day and record the calibration.
- Periodically compare the last several days' calibration reports to see if there is a trend.
- Read the operator's manual to check proper handling and storage of instruments.

# Equipment Factors

- Calibration
- Drift
- Improper Mounting

# Improper Mounting

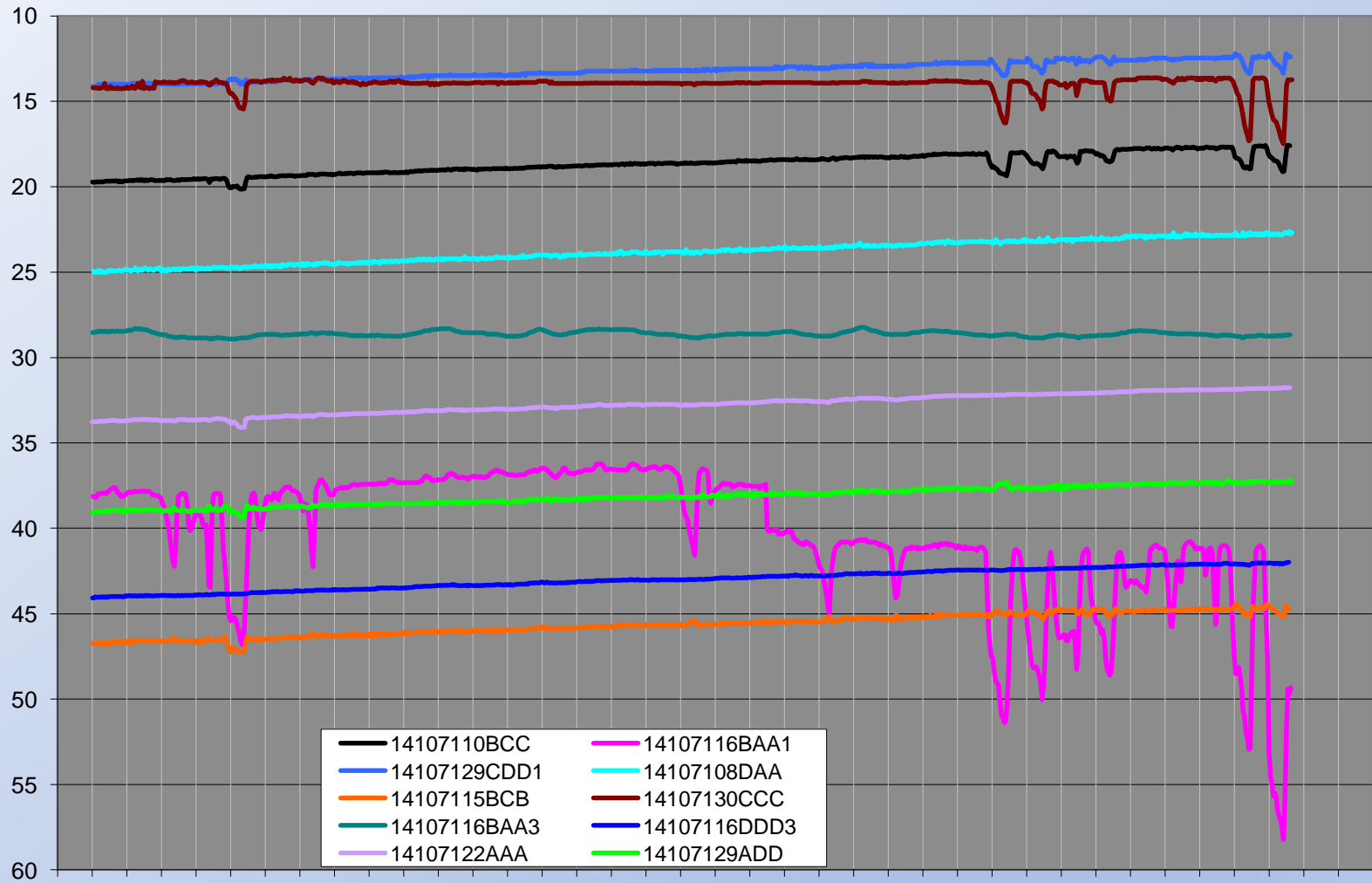


# Equipment Factors

- Calibration
- Drift
- Improper Mounting
- The Truly Weird



# It Looks Like Pumping Data...



# Shazam! Data Magic!

- Statistical Treatments
- Vetting Shaky Datasets
- Proxy Relationships
- Context Absolutely Must Be Maintained!

# Conclusions

- Assumptions are inevitable, and generally are not a problem, provided they are fully understood, conservative, and thoroughly documented.
- Good training and proper equipment maintenance can prevent many issues.
- Be alert for unusual interference and effects.
- Be very careful with statistical treatments, and fully document any data discarded or combined.
- Any proxy or interpolated data must be clearly identified and not combined with observational data.
- Don't blindly accept data as accurate. All data is wrong, but some of it is close enough to use.

# Thank you for your Attention!

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Final reclamation at Big Sky Mine, Colstrip, MT