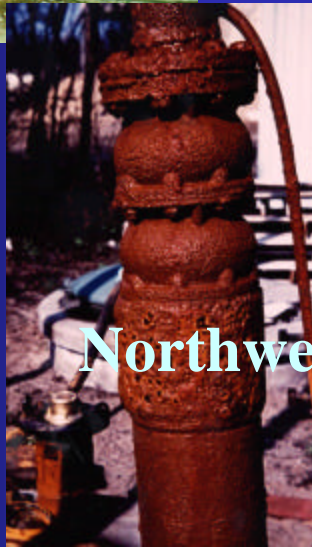
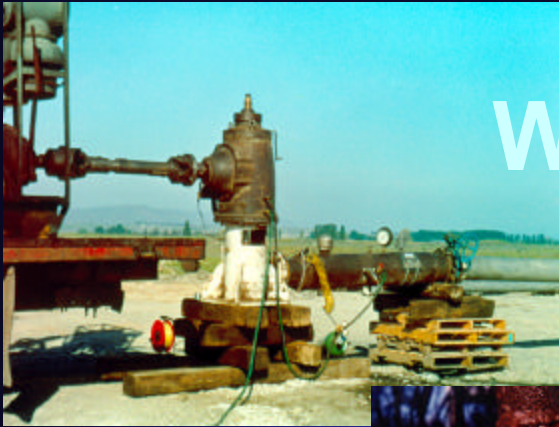


Well Monitoring and Rehabilitation



Northwest Fish Culture Conference
December 4, 2002

Jim Bailey - *HWA Berliner Wasser*



TOPICS

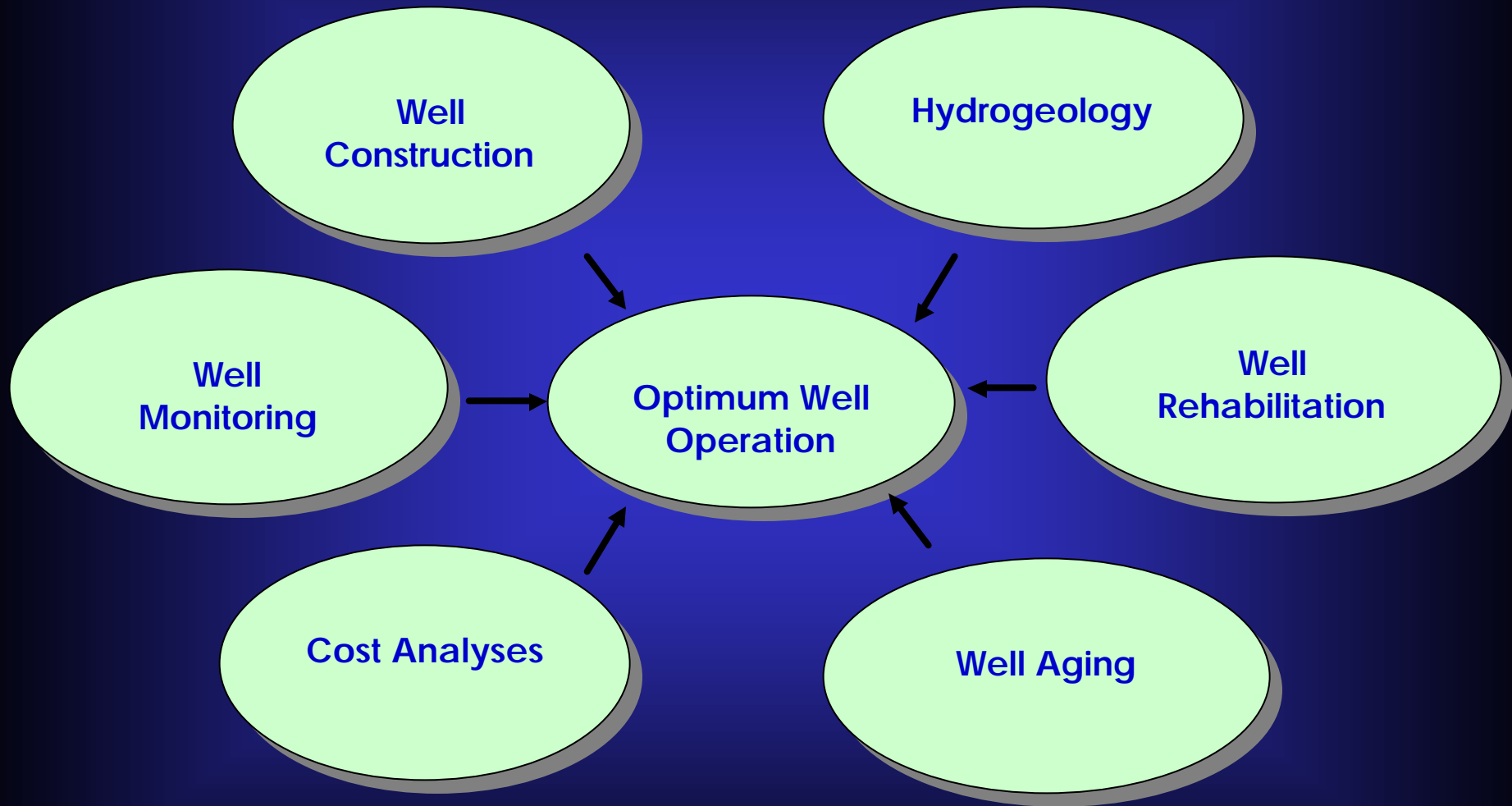
- Well Performance Factors
- Video Inspection
- Long Term Monitoring
- Well Rehabilitation



Well Performance Factors



Optimum Well Performance



Why Good Wells Go Bad?

- Working too hard or over-pumping!
- Poor well location
- Improper pump placement
- Ground water velocity changes
 - Bacterial & Microbial growth
 - Precipitation



Base Line Data

- i) Constant Rate Drawdown Test
- ii) Specific Capacity
- iii) Water Quality



SPECIFIC CAPACITY

- Simple Measure of Performance
- Yield in GPM/Drawdown in Feet
- Yield = 200 GPM
- Drawdown during Pumping = 50 feet

Then:

- $200 \text{ GPM} / 50 \text{ Feet} = 4 \text{ gpm/ftdd} = \text{Specific Capacity}$



Water Quality

- Anions
- Cations
- Bacteriological

Well Video Inspection



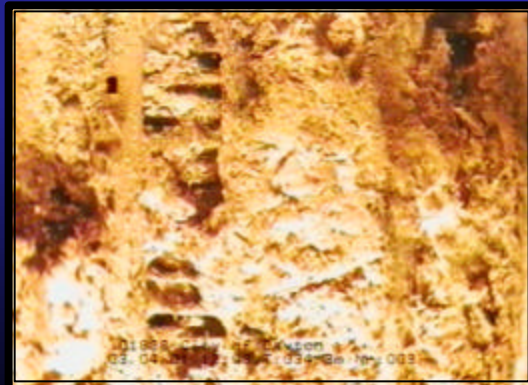
Why Video Inspection

New Well
Construction

Periodic
Monitoring

Well
Rehab

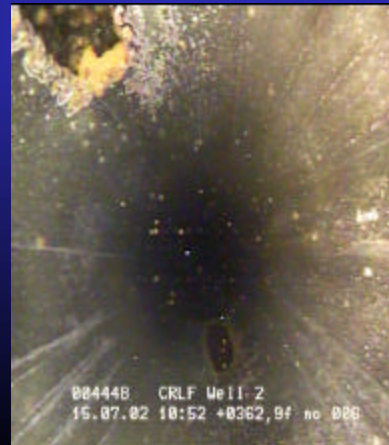
ID
Problem



Camera Technology



- Optical resolution
- Viewing angles
- Lighting
- Video editing options



Long Term Monitoring



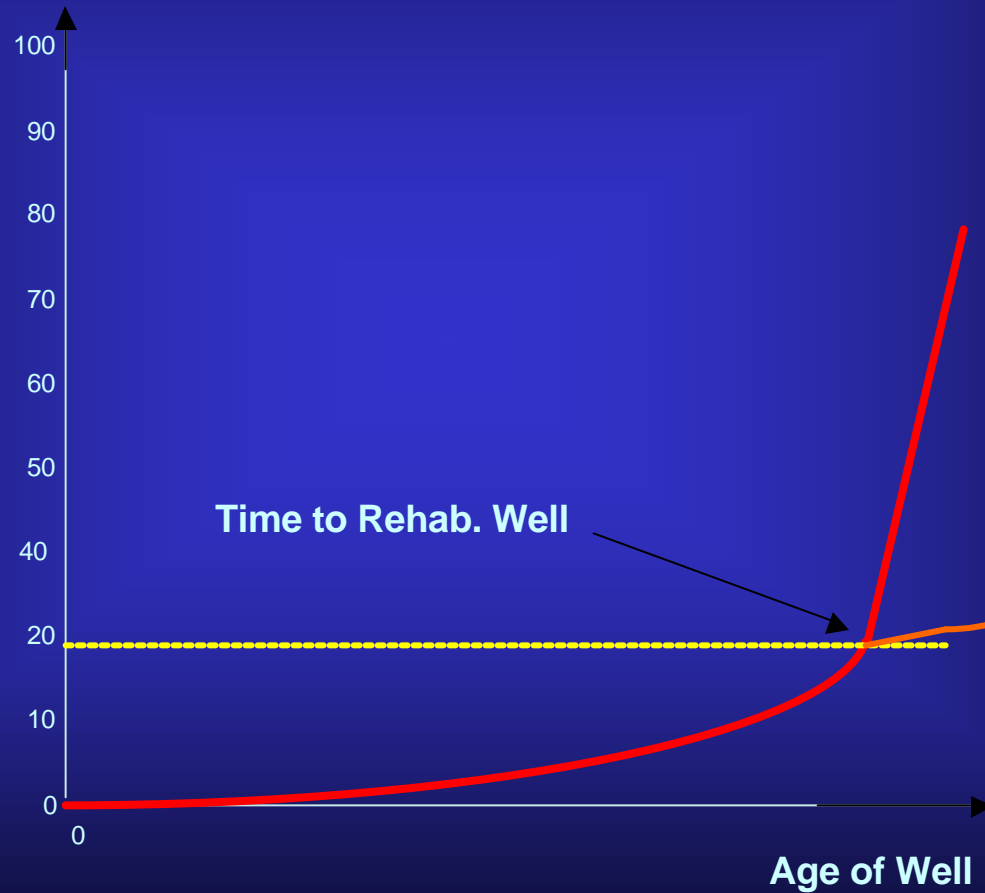
Long Term Monitoring

- Flow & Aquifer Level Sensing Telemetry/SCADA
- Specific Capacity
- Well Inspection
- Water Quality/Bacteriological

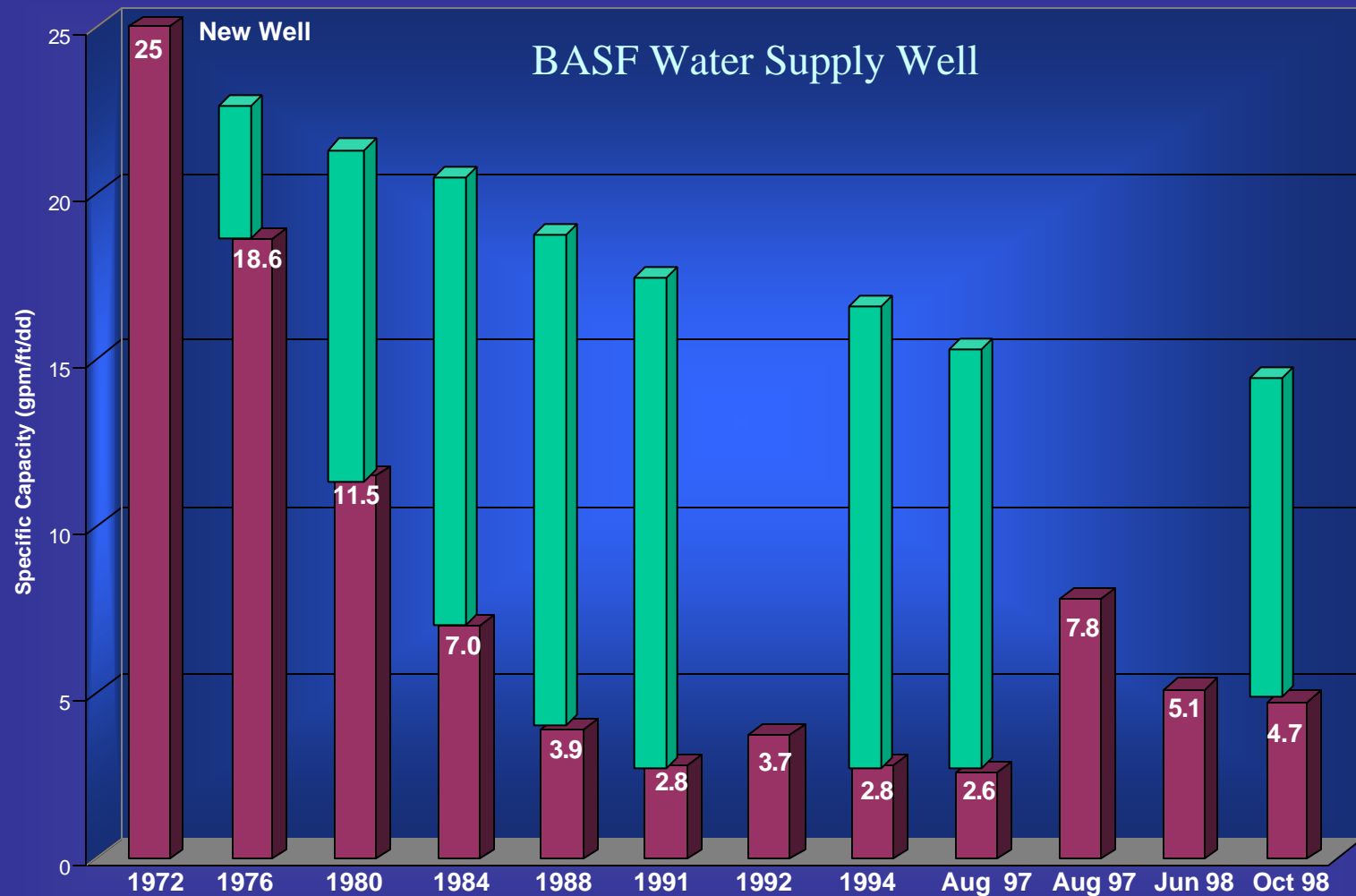


Well Aging

Reduction in Specific Capacity in %



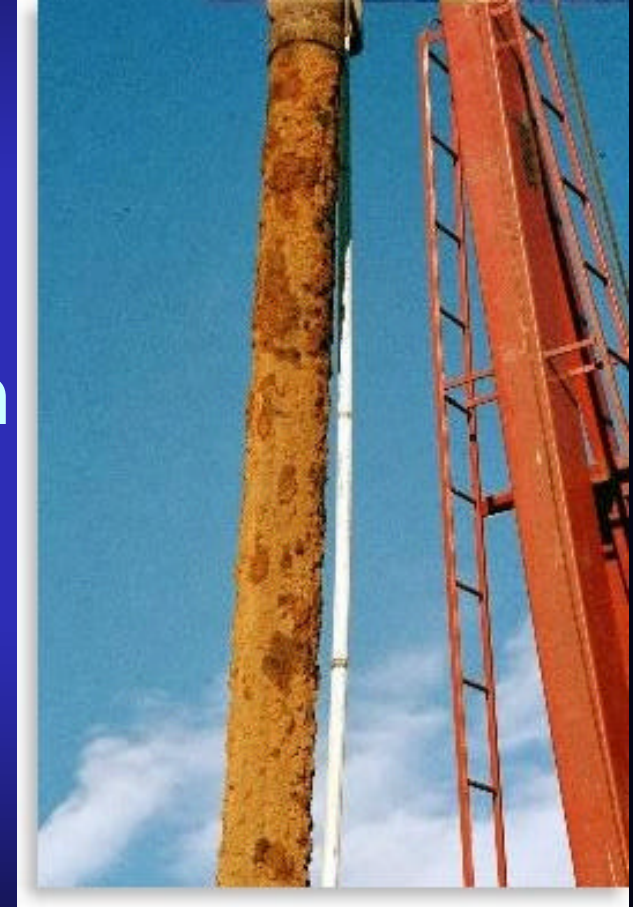
Declining Specific Capacity



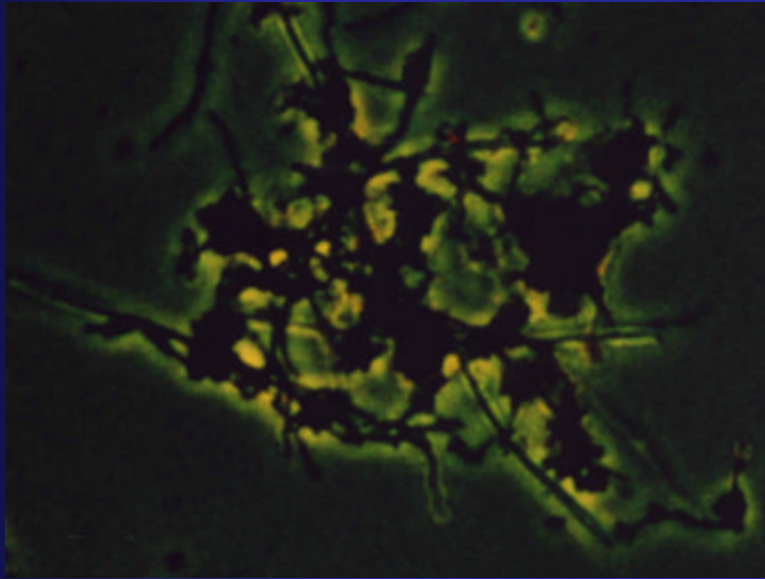
Periodic Inspections



- Pump
- Pump column
- Screen



Iron Bacteria

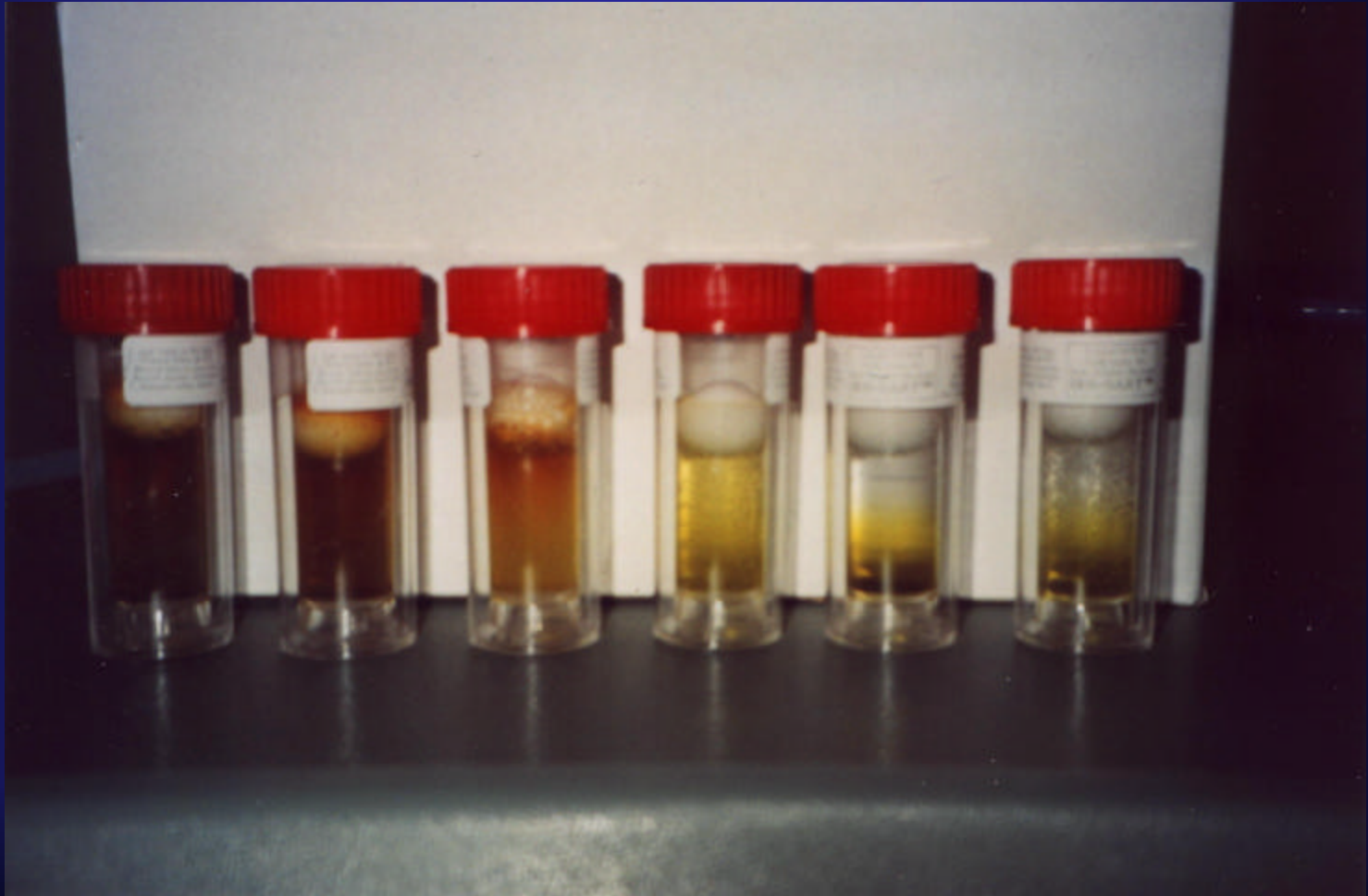


OPTIMUM GROWTH

- AVAILABILITY OF BACTERIA
- AVAILABILITY OF NUTRIENTS
 - Iron & Manganese from Formation
 - Nitrates from Agriculture
- AVAILABILITY OF OXYGEN
 - Fluctuations in Ground Water Table
 - Cyclic Pumping
 - Cascading Water



BART Testing



WELL REHABILITATION



Well Rehabilitation Techniques

- Chemical
- Mechanical
- Impulse Generation



Mechanical Treatment

- **Brushing**
- **Surging/Swabbing**
- **Jetting**
- **Freezing**



Brushing/Surging

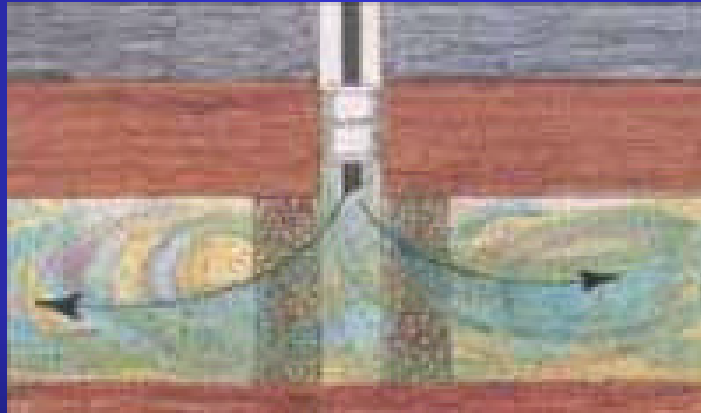


Jetting



Freezing

- Liquid Carbon Dioxide
Aqua Freed®



Impulse Generation

- **High Pressure Inert Gas**

Hydropuls®

AirBurst®

- **Explosive Charge**

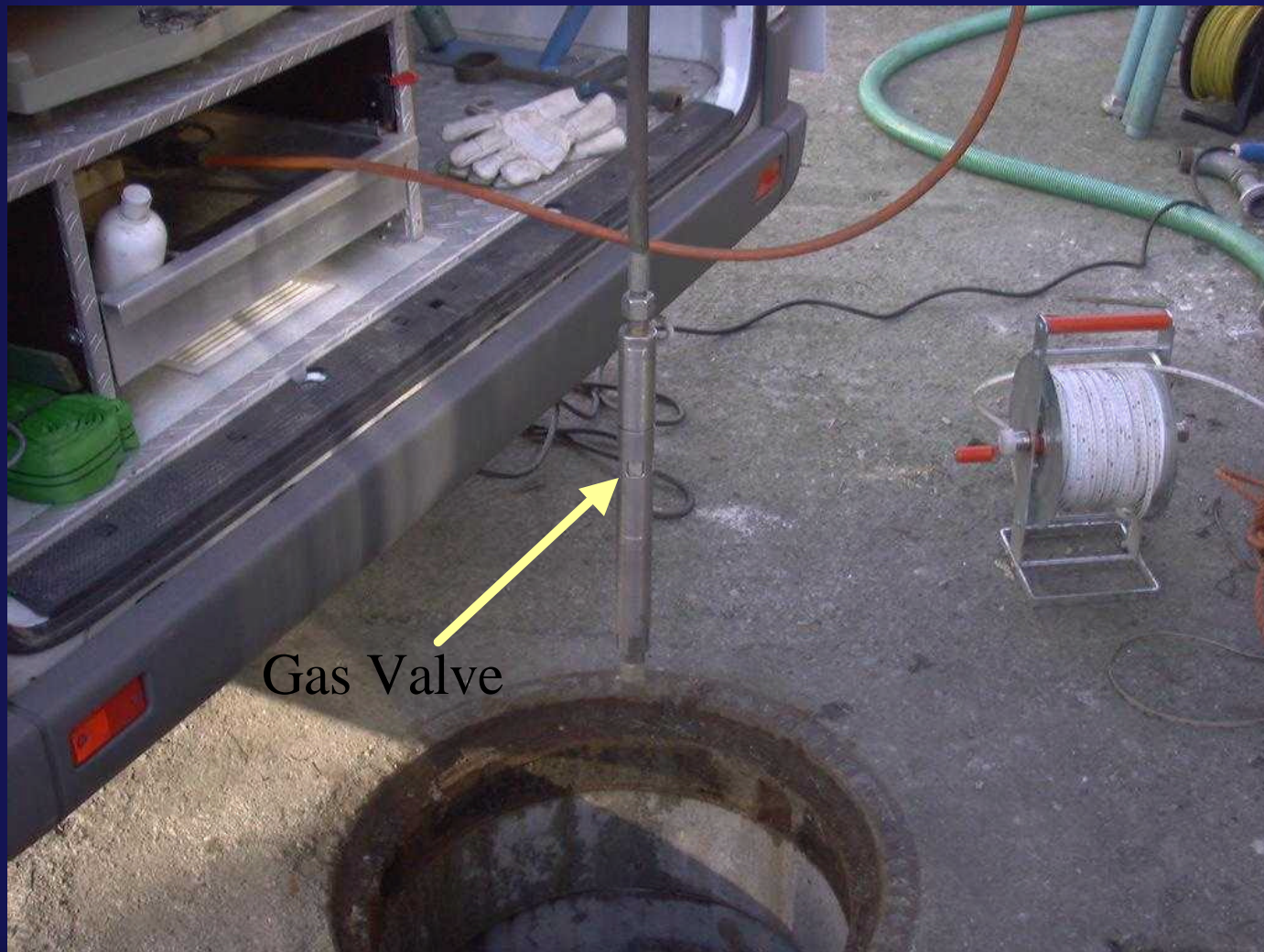
Sonar Jet ®

Ener-Jet ®

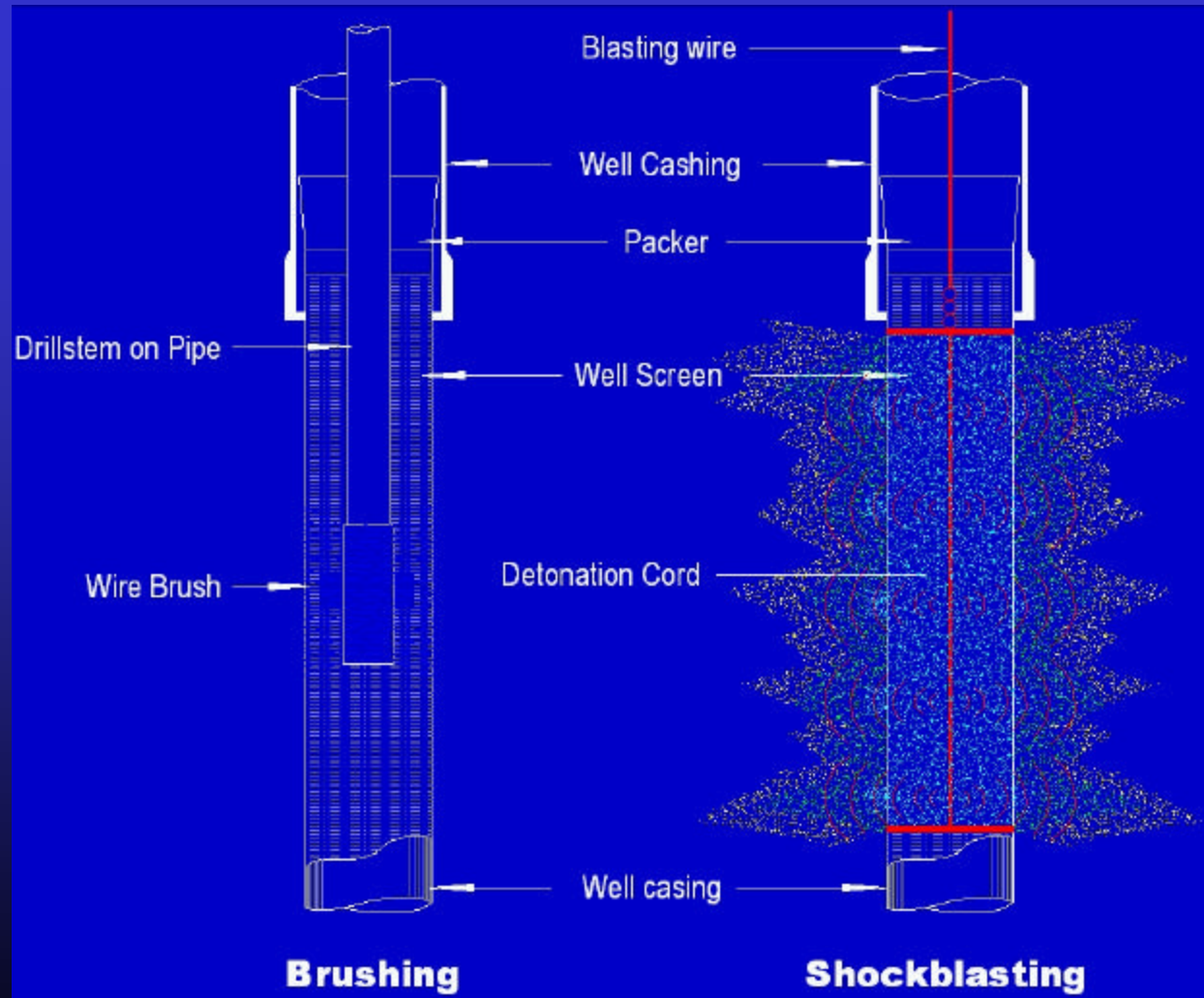
Shockblasting®



Impulse Generator- hydropuls®



Shockblasting® Illustration



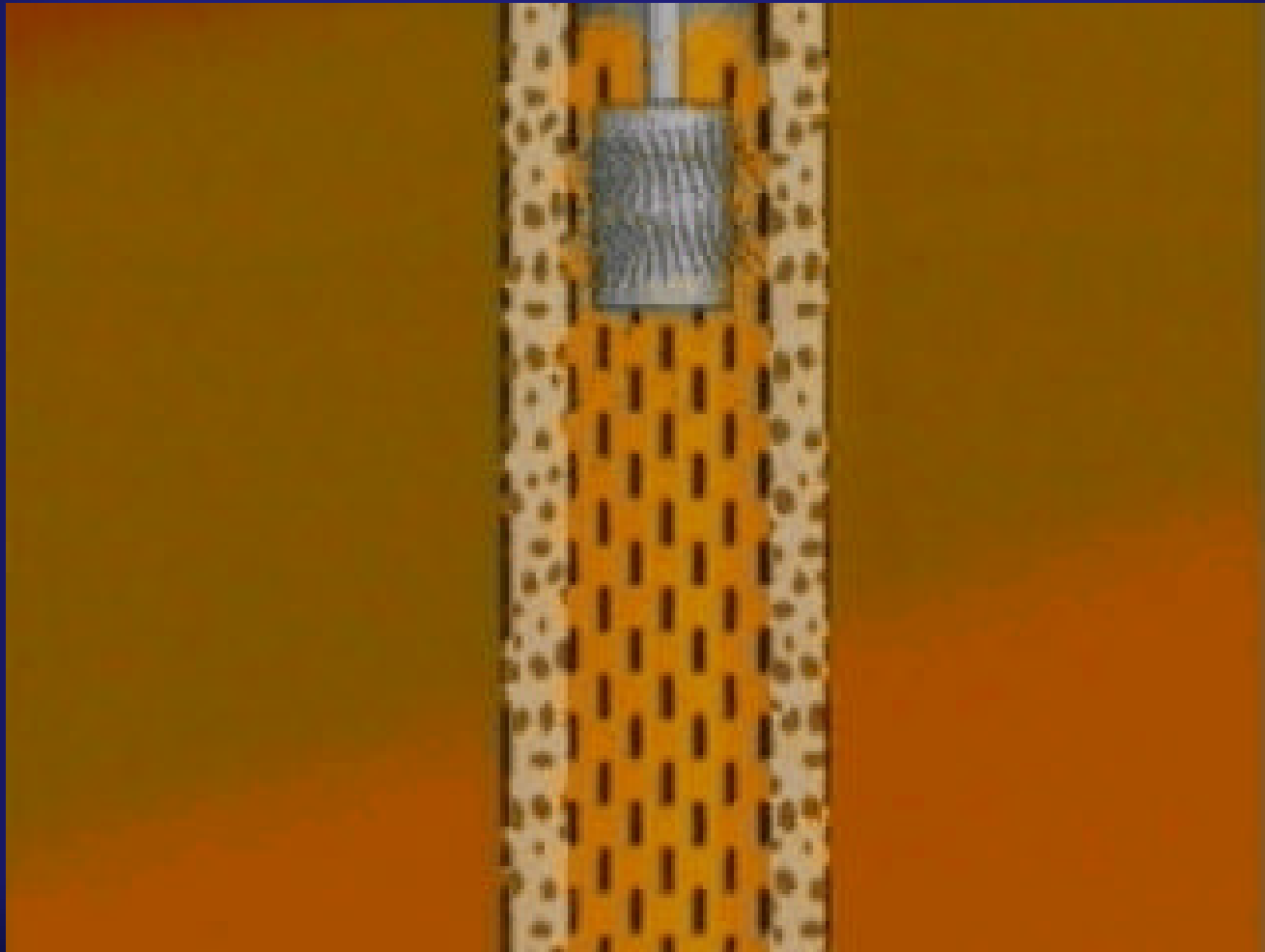
Well Rehabilitation Process

- Analysis of well conditions (specific capacity test, video camera inspection)
- Mechanical cleaning (Brushing)
- Well rehabilitation technology
- Bailing/ isolation pumping
- Final diagnosis (specific capacity test, video camera inspection)
- Interpretation/report

Aquifer Analysis



Mechanical cleaning (Brushing)



Well Rehabilitation



Isolation Pumping



Final Diagnosis

Before Rehabilitation



After Rehabilitation

Summary

- Get to know your wells history
- Develop a consistent monitoring program
- Decline in yield is most often due to bacteria
- Operations impact a well's life
- Rehabilitation possible on most wells

