

Water Well Asset Management Programs

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Water Advanced Solutions

Overview

1. Introduction
2. Asset Management Programs
3. Well Plugging and Rehabilitation
 - I. Effects of Plugging Conditions
 - II. Rehabilitation Procedures and Technologies
 - III. Review of How CO₂ Technology Works
4. Traditional Approach vs Asset Management
 - I. Run to Failure
 - II. Benefits of Maintaining Wells with In Well Maintenance Tools
 - III. Benefits of an Asset Management Programs
5. Questions

Introduction:



Jeff Austin:

- **Water Systems Consultant since 2011**
- **Pacific Northwest**
- **With Utility Service since 2011**
- **CEU Trainer with OAWU and AWWA-PNWC**
- **50+ Asset Inspections Annually**
- **Work with customers to solve maintenance and water quality issues throughout the distribution system**

Water Advanced Solutions

Unique Technologies

Asset Management Programs

Water
Wells



Filters



Tanks



Network
Assets



Meters,
AMI...



Ice
Pigging



Waste
Water



Biosolids
Drying



The North American leader in Asset Management

- Over 8000 assets under WAS programs

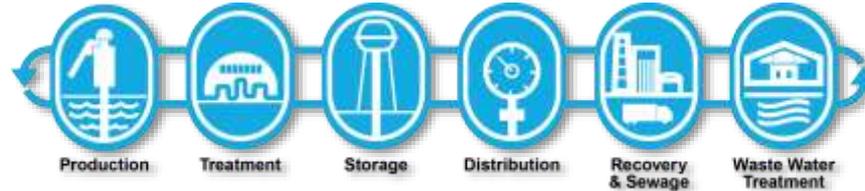
WAS responds by providing customized system Asset Management solutions through:

- Local water system consultants
- Regional water system specialists and service centers
- Technical experts in water source, quality, storage, metering & distribution

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Asset Management Programs



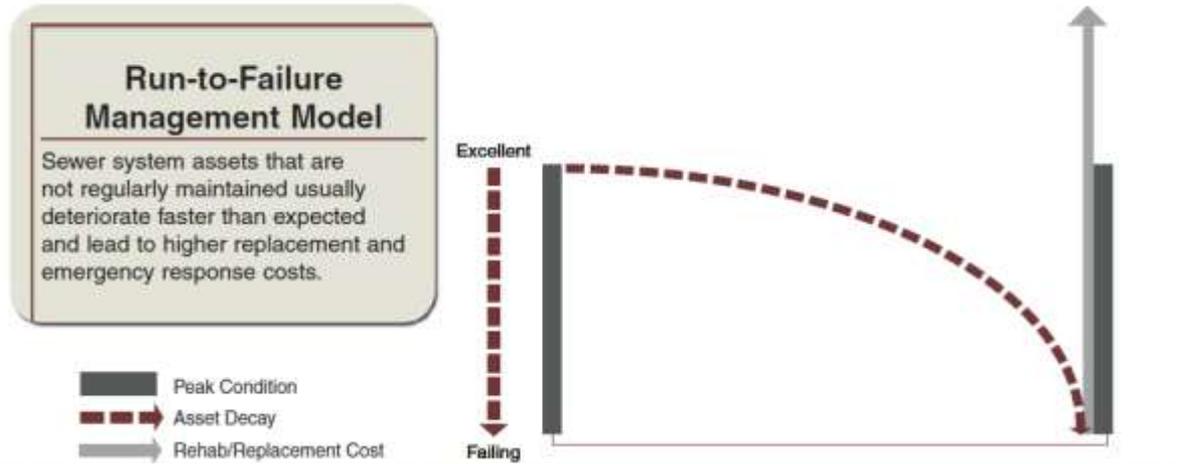
Provide water system Asset Management Services through Maintenance Program (MP) which cover:

Asset Management Program
(MP)

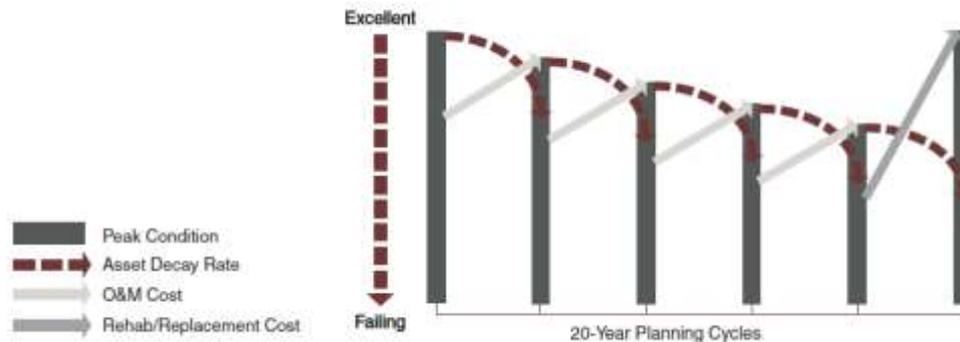
- Condition Assessment
- Rehabilitation
- Maintenance
- 100% Transfer of Risk
- Single Source Responsibility
- Predictable Budget
- Defined performance
- “Best practices” recommendations

Complemented with a financial solution

Water System Maintenance Programs are Designed to Extend the Useful Life of Assets



Cost-effective!



Asset Management Model

Components are regularly maintained over long planning cycles, and finally replaced when deterioration outweighs the benefit of further maintenance. Costs are well-distributed over the life of the asset.

Benefits of Asset Management

Asset Management = Preventative Maintenance

- Extends the useful life of the water asset
- Ensure the asset operates in case of an emergency
- Lower costs for operations and maintenance
- Budgeting based on sustained performance
- Better managed risk and response to emergencies
- Defensible decision-making
- Improved public confidence
- Improved regulatory compliance



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Well Plugging Causes and Effects

Causes

- Biofouling-Mineral Encrustation
- Mechanical-Formation Fines (Silt and Clay)
- Chemical- Precipitation of Minerals

Effects

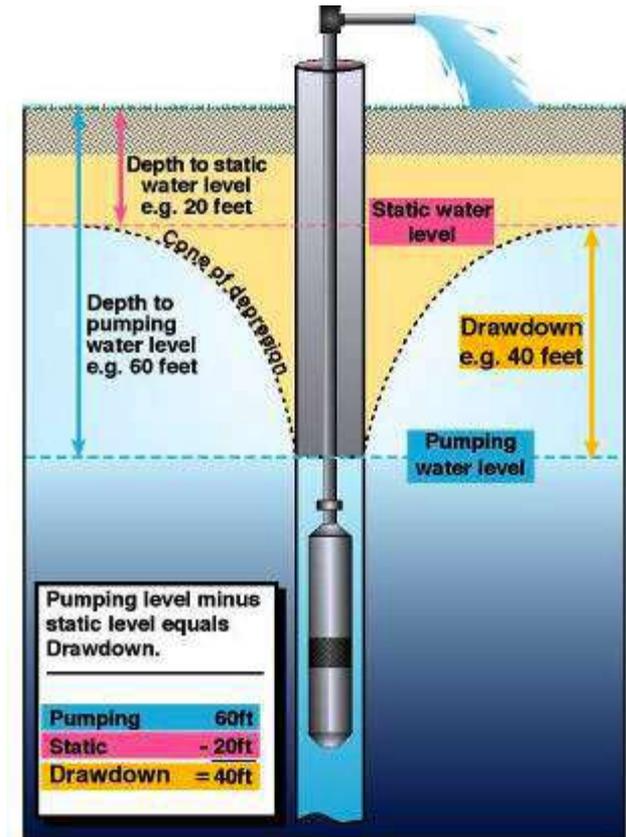
- Reduced production
- Increase sand production
- Loss of efficiency (higher cost)
- Changes in water quality
- Corrosion
 - Metal loss,
 - Premature Failure of Well Casing

Potential Total Loss of Capital Investment



Rehabilitation Goals

- GPM
- Water Quality
- Sand
- Efficiency
- Specific Capacity
 - $\text{Specific Capacity} = \text{Pumping Rate} / \text{Drawdown}$



Results From Rehabilitation

WELL # 26-Long Beach Results (Cost \$65,000.00)			
	ORIGINAL	BEFORE	AFTER
G.P.M.	3,000	3,000	3,000
SYSTEM PRESSURE IN PSI	45	45	45
DRAWDOWN (FT)	115	265	81.0
SPECIFIC CAPACITY	26.09	11.32	37.04
STATIC WATER LEVEL (FT)	60	60	60
PUMPING WATER LEVEL (FT)	175	325	141.0
TOTAL DYNAMIC HEAD IN FEET	278.95	428.95	245.0
INPUT KW	225.21	346.32	197.76
ACRE FEET PUMPED PER DAY	6.63	6.63	13.26
KWHR PER ACRE FOOT	407.70	626.93	358.01
COST PER KWHR	\$0.15	\$0.15	\$0.15
DAYS PUMPED PER YEAR	270	270	270
HOURS PUMPED PER DAY	12	12	12
ACRE FEET PUMPED PER YEAR	1789.78	1789.78	1789.78
COST PER ACRE FOOT	\$61.15	\$94.04	\$53.70
OPERATING COST PER YEAR	\$109,453.46	\$168,309.95	\$96,112.65



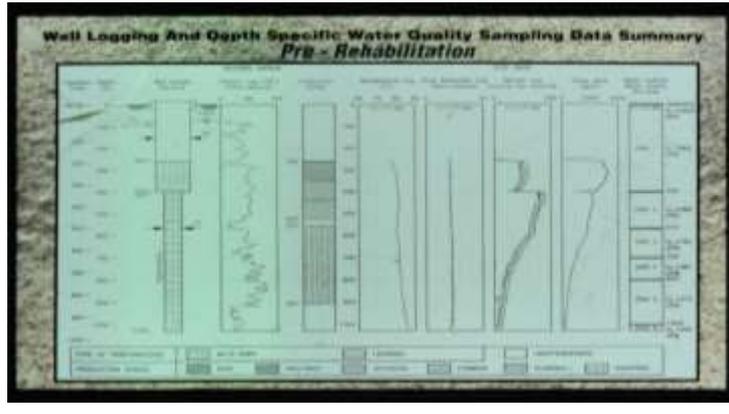
327%
Improvement

PROJECTION	
FIVE YEAR PROJECTED SAVINGS 100%	\$360,986.49
PAYBACK PERIOD-ACTUAL	
PAYBACK PERIOD @ PROJECTED (YEARS)	0.9

Actual Plugging Impact Before and After Rehabilitation

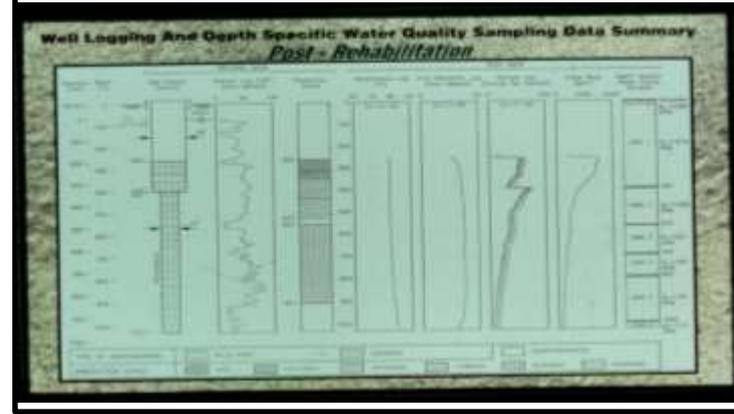
Total Flow 3000 gpm Before Rehabilitation

Zone 1: 600 gpm
Zone 2: 568 gpm
Zone 3: 793 gpm
Zone 4: 481 gpm
Zone 5: 314 gpm
Zone 6: 244 gpm



Total Flow 3000 gpm After Rehabilitation

Zone 1: 1,074 (+79%)
Zone 2: 1,002 (+76%)
Zone 3: 267 (-64%)
Zone 4: 150 (-69%)
Zone 5: 194 (-38%)
Zone 6: 313 (+28%)



9 Steps for Effective Rehabilitation

1. Pre-Rehabilitation Pump Test
2. Remove Pumping Equipment
3. Video Inspection
4. Mechanical Cleaning/Wire Brush
5. Rehabilitation Process Application
6. Re-Development
7. Video Inspection
8. Re-Install Pumping Equipment
 - a. Install Maintenance Tools
9. Post Rehabilitation Pump Test



Well Rehabilitation Procedures and Approaches

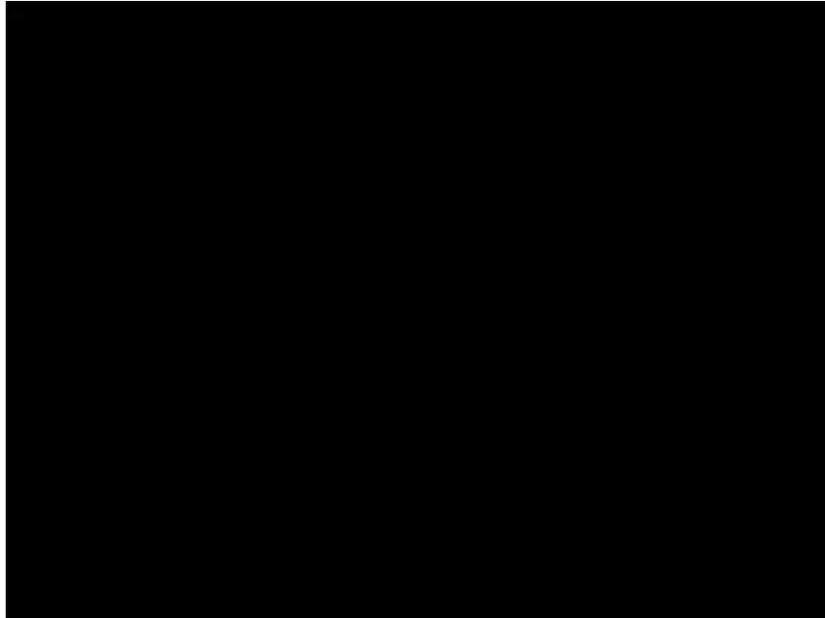
- Can Involve Many Different Strategies or a Combination of More than one:
 - Chemical
 - Mechanical
 - Thermal
 - CO2 (Aqua Freed)
 - Percussive (Airburst)
 - Explosives (Sonar Jet)
- Must be Custom Tailored, Based on Cause of Problem, Well Construction Details and Type of Formation
- Must Have Penetration to Clean the Surrounding Formation
- Must Have Good Agitation During Redevelopment
- Must Achieve Effective Deposit Disruption and Removal

CO2 Technology (Not Dry Ice)



CO2 Technology

- Broad Based Rehabilitation Technology
- Environmentally Safe (Green Technology)
- Excellent Generation and Penetration of Energy
- Sensitive to Delicate Conditions (Old or PVC Wells)
- Excellent at Removing Bacterial Biofilms and Mineral Deposits



- **How CO2 Works**

Carbon Dioxide has surfactant properties that helps to penetrate the aquifer as well as scale & biofilm

Energy released during Phase Changes:

Liquid to Gas (570 Times Volume Expansion)

Liquid to Solid

Solid to gas (Sublimation)

Formation of Carbonic Acid (H_2CO_3) a mild acid (Approx. pH=5) allowing some dissolution of scale

Pore Water Freezing allowing scale and biofouling to be dispersed

Rehabilitation Technology



Step 1- Seal and Inject
Gaseous CO2



Step 2- Liquid CO2



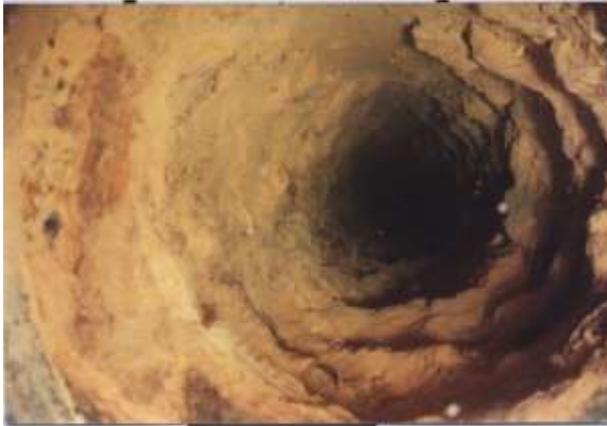
Step 3- Redevelopment

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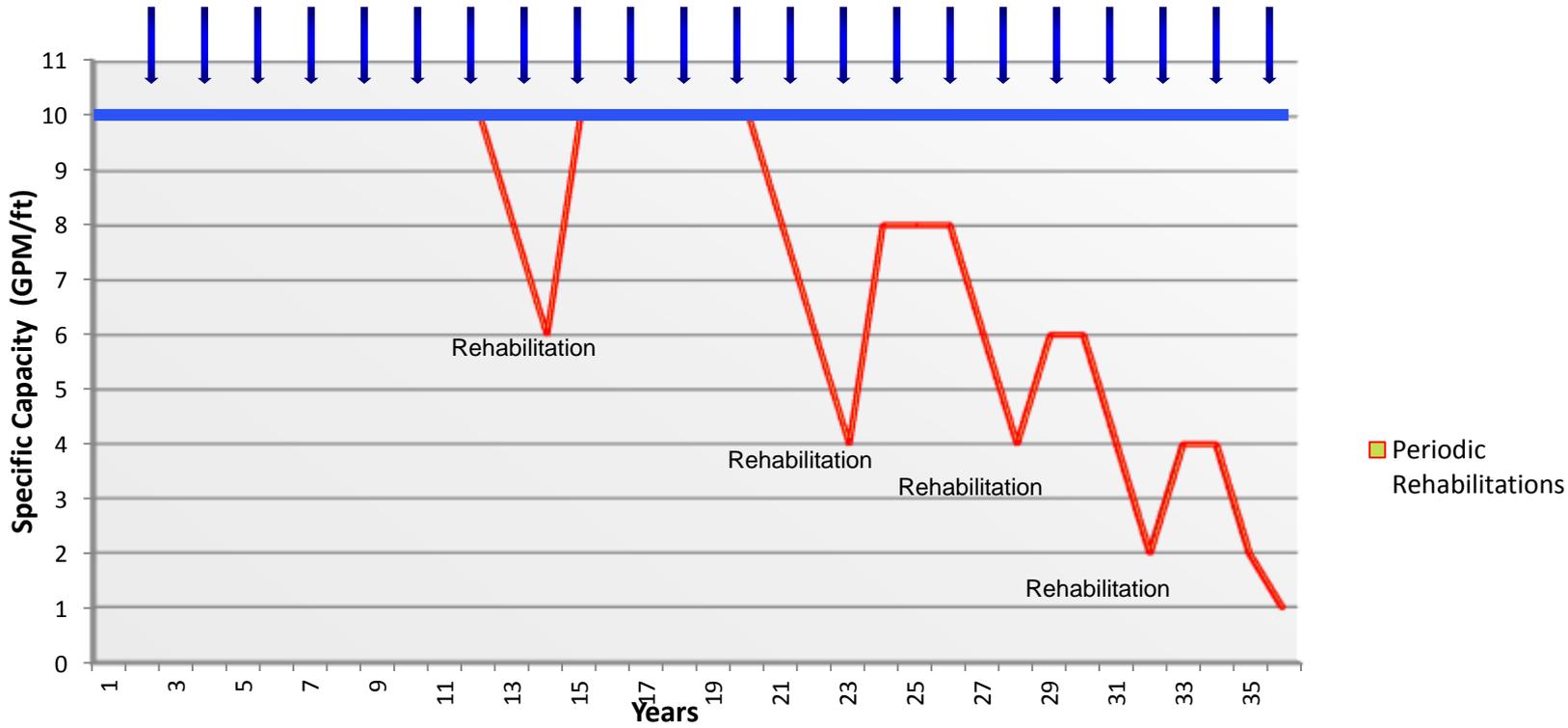
What Happens When We Wait Too Long to Rehab?

- Extensive and Hardened Mineralization



Historical Standard Operation

Operate to Failure Compared to Proactive Maintenance of Wells



Water Well Services Asset Management

Rehabilitation and Maintenance of Wells on time based intervals

- Improve production
- Improve water quality
- lower operating cost
- extend the life cycle of the well asset

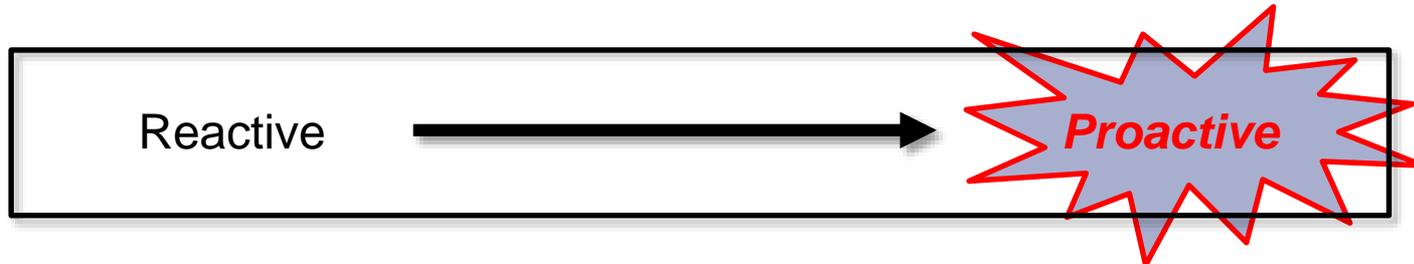
Services Include:

- **Well and Pump Condition Assessment**
- **Customized Rehabilitation**
- **Time Based Preventative Maintenance**
- **Reassignment of maintenance risk to for:**
 - Production
 - Water Quality
 - Pumps



Water Well Asset Management Program

- In well preventative maintenance device used for scheduled service
- Allows wells to be effectively maintained without pulling the pump
- Reduced down time during maintenance service (usually less than 24 hours)
- Equipment allows effective energy to be delivered into a well for cleaning
- Scheduled service compared to reactive rehabilitation
- Fixed budget pricing

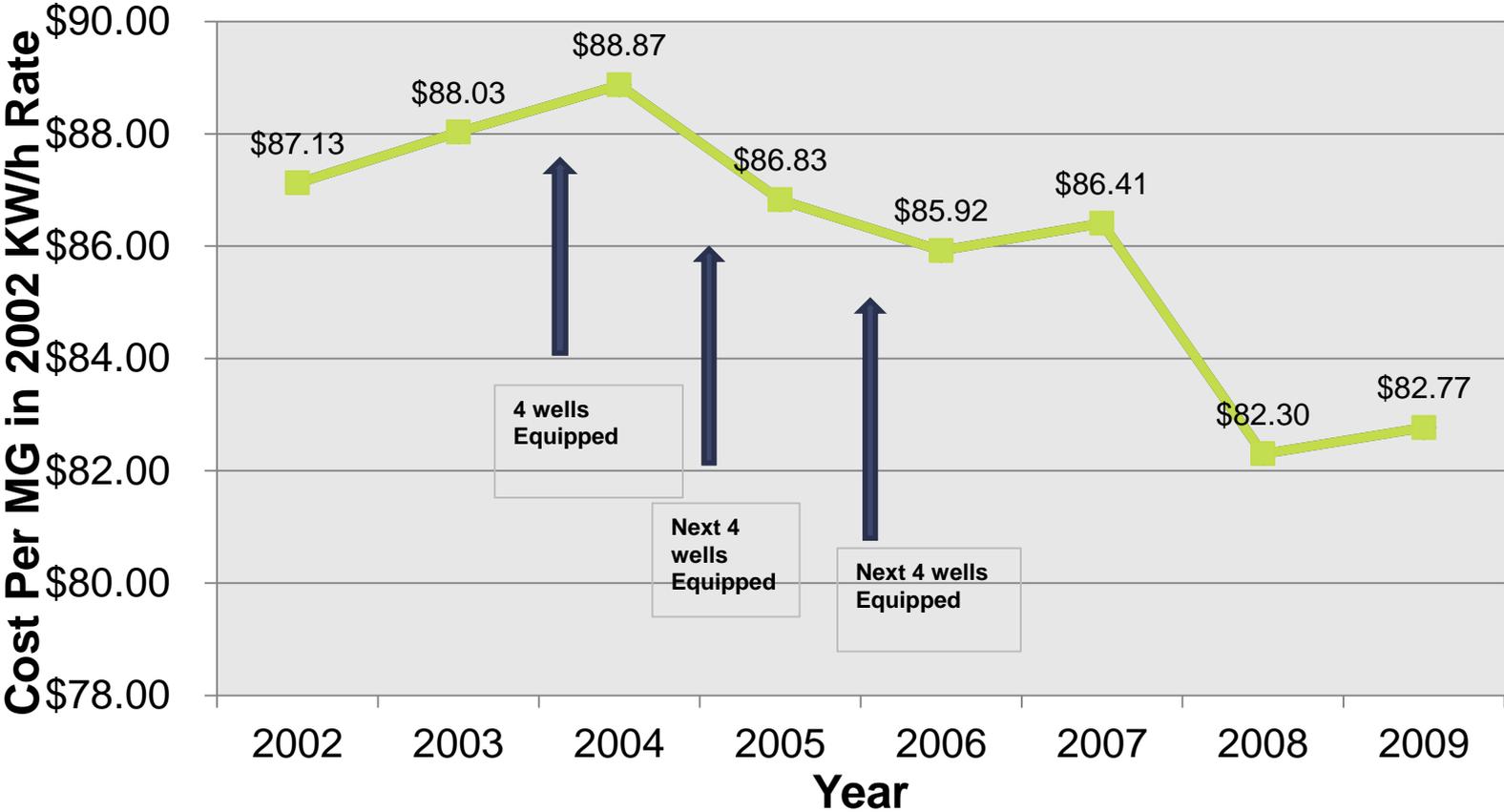


Maintenance Technology



AquaGard Installed

Powesheik Rural Water Pumping Cost Reduction Associated With Aqua Gard Well Maintenance



Well Asset Management Options

- **Full Service Asset Management Program**
 - Complete Transfer of all risk for well production, water quality and pump repair and maintenance (Guaranteed)
 - All future well rehabilitation and maintenance included
- **Limited Service Asset Management Program**
 - Limited Transfer of risk.
 - Rates cover future maintenance
 - No future rehabilitation or pump work is covered in the rates
- **Service Program**
 - No Transfer of risk
 - Rates cover Rehabilitation and annual testing (any additional work will be charged)
 - No future rehabilitation or pump work is covered in the rates

Well Asset Management

Benefits of Well Asset Management

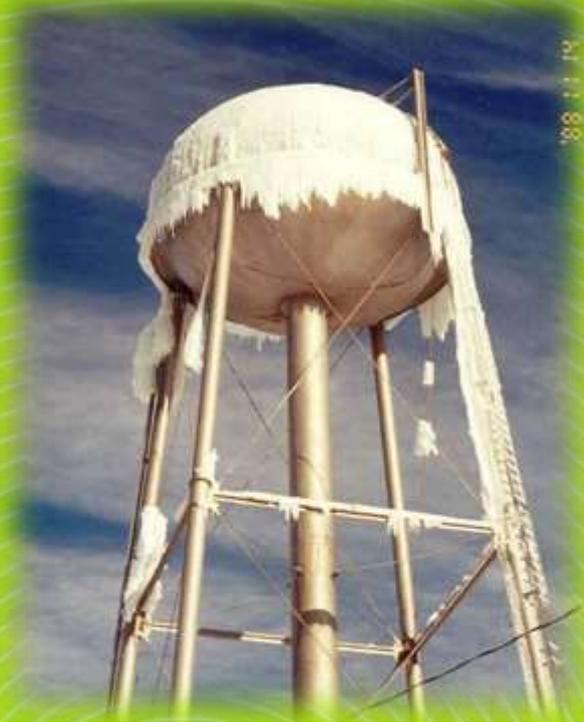
- **Extend Asset Life Cycle (Potentially Indefinitely)**
- **Improve and/or Maintain Well Performance**
- **Reduced or Maintain Operational Cost (Specific Capacity and Well Efficiency)**
- **Maintain Consistent Water Quality**
- **More Predictable Maintenance Cost (Flat and Fixed Annual Fee)**
- **Improved Annual Knowledge of Well and System Condition**
- **Potential Single Source Responsibility**
- **Time Based Proactive Maintenance and Management of Wells**

**Best Sustainable Practice to Maintain Water Well
Production, Quality & Equipment**

Chilling Questions?

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