Water Well Maintenance and Rehabilitation

Water wells require regular maintenance to ensure adequate water flow and optimum water quality.

As a water well ages, the rate at which water may be pumped (commonly referred to as the well yield, flow or performance) tends to decrease, especially in wells that were not properly developed when first drilled. This fact sheet briefly describes common well problems and discusses prevention and rehabilitation measures.

Water Well Maintenance

Water wells require regular maintenance to ensure adequate water flow and continued drinking water safety. To ensure water quality, well water should be tested annually for total coliform bacteria and *E. coli* bacteria by a state accredited testing laboratory.

Every three years, additional testing is recommended for pH and total dissolved solids as well as tests related to land uses occurring or expected to occur within sight of the well. Additionally, if there are obvious stains, tastes, or odors in water, seek testing that will help identify the source of these symptoms.

Water wells should also be inspected annually for obvious signs of damage or contamination. Be sure the area within 100 feet around the well is clear of debris or items that might pollute the water supply.

Get the well professionally inspected by a water well contractor every ten years. Keep all records related to the water well including:

- Water well completion report or log (if you have it) which should include information such as water well depth, date drilled, construction (including casing specifications, grouting and screen), and water well yield or flow rate in gallons per minute (gpm)
- Water quality test reports
- Past inspection reports
- Invoices from work done by water well contractors (including pump replacement)
- Water treatment equipment warranties, invoices and manuals

To find some of this information you can check with the Pennsylvania Department of Conservation and Natural Resources (PA DCNR) Pennsylvania Groundwater Information System (PaGWIS) or contact a local well driller.

Well Performance

As a water well ages, the rate at which water may be pumped (commonly referred to as the well yield, flow or performance) tends to decrease, especially in wells that were not properly developed when first drilled. A drop or complete loss of water production from a well can sometimes occur even in relatively new wells due to a lowered water level from persistent drought or over-pumping of the well which can dewater the water-bearing zones. More often, reduced well yield over time can be related to changes in the water well itself including:

- Incrustation from mineral deposits
- Bio-fouling by the growth of microorganisms
- Physical plugging of "aquifer" (the saturated layer of sand, gravel, or rock through which water is transmitted) by sediment
- Sand pumping
- Well screen or casing corrosion
- Pump damage

This fact sheet briefly describes these common problems and discusses alternative prevention and rehabilitation measures.

Water Well Rehabilitation

Measures taken to correct these problems are referred to as well rehabilitation or restoration. A successful well rehabilitation will maximize the flow of water from the well. The chances for successful rehabilitation are dependent on the cause(s) of poor well performance and the degree to which the problem has progressed.

Upon noticing loss of performance in your well have a professional water well contractor inspect your well, preferably with a downhole camera.

A common measure of the delivery of water by a water well is referred to as the "specific capacity" which is defined as the pumping rate (gallons per minute) divided by the drawdown or increased depth to water during pumping (in feet).

Generally, a decrease of 25% or more in well yield indicates that rehabilitation is in order. Delaying rehabilitation procedures can significantly increase costs and in some cases make rehabilitation impossible.

To detect deterioration of well performance, you must have a point of reference. Often this reference is the original well construction and pump test data which are normally supplied to you by the well driller on a well completion report or well log when the well is installed. However, even if you do not have this information, significant changes in your well are also a warning sign. Major changes in any of the following well characteristics is an indication that your well or pump is in need of attention:

- Decreased pumping rate
- Decreased water level
- Decreased specific capacity
- Increased sand or sediment content in the water (cloudiness)
- Decreased total well depth

The two most common methods to rehabilitate a water well are:

- chemicals to dissolve the incrusting materials from the well
- physically cleaning the well

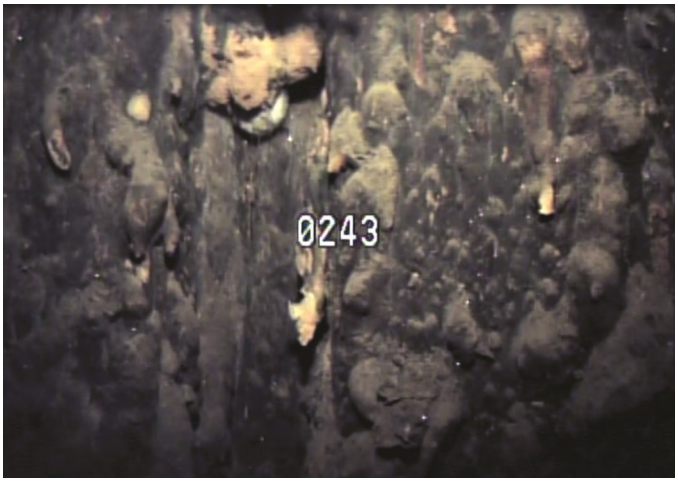
Physical methods include using a brush attached to a drilling rig, high pressure jetting, hydrofracturing, and well surging.

Brush to be attached to drilling rig as one method of physical rehabilitation.

The latter three techniques all include injecting water (and sometimes chemicals) into the well under extreme pressure. Sometimes contractors will use a combination of these methods depending upon the reason(s) for the decrease in well performance.

Reduced Yield from Incrustation or Bio-Fouling

Chemical and biological incrustation are common causes of well failure. Incrustations are physical obstructions which develop on well screens and rock fractures or openings delivering water to the well screen or borehole.



Well video image showing heavy biological and scale fouling, completely covering the screened section of the well.

In severe cases, the obstruction to flowing water can render the well useless. Major forms of incrustations can occur from build up of calcium and magnesium salts, iron and manganese compounds, or plugging caused by slime producing iron bacteria or other similar organisms (bio-fouling).

Treatment of Chemical Incrustation

The principal means used for rehabilitation of chemical incrustation problems involves the use of strong acid solutions to dissolve incrusting materials.

Once loosened or dissolved, the incrusting materials are pumped from the well with the acid solution for disposal.

The type of acid to be used, its form (liquid, granular, pelletized), the procedures used to introduce and agitate the acid solution, and the severity of incrustation all play a part in determining the success of acid treatment. It is common for acid-treated older wells to completely recover or even exceed the original well yield assuming any material dislodged by the acid is removed from the well.

While acid treatment methods for incrustation removal are very effective, mechanical methods, such as wire brushing or scraping, are often used in conjunction with acid treatment to improve results.

A less common mechanical approach is the use of controlled blasting. Controlled blasting involves the use of explosives, carefully set at specific locations in the well bore, to fracture consolidated rock aquifer and incrusting materials. Experience has shown this technique, when done properly, to be useful for temporary well yield improvement. However, cracks opened by blasting often eventually become incrusted and additional rehabilitation measures are required to maintain well productivity.

Treatment of Bio-Fouling

The primary cause of bio-fouling, or biological clogging, of well screens and rock fractures is attributed to iron bacteria. These and other similar bacteria create a slimy, voluminous "biomat".

A submersible pump being pulled from a well exhibiting iron oxide, iron bacteria and biofilm.

Rapid growth of these bacteria can quickly clog well screen pores and render a well virtually useless in a matter of months. Once iron bacteria become established in a well, they are extremely difficult to eradicate.

Treating iron bacteria colonies in water wells is often a perpetual process that seeks to maintain well performance at an acceptable level. In general, chemical means of control are most effective. However, best results are achieved when chemical bactericides are used in conjunction with physical agitation of the well bore water to remove the biological residue.

The chemical of choice for most small diameter wells is chlorine. It has the advantage of being readily available, inexpensive, and is generally accepted by health officials for use in potable water supplies. For general disinfection purposes following routine well and piping construction, repair, or pump installation, a 50 mg/L dose of free chlorine is recommended. For treatment of severe iron bacteria problems concentrations as high as 500 to 2,000 mg/L are used.

However, chlorine treatment of iron bacteria problems may not be effective without subsequent agitation of the well water. Turbulent flow causes greater surface area exposure of slime growths to the chlorine solution and assists in dislodging obstructions.

For more information on how to shock chlorinate a well, consult our fact sheet Shock Chlorination of Wells and Springs or contract with a professional well driller.

Since precipitation of iron in the bacteria biomatting contributes to clogging of flow spaces, rehabilitation results are usually improved when acid treatments are alternated with bactericide treatments.

However, chlorine and acid must never be in the well at the same time.

Failure Caused by Physical Plugging and Sand Pumping

A portion of the loss in well performance over time can often be attributed to the slow migration of fine particles from the aquifer toward the borehole and into the well screen. In some cases the screen itself can become clogged. To prevent pump damage, replacement of a deteriorating screen may be a wise decision. There are several reasons for sediment plugging including:

- Improper well design (poor screen placement, slot design, etc.)
- Insufficient pumping or surging to remove material from the well (well development) during initial construction
- Removal of aquifer formation cementing materials holding sands together
- Screen and/or casing corrosion
- Over pumping of the well beyond its design capacity

Treatment of Physical Plugging

The most important preventative measure to avoid physical plugging is proper well development. Adequate well development will stabilize the aquifer material so that subsequent pumping from the well will not result in excessive sediment removal. Removal of fine silt and clay particles introduced in some drilling fluids, or which naturally occur in certain kinds of aquifers, can only be accomplished with the use of chemical treatments.

As with other chemical rehabilitation treatments, agitation of the chemical into and out of the aquifer formation is crucial to success of the operation. This agitation may be provided by a surge plunger, compressed air, well pump, or high-velocity jet.

Use of a high-velocity jet is generally recognized as the most effective means of agitation. When water from the well is re-circulated for jetting, sediment should be removed prior to reuse. Continuous removal of dislodged sediment, as done in a re-circulating jet operation, gives the best results as the cleaning solution is able to penetrate more deeply into the aquifer medium.

Failure Caused by Corrosion

Corrosion of metal casing and other well components can seriously reduce the useful life of a well in several ways.

Hole in casing caused by corrosion.

Corroded and enlarged well screen holes may lead to sand pumping, which in turn results in abrasive deterioration of pump parts and enlarged screen openings leading to excessive sediment velocities.

In this case, abrasive materials carried in high velocity flows can lead to erosion of the screen openings. A screen or well casing that has undergone significant corrosive deterioration may collapse altogether. A final negative impact of well corrosion is that water from a seriously affected well may be such low quality that uses are limited.

Treatment of Corrosion

The best way to avoid or fix corrosion problems is to select appropriate corrosion resistant casing and screening materials. Carbon steel screens are less expensive than stainless steel but are more susceptible to corrosion. Keep in mind that excessive acid-rehabilitation well treatments can also significantly accelerate general corrosion.

Failure Caused by Pump Damage

Water well pump damage is usually the result of one or more of the following factors:

- Pumping of abrasive sand or sediment
- Corrosion of pump parts
- Excessively high operating temperatures
- Pump cavitation

Abrasive deterioration resulting from sand pumping is the leading cause of pump failure.

Abrasion caused by pumping sand.

Excessive sediment concentrations in well water can be brought about by inadequate initial well development, absence of a well screen in a loose rock formation, oversized screen openings, excessive well screen entrance water velocities resulting from undersized openings, or well screen corrosion.

Treatment of Pump Damage

Usually a pump will show some evidence that maintenance is in order. Most major causes of pump failure are related to mechanical problems such as bearings, stuffing boxes, impellers, and pump bowl assemblies. Maintenance, repair and replacement of the pump and motor parts should be in accordance with the manufacturer's recommendations.

Correction of recurring sand pumping problems is in some cases cost prohibitive. Total well replacement may in the long run be more economical than rehabilitation of a severely deteriorated well. This is especially true of shallow wells.

However, when drilling a new well is not feasible, it is sometimes possible to extract and replace a severely damaged well screen in the existing well. Installation of a smaller diameter screen (also known as a liner) inside the original well screen has also been used as a remedy. Various devices can also be installed to even out or reduce the flow of water entering the well and thus reduce the potential for sand pumping.

Summary

If your well begins to demonstrate the symptoms of poor performance, don't delay in contacting a professional water well contractor. Consult the National Ground Water Association (NGWA) to find a list of member well drillers in your area. The sooner that they can inspect the well to find the problem and treat it, the more likely you are to have a successful water well rehabilitation.

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National Groundwater Association

Reviewers

Thanks to the following individuals who reviewed this publication

- David Yoxtheimer, P.G., extension associate, Penn State Marcellus Center for Outreach and Research
- Amy Galford, extension educator, Cumberland County
- Kenneth Kerstner, Master Ground Water Contractor, Owner/Operator, Kerstner Well & Pump Service, Easton, PA

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Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

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Code: ART-4024