SUPPORTING WATER WELL INFRASTRUCTURE INFORMATIONAL PACKET

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The National Ground Water Association is a not-for-profit professional society and trade association for the global groundwater industry. Our members around the world include leading public and private sector groundwater scientists, engineers, water well system professionals, manufacturers, and suppliers of groundwater-related products and services. The Association's vision is to be the leading groundwater association advocating for responsible development, management, and use of water.

Cost of Public Water System vs. Water Well Rehab or Replacement

Estimated Average Cost to Rehabilitate an Exisiting Water Well

$1,500-4,500

Estimated Public Water System Hook-up

$14,775

Estimated New Water Well Installation			
	Installed Cost	**Average Useful Life/ Years**	**Cost to Household Per Month**
Well	$7,000	70	
Well pump & 300 gpd use	$2,000	12	$1 (O&M)
Pressure tank	$800	10	
Water softener	$1,400	10	$15 (O&M)
Total Initial Installed cost & amortized cost per month	**$11,200**		$62
Total monthly cost	___		**$78**

Estimated Public Water System Hook-up			
	Installed Cost	**Average Useful Life/ Years**	**Cost to Household Per Month**
Public Water Connection	$13,375	30	
Water Softener	$1,400	10	$15 (O&M)
Min. Total Cost & amortized cost per month	**$14,775**		$88
Water Use Cost [300 gpd]	___		$92
Total monthly cost	___		**$195**

Typical Well System Costs Sources:
*U.S. Environmental Protection Agency. 2004. Taking Stock of Your Water System; A Simple Asset Inventory for Very Small Drinking Water Systems. EPA 816-K-03-002. https://www.epa.gov/sites/production/files/2015-04/documents/epa816k03002.pdf
*U.S. Environmental Protection Agency. 2018. How we use water. URL: epa.gov/watersense/how-we-use-water
*National Centre for Engineering in Agriculture. 2015. Fundamentals of energy use in waterpumping. URL: cottoninfo,com.au/sites/default/files/documents/Fundamentals%20EnergyFS_A_3a.pdf
*US Energy Information Administration. 2019. Electric Power Monthly; Average Price of Electricity to Ultimate Customers. URL: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_3
*The University of California Cooperative Extension, Tulare County, Energy and cost requiredto lift or pressurize water. Publication No. IG6–96, 2005, URL: http://cetulare.ucdavis.edu/pubgrape/ig696.htm

Well Rehabitlition Cost: Survey of national ground water associations contractors, rehab cost represent potential cost of pump replacement, water well pipe casing replacement, and electrical wiring replacement. Cost may vary depending on depth of well and various circumstances.

Well Facts – Information about the local groundwater option:

Facts About Water Wells:

- Number of private household wells in the U.S. – 15,000,000 wells[1]
- Population estimated to be served by private wells in the U.S. – 42 million people[2]
- Typical household of four water use in the U.S. - 300 gallons per day[3]
- Most water wells serve small, rural, and disadvantaged communities across the country.
- Rehabilitating or replacing a water well is more cost effective than connecting to public water systems for both the homeowner and the community.
- Rehabilitating or replacing a water is a cost-effective way of increasing water quality to a home or community.
- **The cost of rehabbing a water well to bring it into compliance with state and local standards can be as low as $1,500 or less.**

Cost Comparison Between Water Wells and Public Systems:

Pumping and Treating Groundwater compared to Public Water Delivery

Household average estimated cost for well pumping and softening 300 gal/day - **$16/month**[4,12,13]

Compared to Household average estimated cost for public water delivery of 300 gal/day - **$92/month**[5]

Well Installation plus Pumping and Treatment compared to Public Water Connection & Delivery

Household estimated cost of typical private well installation, softening & pumping – Private Well **$78/mo**[6,7]

Compared to Public water supply connection and delivery - Public Source **$195/mo**[8]

Estimated installed well (average depth 150 feet) cost range – **$5,325 to $9,180**[9,10,11]
Average estimated distance for regional waterline to reach rural communities - **2.6 miles**[11]Estimated cost range per mile for regional waterline **- $472,100 to $518,200/mile**[11]

U.S. Environmental Protection Agency allows Point-of-Entry/Point-of-Use water treatment for households experiencing water quality problems. Costs for a range of household treatments are[12,13]:

POU/POE	Initial cost	Operation and maintenance cost (per year)	Contaminants treated
No treatment	$0	$0	
Reverse Osmosis	$300	$95	Arsenic, Chromium, Nitrates, Lead, Protozoa
Activated Carbon	$30	$129	Bacteria and protozoa, Lead, PFAS
UV treatment	$1,059	$110	Bacteria, viruses, Protozoa
Adsorptive Media	$520	$104	Arsenic
Pour-through granular activated carbon pitcher filter	$25	$155	Chlorine, taste, odor and particulates
Distillation	$340	$100	Total arsenic, chromium, mercury, nitrate/nitrite and Bacteria, viruses, Protozoa, Lead, DBP
Ion Exchange (softener)	$1,150	$180	Hardness, barium, radium, PFAS

Costs based on data from http://www.cyber-nook.com/chart/default.asp?Usage=10&Years=4 (accessed May 9, 2016)

Source: Water Quality Association and Water Quality Research Foundation.[12,13] (With Permission)

[1] Centers for Disease Control and Prevention (CDC). 2014. Drinking Water; Groundwater and Wells. https://www.cdc.gov/healthywater/drinking/private/wells/index.html

[2] U.S. Geological Survey (USGS). 2018. Estimated Water Use in the United States in 2015. https://pubs.usgs.gov/circ/1441/circ1441.pdf

[3] U.S. Environmental Protection Agency (USEPA). 2018. Water Sense; How We Use Water. https://www.epa.gov/watersense/how-we-use-water

[4] Job, C.A. 2021. Groundwater Economics. CRCPress. Boca Raton, Florida.

[5] U.S. Environmental Protection Agency (USEPA). 2020. Water Sense: Start Saving. https://www.epa.gov/watersense/start-saving

[6] Homeguide.com. 2021. 2021 Well Drilling Costs; Average Water Well Installation. https://homeguide.com/costs/well-drilling-cost (cost range $3,750 to $15,300); and various industry sources.

[7] National Ground Water Association. 2021. Cost Comparisons of Local Groundwater Sources to Regional Waterllines. https://my.ngwa.org/NC__Product?id=a182J00000ELp1eQAD

[8]St. Elmo, MN. 2020. Minnesota 3M PFC Settlement Request for Project Funding Applications ID 100051/2/5/6 (average connection cost $14,279); and various industry sources (average connection cost $13,375).

[9] Homeguide.com. 2021. 2021 Well Drilling Costs | Average Water Well Installation. homeguide.com/costs/well-drilling-cost

[10] Costhelper.com. 2021. 2021 Cost of Well Drilling - Estimates and Prices Paid. home.costhelper.com/well-drilling.html (cites 280-ft well in Arizona costing $6,750)

[11] National Ground Water Association. 2021. Cost Comparisons of Local Groundwater Sources to Regional Waterllines. https://my.ngwa.org/NC__Product?id=a182J00000ELp1eQAD

[12] Verhougstraete M, Reynolds KA, Pearce-Walker J, Gerba C. Cost-benefit analysis of point-of-use devices for health risks reduction from pathogens in drinking water. J Water Health. 2020 Dec;18(6):968-982. doi: 10.2166/wh.2020.111. PMID: 33328368.

[13] Verhougstraete, Marc P., Joe K. Gerald, Charles P. Gerba, Kelly A. Reynolds, 2019. Cost-benefit of point-of-use devices for lead reduction, Environmental Research, Volume 171, Pages 260-265.

Water Well Rehabilitation

Private Wells and Public Water Systems

The situation is not always bleak when a household water well fails to produce the amount of water that it did when it was first installed. Instead of the expense of abandoning the well and installing a new one, a professional contractor can often "rehabilitate" the well and restore flows that provide enough water for all of a family's daily needs.

Several factors are involved in a contractor's decision to rehabilitate a well, including the ground formation that the well is drilled in, the construction of the well, and the problem that has caused the decreased flow. Sometimes, the water table in the area has dropped and simply drilling the well deeper is the answer.

Following are more answers to questions concerning well rehabilitation.

How can you tell if water well rehabilitation can work?

A professional contractor can do tests to see if rehabilitating measures will be successful. The well will often be shut off for 24 to 48 hours to see if the static level—the level of the water table in a well when the pump is not operating—returns to or gets near the original level. If so, rehabilitation will usually work.

Before starting the project, contractors will often lower a downhole video camera into the well to make sure no other problems will be encountered.

What are reasons for drops in water production?

Along with the water table dropping, which has happened in several parts of the country because of drought, there can be other reasons for reduced productivity. The most common is the plugging of holes along the well's casing and incrustations forming on the well screens. The amount of water going through the well system will drop significantly if several holes or portions of the screens are clogged. Calcium carbonate, iron bacteria, silt, clay, and "slime"—a combination of sediment and deposits—are all common well cloggers.

What methods are used to rehabilitate a well?

Two typical methods are (1) using chemicals to dissolve the encrusting materials so they can be pumped from the well, and (2) cleaning the well with a brush that can be attached to a drilling rig. High pressure jetting, hydrofracturing, and well surging are also procedures in which water is injected into the well at extreme pressures. Contractors will often use a combination of these methods.

What chemicals are put in the well? Are they safe?

For iron bacteria and slime, a liquid bacteria acid is effective. For clogs with carbonate scale, sulfamic acids are used with inhibitors and modifiers. If the bacteria problem is persistent, some of the more aggressive chemicals are muriatic acid and hydroxyacetic acid.

The chemicals are placed in the well and agitated frequently for 24 to 72 hours. The chemicals are safe to use, and the well is then pumped with water before a water test is given to ensure that the well system is ready to be put back in service.

What is the difference between high pressure jetting, hydrofracturing, and well surging?

High pressure jetting features a tool with an adjustable, multihead, water-powered jet that lowers into the well and injects water at a high pressure, dislodging debris from the well.

With hydrofracturing, water is sent into the entire well at an extreme pressure. The water removes debris from the clogged perforations in the casing and can crack the formations underground to create new sources of water.

Well surging is the repeated injecting and flushing out of water in a well system. With repeated flushing, the debris is washed away.

Where can I get more information?

For more information on your private water well, contact your local contractor. Also, visit the website of the National Ground Water Association, *www.ngwa.org*, and its site just for well owners, *www.wellowner.org*.

Private Wells and Public Water Systems

Private Wells and Public Water Systems

The water source provided for your family is one of the most important parts of your home. Thus, deciding where the water will come from is one of the biggest decisions you will make in your life. More and more local governments are putting in public systems and encouraging everyone available to hook up. Some are even asking well owners to give up their wells to get on the public system. That decision, though, may not always be in a well owner's best interest.

Before you do anything, you should consider several of the following facts. There are many distinct differences in being a private well owner and a user of a public water system.

Private Well Facts

A well can be designed to meet your specific needs in regards to quantity and quality of water. Installed on your property, a properly constructed and maintained well can provide adequate amounts of safe drinking water and operate on pennies per day. The pump, tank, and casing should last for many years. When the well is paid for, it will belong to you.

That means you are in control of it. But be aware that while properly installed wells are safe, they are like other mechanical devices around your home or even your car—they will need regular maintenance from time to time. Professional contractors can provide annual well checkups and a water testing. There are even water-testing kits on the market for which you can administer the tests yourself.

Occasionally, there may be a problem with minerals or odors. However, since your well is a small, closed system, problems can easily be diagnosed and treated. Always remember this is your well and your water. You control what happens to them and goes in them.

Public Water System Facts

Public water systems are expensive to build and maintain. Therefore, they require many hook-ups to be economically successful for the local government in charge of them. Water bills come forever, and consumers have no control over the rates.

And since consumers don't own the water, they don't have control over its contents. Public systems have to meet established standards, and report those to you. But their water can include additives you may not want to drink. The water is tested when it leaves the plant and at checkpoints along the system. However, there is no guarantee that the water leaving the plant is exactly the same when it flows from your tap. Many systems are huge, and it is simple reasoning to think that the bigger the system, the greater the opportunity for contamination. When a public system has a problem, it is often difficult to find or restrict to one area of the system. There are reported cases of contamination causing systems to shut down for days or requiring users to boil their water for much longer.

Rural areas often have other problems with public systems. If pipelines are especially long in order to reach the areas and water usage happens to be low, water can become stale. A more serious problem can occur when chlorinated water meshes with organic materials to form gases called trihalomethanes. Other problems a system can bring to rural areas are undesired growth and an increased cost of living. This is known as "urban sprawl."

Choosing a water supply is an extremely important decision. Please don't make it hastily. Learn as much as you can about water systems and their sources before you choose.

Where can I get more information?

For more information about getting a private water well or more details about the well you already own, contact your local contractor. Also, visit the website of the National Ground Water Association, *www.ngwa.org*, and its site just for well owners at *www.wellowner.org*.

COST COMPARISONS OF LOCAL GROUNDWATER SOURCES TO REGIONAL WATERLINES

Water wells, even with additional household treatment, are more cost-efficient in delivering drinking water to rural and suburban residences than long regional pipelines, based on seven case studies. When wells are not maintained properly or concerns about groundwater quality are raised, homeowners have alternatives to consider: improving their existing well system, adding household water treatment or seeking water supplied by a regional waterline. Factors for the homeowner to evaluate when deciding between water well improvement or waterline supply include reliability of service, water quality, cost and management control.

Economies of scale certainly apply. One well can supply more than one household and this approach has been used across the country. For communities that lack any reliable water sources because of overdrafted or contaminated aquifers, as demonstrated in the California drought, connection by pipe may be a necessity.[1] Replacement or rehabilitation of existing wells or, for community systems, central treatment may be efficient responses to water supply needs. In other cases, point-of-entry/point-of-use units for treatment of groundwater can be cost-effective alternatives for households and communities.[2]

[1] Cagle, Susan. 2020. 'Lost communities': thousands of wells in rural California may run dry. In *The Guardian.* URL: https://www.theguardian.com/environment/2020/feb/28/california-water-wells-dry-sgma (Accessed April 9, 2020).

[2] Verhougstraete, Marc; Reynolds, Kelly; Tamimi, Akrum; and Gerba, Charles. 2016. Cost Benefits Of Point-Of-Use Devices In Reduction Of Health Risks From Drinking Water. Unpublished. Water Quality Research Foundation. Table 2. Point-of-use/point-of-entry devices and associated costs. p. 7

Groundwater is generally considered a safe water source[3] in the United States[4], especially from adequately deep water supply wells[5]. Over 41 million Americans rely on groundwater supplied by private wells and springs and 87 million more people receive their water from groundwater-supplied public water systems ranging in population served from 25 to 2.3 million.[6] Servicing a well can be provided through a local water-well contractor. [7] Private well water systems are typically leak-free so that water pumped is put to use rather than lost.[8] For public water systems, centralized management removes the burden of water supply management from water consumer. Average water loss in the United States from water system transmission and distribution pipelines is 16 percent, increasing costs to treat and deliver water to consumers.[9] From a quality standpoint, well owners can manage protection of their wells from onsite contaminant sources. Well owners can arrange for regular well inspection and testing to ensure groundwater quality is safe at reasonable cost. Public water systems' water quality is high and must meet federal and state drinking water standards before water is delivered to the homeowner's water supply connection.

The National Ground Water Association prepared a white paper on the cost of local groundwater supply in comparison to connection to a regional water system by waterline. The Association drew on seven case studies. Five cases of well replacement from Georgia, Texas, North Carolina, and Arkansas found that on average, capital costs for well installation were $10,000 for wells averaging 376 feet in depth. Monthly cost savings per household of private well operation compared to a regional waterline connection ranged from $33 to $97 depending on financial assistance for well installation and varied based on well depth and length of the alternative water transmission line. A sixth case study found that well rehabilitation saved a community of 24 homes using 3 wells from $22 to $33 per month per household in operating costs compared to connecting to a regional waterline. A seventh case focused on a previously groundwater-supplied community of 1500 deciding on connection to a 10-mile water line rather than conceptual local groundwater supply alternatives with treatment for radium to meet regulatory safe standards. The estimated monthly household non-waterline alternative charges were from 20 to 36 percent less than the current water charges, suggesting that non-waterline alternatives for central groundwater treatment or point-of-entry or point-of-use should have been given greater consideration in the decision process for addressing groundwater radium concentrations.

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[3] Chilton, J. 1996. Chapter 9 - Groundwater. In Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring - Second Edition. Deborah Chapman, editor. UNESCO/WHO/UNEP ISBN 0 419 21590 5 (HB) 0 419 21600 6 (PB).
https://www.who.int/water_sanitation_health/resourcesquality/wqachapter9.pdf

[4] Clean Water For Layman.com 2015. A Layman's Guide to Clean Water. http://www.clean-water-for-laymen.com/clean-water-source.html

[5] Mechenich, C. and Shaw, B. 1996. Do Deeper Wells Mean Better Water? Wisconsin Cooperative Extension Service, publication G3652. https://polk.extension.wisc.edu/files/2010/12/Do-Deeper-Wells-Mean-Better-Water.pdf

[6] U.S. Environmental Protection Agency. 2020. Drinking Water Government Performance Results Act Tool. URL: https://www.epa.gov/ground-water-and-drinking-water/drinking-water-performance-and-results-report)

[7] Wellowner.org. 2020. Find a water well contractor. URL: https://wellowner.org/find-a-contractor/.

[8] Water industry sources, communication, June 17, 2020.

[9] U.S. Environmental Protection Agency. 2013. Water Audits and Water Loss Control For Public Water Systems. URL: https://www.epa.gov/sites/production/files/2015-04/documents/epa816f13002.pdf (Accessed June 17, 2020).

Addressing local groundwater supply reliability and quality through wells or treatment at or near the groundwater source is less costly than installing a regional waterline for long-distance water supply. All reasonable alternatives should be investigated, including decentralized technologies. Each situation should be evaluated on its own basis, as circumstances vary among locations. Less dependence on imported water from distant sources offers the opportunity to maintain lower operational costs.[10] Regional waterline infrastructure is expensive compared to local groundwater supply to meet small community water needs, even when water quality treatment is involved as in the case examined.

[10] Sedlak, David.2014. Water 4.0; The Past, Present, and Future of the World's Most Vital Resource. Yale University Press, New Haven CT, USA. 332p. Page 265.