

Wells Construction: Hand Dug and Hand Drilled (Peace Corps, 1980, 282 p.)

 **(introduction...)**

 **Acknowledgments**

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Glossary

apron - A slightly sloped concrete pad which surrounds the well and helps prevent contaminated surface water from finding its way back into the well.

aquifer - A water-bearing layer (stratum) of permeable rock, sand, or gravel.

artesian well - A well that reaches water which, from internal pressure, flows up like a fountain.

bit - The piece which operates at the bottom end of the tool string to loosen the soil or rock to deepen the hole.

bottom plug - A concrete slab across the bottom of a well which can act to prevent anything from entering the well or allow only water to enter.

bottom section - That part of the well that extends beneath the water table.

brake post - An anchored cylindrical object which can act as a friction brake for rope wrapped around it. casing - Metal pipe used to reinforce a drilled well.

cement - A gray powder used as an ingredient in mortar and concrete.

concrete - A hard strong building material made by mixing cement, sand and gravel with sufficient water to cause the cement to set and bind the entire mass.

consolidated ground formation - Any of the various kinds of rock; hard rock; examples: granite. contaminate - To make impure or unclean.

curb - A part of the well lining that extends out from the lining into the surrounding soil, helps to hold it in place and prevents it from sliding down.

cutting ring - A sharp edged ring used on the bottom of a lining that is being sunk into place to make sinking easier.

development - See well development.

drive cap - A strong protective covering, screwed on to the top of a metal casing pipe and then struck to drive the pipe into the ground.

drop pipe - That section of pipe in a deep well pump assembly which extends

between the pump cylinder and the pump body.

foot valve - A valve at the bottom of the suction pipe which prevents the water pulled up into it by the cylinder from flowing back into the well.

form - The structure or material around or in which concrete will exactly conform to.

ground water - Water deep enough in the ground so that it cannot be drawn off by plants or evaporated out through the ground surface; accumulates in quantity in aquifers from which it can be drawn out of the ground through wells.

grout seal - Mortar or concrete used to fill in a space to make it waterproof.

head wall - A short wall which extends above the ground level around a well.

hydrologic cycle - Continual natural cycle through which water moves from oceans to clouds to ground and ultimately back to oceans.

impermeable - A substance through which water cannot penetrate.

intake section - That part of the bottom section through which water enters the well.

laterite - A residual product of rock decay that is red in color; prevalent in Africa; difficult to penetrate but has little strength for construction purposes.

level - (Adj.) perfectly horizontal; (noun) a device used to establish a perfectly

horizontal line.

lining - Masonry wall built to reinforce dug well hole walls.

lining ring - A hollow circular column, usually made of concrete, which is used to reinforce a dug well.

middle section - That part of the well between the ground surface and the water table.

mold - Form used in the construction of linings and lining rings.

percussion - The act of tapping sharply.

permeability - The speed which water can move through a certain type of soil or rock. Water will move much faster through sand than it will through clay so the sand is said to be more permeable. platform - See apron. plumb - Perfectly straight down or up.

pump cylinder - That part of the pump in which the piston and cup seals slide to move water. sinking method - Any technique used to dig or drill a well. stable ground - Firm soil; not likely to cave in.

suction pipe - That part of the pump assembly which extends beneath the cylinder into water.

surface recharge - The amount of water that soaks down through the ground to reach an aquifer in a certain length of time.

surface water - Water that is found on the ground surface in puddles, streams, rivers, lakes or oceans.

surge plunger - A device that can be inserted into the casing pipe and is moved up and down to develop the well.

swivel connection - A device used to connect two pipes or hoses and which permits one or both to turn freely.

tool string - The entire length of equipment and connections operated in the hole to sink a drilled well.

top section - That part of the well above the ground surface.

transpiration - The passage of water vapor from plants into the atmosphere.

unconsolidated ground formation - any type of soil other than hard rock; examples: sand, gravel, clay.

valve - A structure that permits the movement of fluid in one direction only.

water source - Any place where people could possibly come to gather water; for example a well, spring, river, lake, reservoir, public tap, private home faucet.

water table - The upper limit of that portion of the ground which is wholly saturated with water.

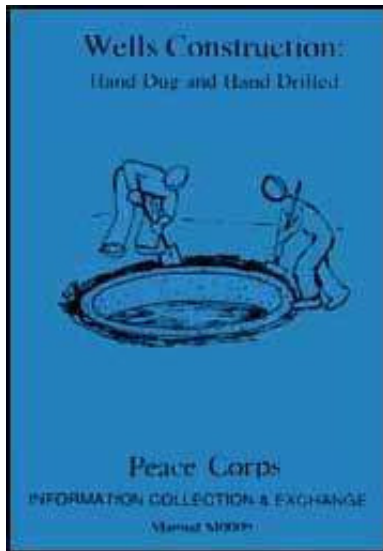
watertight seal - An impermeable material used to prevent water from moving

from one area to another.

well development - The process of rearranging the soil particles around the intake section of a well to permit easier and better water flow into the well.



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Abramo, V.J., ed. Peace Corps Wells Manual for Volunteers (1972). ACTION/Peace Corps. Information Collection and Exchange, Washington, D. C. 20525, U.S.A. (Book, 135 pp.) This is essentially a conference report written after a meeting of

PCV's working on wells projects in W. Africa. General coverage of organization and techniques. Much good information, but sometimes difficult to locate. The scope is limited and occasionally omits variables that might apply in special cases. Now out of print.

Allesbrook, J.C.P. "Driven Tubewells", in Appropriate Technology (Vol. 4, No. 4, Feb 1978). Intermediate Technology Publications Ltd., 9 King Street, London WC2E 8HN, England. (Periodical Article, 2 pp.) Short quick description of driven wells with an interesting method presented for making a drive point out of a piece of metal pipe.

"Where Shall We Dig the Well?" in Appropriate Technology (Vol. 4, No. 1, May 1977). Intermediate Technology Publications Ltd., 9 King Street, London WC2E 8HN, England. (Periodical Article, 3 pp.) An overview of various geological situations and where one is likely to find water in them. Unfortunately, the article is helpful only if you know the geological conditions in a given area.

Anderson, Keith E. Water Well Handbook (1971). Missouri Water Well and Pump Contractors Assn., Inc., P.O. Box 250, Rolla, MO 65401, U.S.A. (Book, 281 pp.) Intended as a reference book to supply all charts, tables and other data commonly needed by drillers, engineers and geologists working with water wells. Topics include mathematical formulas and conversion tables, water data, quality of water, cable tool drilling, rotary drilling, air rotary drilling, pipe and casing, pumps, electrical data, flow measurement, geology and hydraulics of wells, water supply and equipment. Because the book is meant for use in U.S., all sizes and measurements are in American terms, with limited use in developing countries. Although there are no "how-to" explanations, many of the tables are very

informative.

Annual Report (1976). WHO, International Reference Centre for Community Water Supply, P.O. Box 140, 2260 Leidschendam, Netherlands. (Booklet, 48 pp.) A description of activities of the IRC. They leave unclear just exactly who is to receive their efforts and what specific services they have to offer.

Assignment Children (April-dun 1976). UNICEF, Carnets de l'enfance/Assignment Children, Palais Wilson, Case postale 11, 1211 Geneve 14, Suisse. (Quarterly Review, 131 pp.) Several articles in a variety of languages about real needs and planning of water supply development in small communities. Interesting and useful discussion of successful approaches to the problem.

Chad Wells 1977 (1977). "Chad PCV Report." (Report, 27 pp.) A short history of the Peace Corps/Chad well drilling program up to 1977. Details are given on pump development. A good quick overview of methods and materials used, but readers must understand the technology. Fine drawings of an example well, and some of the equipment, plus lists of materials suppliers and references.

Community Water Supply and Excreta Disposal Situation in the Developing Countries; A Commentary (1970). World Health Organization, Distribution and Sales Service, 1211 Geneva 27, Switzerland. (Booklet, 11 pp.) Comments and analysis of 1970 WHO survey to determine "water supply and excreta disposal conditions and needs in 75 developing countries." The booklet concludes that "It is hard to find a successful rural community water supply programme that did not involve active community participation."

Darrow, Ken and Rick Pam. Appropriate Technology Sourcebook (Nov 1976). AT Project, Volunteers in Asia, Box~4543,~ Stanford, CA 94305,U.S.A. (Book, 304 pp.) A guide to practical plans and books for village and small community technology. Publications were chosen that provide enough practical information to be of significant help in understanding principles and in actually building the designs included. Highly recommended.

Denis, A. and N. Fernando. "Low Cost Tube Wells", in Appropriate Technology (Vol. 2, No. 4, Feb 1976). Intermediate Technology Publications Ltd., 9 King Street, London WC2E 8HN, England. (Periodical Article, 2 pp) This brief article lists simple drilling equipment, outline of procedures, and comparison of locally available materials for use as casing in a small diameter well. Be aware that the bamboo procedure outlined here was tried unsuccessfully according to Bruce Eaton, The Chief Driller's Report on JJCIP (q.v.).

Design and Control of Concrete Mixtures (July, 1978). 11th edition. Portland Cement Association, Old Orchard Rd., Skokie, Illinois 60076, U.S.A. (Report, 121 pp.) Everything a reader would want to know about the properties and variables of concrete, telling everything about what you can and cannot do with concrete. Much of this information is not specifically useful for simple concrete work in developing countries, although it could be a source for design ideas.

Dulansey, Maryanne. Water Resource Development (March 1977). American Council of Voluntary Agencies for Foreign Service, Inc., Technical Assistance Information Clearing House (TAICH), 200 Park Avenue South, New York, N. Y. 10003, U.S.A. (Booklet, 23 pp. plus appendices.) Offers a summary of the experience of U.S. non-profit organizations: their programs, result 9 and

recommendations. It was quickly put together for water conference, citing the large amount of work done by NGO's and recommending that they be coordinated for future efforts.

Eaton, Bruce. The Chief Driller's Report on JCCIP (June 1976). Agricultural Development Agencies in Bangladesh, 549F, Road 14, Dhanmandi, Dacca-5, Bangladesh. (Booklet, 29 pp.) A comparison of 20 wells completed with different kinds of equipment and using different techniques. The booklet emphasizes that when propellor pumps are installed directly in a PVC casing, the casing acts as a riser pipe and does not work very well for a number of reasons. Booklet offers a comparison of several different drilling and developing methods, and it is recommended for appropriate drilling projects.

Freedman, Ben. Sanitarian's Handbook (1977) 4th edition. Peerless Publishing Co., P.O. Box 30187, New Orleans, Louisiana 70130, U.S.A. Gives you everything you need to know about sanitation. Mostly geared to U.S., but a wealth of good basic information, including 180 pages on water. It is highly technical, and the nonspecialist can get most of the information elsewhere.

Gibson, U.P. and R.D. Singer. Water Wells Manual (Jan 1969). Premier Press, Box 4438, Berkeley, CA 94704, U.S.A. (Booklet, 156 pp.) This booklet (formerly Small Wells Manual, published by USAID), covers exploration and development of ground-water supplies. Discusses wells up to 4 inches in diameter, 100 feet deep, with yields up to 50 U.S. gal./min. Much of the technical information on drilling is taken from Ground Water and Wells (q.v.), plus descriptions of some less ~ technical drilling methods. Requires a good knowledge of English and a technical orientation.

Gordon, R.W. Water Well Drilling with Cable Tools (1958). Bucyrus-Erie Company, 1100 Milwaukee Ave., South Milwaukee, Wisconsin 53172, U.S.A. (BOOK, 230 PP.) Excellent book, describing cable-tool drilling equipment and procedures, but it is needed only by people working with an actual rig they must become familiar with.

Ground Water and Wells: A Reference Book for The Water-Well Industry (1975). UOP-Johnson, Universal Oil Products, Johnson Division, St. Paul, MN 55165, U.S.A. (Book, 440 pp.) An excellent book for anyone working with wells, specifically with drilled wells. Generally acknowledged as the basic reference work on drilled wells.

Guidelines and Criteria for Community Water Supplies in the Developing Countries (1969). USAID and USPHS, Development Information Center, DS/DIU/DI, Room 105, SA 18, Agency for International Development, Washington, D. C. 20523, U.S.A. (Book, 101 pp.) Offers data on water supply programs in 12 developing countries in various parts of the world, although Africa is excluded. Makes recommendations for development and planning of large water supply programs. Sometimes written in a hard-to-read format, but ten years ago this study came to conclusions that were ahead of its time and have still not been effectuated. The book concludes that design of water supply systems must take into account the people who will be using them and that what works in a developed country is often not appropriate in a developing country.

Huisman, L. and W. Wood. Slow Sand Filtration (1974). World Health Organization, Distribution and Sales Service, 1211 Geneva 27, Switzerland. (Booklet, 11 pp.) Intended as a defense of slow-sand filtration for large treatment systems. Chiefly a discussion of large-scale slow-sand filtration, useful and appropriate in many areas. Offers excellent basics on slow-sand filtration. Tells

how it works and how to build slow-sand filter, although no simple plans are given for a small scale filter, probably because the authors feel that such filtration can be more efficiently and effectively done on a large scale.

Karr, William V. Ground Water: Methods of Extraction and Construction (1969). International Underground Water Institute. Contact: Ranney Water Systems, Inc., 1134 Corrugated Way, Columbus, OH 43201, U.S.A. (Book, 95 pp.) Academic presentation of radial collection well techniques, for those who might possibly use one for large water supplies. Covers large diameter caissons sunk an average of 30 m, with 18 to 24 inch thick walls.

Kear, D. and B.L. Wood. The Geology and Hydrology of Western Samoa (1959). New Zealand Geological Survey. Geological Survey Division, Department of Scientific and Industrial Research, Private Bag, Wellington, New Zealand, Attention: Publications. (Book, 92 pp. plus maps.)

An excellent, moderate-level presentation and discussion on the availability of fresh water on islands. To quote from the book, "The basic theoretical factors in the general area of underground water are described; the possible sources of water in Samoa are listed and described; the technical, administrative, and educational requirements of Samoan water supply are discussed; the present supply position is reviewed; and the suggested sources of supply are given for most of the Territory." This may not be available.

Leopold, Luna and Walter B. Langbein. A Primer on Water (1960, 1966). Geological Survey, available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. for \$0.35. (Booklet, 50 pp.) An

introduction to water and where it comes from, intended for use by the average American citizen who has never had to think about water because it always comes from the faucet.

Mann, H.J. and D. Williamson. Water Treatment and Sanitation (Jan 1976). Revised edition. Intermediate Technology Publications Ltd., 9 Ring Street, London WC2E 8HN, England. (Booklet, 90 pp.) Mostly an overview of basics, but the booklet offers 21 pages on water testing and treatment, with emphasis on sand filtration. It also includes information on measuring water flow, pumps, latrines, sewage treatment, and final disposal of waste, but a field worker could not treat water using this manual alone.

Manual of Individual Water SUPPLY Systems (1975). USEPA reprint. U.S. Environmental Protection Agency, Water Supply Division, Washington, D.C. 20460, U.S.A. (Book, 155 pp.) This book offers basic information, primarily on drilled wells, to a homeowner wishing to understand more about his or her water system. It emphasizes sanitary protection of water sources, and is an interesting overview of the different systems one could build. It is not meant to be a "how-to" manual.

Matthias, A.J. and E. Smith. How to Design and Install Plumbing (1967). 4th edition, revised. American Technical Society, 5608 S. Stony Island Ave., Chicago, Illinois 60637, U.S.A. (Book, 446 pp.) Overview of what to look for and roughly how to plan plumbing systems in various situations. Does not offer "how-to" descriptions of the actual work involved to cut, thread, or otherwise connect pipe, and assumes availability of manufactured pipe and joints.

McJunkin, F. Hand Pumps for Use in Drinking Water Supplies in Developing

Countries (1977). WHO, International Reference Centre for Community Water Supply, P.O. Box 140, 2260 Leidschendam, Netherlands. (Book, 230 pp.) This book is an excellent introduction and analysis of the technical aspects of hand pumps, including quite a bit of detail. Offers the state-of-the-art on manufactured hand pumps and some mention of locally made pumps. Gives a good idea of what is available, how it is designed, and why designs are as they are. Free if requested from developing countries; otherwise, \$8.00.

McJunkin, F.E. Surveillance of Drinking Water Quality (1976). World Health Organization, Distribution and Sales Service, 1211 Geneva 27, Switzerland. (Book, 135 pp.) This book offers "...information and guidelines for planning, organizing, and operating programmes for surveillance of drinking-water quality at the national or regional level in developing countries." It is more oriented toward organizing a national water quality program, although there is some good detailed information on relatively simple methods of water testing and what it means, the significance of large planning and some good "how-to" methodology. You will learn that disinfection, usually with chlorine, is relatively simple, easy to monitor, and the single most effective water treatment technique.

McJunkin, F.E. and C.S. Pineo. The Role of Plastic Pipe in Developing Countries (1969). USAID. Development Information Center, DS/DIU/DI, Room 105, SA 18, Agency for International Development, Washington, D. C. 20523, U.S.A. (Book, 150 pp.) The premise of this book is that because pipe is the single major component of most water supply systems, the cost of construction of these systems could be reduced if the pipe were manufactured in the country. Book is intended as an awareness piece for decision makers and engineers and "should enable the reader to (1) weigh the merits of plastic as a pipe material, (2) quickly acquire an

awareness of the state of the art, (3) prepare design criteria and standards and specifications for manufacture, testing and installation of plastic pipe, (4) organize a testing program, and (5) undertake preliminary feasibility studies of manufacture and marketing of plastic pipe." It has limited use as a field document.

Miller, Arthur P. Water and Man's Health (Jul 1967). USAID reprint. Development Information Center, DS/DIU/DI, Room 105, SA 18, Agency for International Development, Washington, D. C. 20523, U.S.A. (Book, 92 pp.) Now out of print but many copies are still around in Peace Corps or AID offices. An excellent presentation of background information on specific water-related diseases; water's relatedness to disease; the seriousness of water transmitted disease; method of transmission; the history of discovery of causative agents; human susceptibility to water-borne disease; and methods of control. Offers information on chemical pollutants as a likely source of water contamination, the resulting physical conditions from overdoses, and recommended maximum concentrations in drinking water. This book is now being rewritten by F.E. McJunkin and is expected to be available by late 1980.

More Water for Arid Lands (1974). National Academy of Sciences, 2101 Constitution Ave., Washington, D.C. 20418, U.S.A. (Book, 153 pp.) Report of an ad-hoc panel of the Advisory Committee on Technical Innovation, Board on Science and Technology for International Development, Commission on International Relations. Discusses "little known but promising technologies for the use and conservation of scarce water supplies in arid areas . . . The technologies discussed should, at present, be seen as supplements to, not substitutes for, standard large-scale water supply and management methods." A most useful overview of techniques that can be used for water supply and water conservation in arid areas,

but offering no real "how-to" information. A good bibliography for readings in selected areas, and a French edition is available.

Okun, D.A. and G. Ponghis. Community Wastewater Collection and Disposal (1975). World Health Organization, Distribution and Sales Service, 1211 Geneva 27, Switzerland. (Book, 285 pp.) A description of largescale sewage treatment plant design and construction. Good information on hydraulics, laying pipe, and water treatment.

Pacey, Arnold. Hand-Pump Maintenance in the Context of Community Well Projects (1978) Intermediate Technology Publications Ltd., 9 King Street, London WC2E 8HN, England. (Booklet, 38 pp.) This presents the basics of a hand-pump installation program needed for a supply of clean water from wells, offering a choice between three different levels of technology and their concurrent levels of local community involvement. Probably the best introduction to pumps, since it deals with community aspects and not just with technology. Highly recommended.

Rajagopalan, S. and M.A. Shiffman. Guide to Simple Sanitary Measures for the Control of Enteric Diseases (1974). World Health Organization, Distribution and Sales Service, 1211 Geneva 27, Switzerland. (Booklet, 103 pp.) Good, practical plans and things to look for in constructing and maintaining sanitary water sources, concentrating on methods of simple disinfection with chlorine.

Shallow Wells, Shenyanga Region, Third Progress Report (1976). Governments of Tanzania and Netherlands. (Booklet, 55 pp.) A description of a wells project in the Shenyanga region of Tanzania. Interesting quick discussion of a large project which dug wells, lined them with pre-cast concrete rings, and installed a locally

manufactured hand pump. Offers good plans and detailed descriptions of equipment and work.

Sternberg, Y. and R. Knight. Development of PVC Well Screens for Local Fabrication in Developing Countries (1978) Public Utilities Report No. RES14. International Bank for Reconstruction and Development, 1018 H St., N.W., Washington, D.C. 20006, U.S.A. (Working Paper, 8 pp.) This paper describes the development and manufacture of a continuously slotted well screen made of specially reinforced PVC pipe. Where PVC is extruded and where motorized lathes are used, these well screens might be produced at low cost. This may be a new breakthrough in well screen manufacture, and it is now being field tested.

Wagner, E.G. and J.N. Lanoix. Water Supply for Rural Areas and Small Communities (1959). World Health Organization, Distribution and Sales Service, 1211 Geneva 27, Switzerland. (Book, 337 pp.) The book is old, rapidly becoming outdated. It is expensive and oriented to larger pumps and distribution systems, but still probably serves as the basic reference book on the subject. Almost everything in the book is covered better and in more detail by some other book, but no other reference has all of the basics together and easily accessible in one place.

Walton, William C. Groundwater Resource Evaluation (1970). McGraw-Hill Press, 1221 Avenue of the Americas, New York, N.Y. 10020, U.S.A. (Book, 664 pp.) This book offers equations and methods used to quantitatively appraise the hydrogeologic parameters affecting the water-yielding capacity of wells and aquifers, and those used "to quantitatively appraise the response of wells and aquifers to heavy pumping." A college-level engineering text.

Water Purification, Distribution, and Sewage Disposal for Peace Corps Volunteers (1969). Volunteers in Technical Assistance (VITA), 3706 Rhode Island Ave., Mt. Ranier, Maryland 20822, U.S.A. (Book, 243 pp.) An early attempt at an appropriate technology manual on these subjects. The book answers most technical questions, but concentrates on a technical point of view without information on using locally available materials. There is much useful material, organized with lesson plans, but the book also includes some irrelevant material.

Water Resources Development-2 (1974). Action for Food Production (AFPRO), C-52, N.D.S.E. Part II, New Delhi 110049, India. (Booklet, 72 pp.) This booklet offers some "how-to" plans for several different water sources, including drilling wells by hollow rod system, a multiple-well scheme for irrigation, lined dug wells, and blasting procedures. The material is good, relatively simple, and geared to locally available material in India.

Water Well Journal. National Water Well Association, 500 W. Wilson Bridge Rd., Suite 130, Columbus, Ohio 43085 U.S.A. (Monthly periodical.) Intended for commercial well drillers and water well equipment suppliers in the U.S. The magazine annually publishes a buyers' guide and a directory of manufacturers as well as offering interesting articles on new and old techniques and equipment, business and industry practices.

Watt, S. and W.E. Wood. Hand Dug Wells and Their Construction (1976). Intermediate Technology Publications Ltd., 9 King Street, London WC2E 8HN, England. (Book, 234 pp.) The best book on hand dug wells available. Emphasis on one specific kind of dug well construction with concrete, but considerable description of alternative methods. Many useful pictures and drawings.

Well Drilling Operations (1965). Departments of the Army and the Air Force, TM-5-297/AFM85-23. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. (Book, 249 pp.) This book offers about 50 pages of introductory discussion and material on hand-dug, bored, jetted, and driven wells. The rest is primarily a good basic discussion of cable tool and rotary rigs.

White, Anne U. and Chris Seviour. Rural Water Supply and Sanitation in Less-Developed Countries (1974). International Development Research Centre, Box 8500, Ottawa, Canada K1G 3H9. (Booklet, 81 pp., with annotated Bibliography.) This booklet provides a good overview of the subject with perhaps more emphasis on the design and planning of projects than on actual "how-to" methods. It offers an excellent 5 page introduction on the history and development of water supply, and current trends.

Winter, G. and A.H. Nelson. Design of Concrete Structures (1973). McGraw-Hill Press, 1221 Avenue of the Americas, New York, N.Y. 10020, U.S.A. The text for a basic college level course design with concrete. There is a lot of higher math this book, but anyone with mechanical or engineering background can persist to figure out the exact design requirements of any concrete structure. Not recommended to those without solid technical education.

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