A Well Studied Artifact: Irrigation-Related Artifacts and Their Implications for the Study of Homesites in Desert Environments

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Virtually all homesites in desert environments are characterized by one simple goal: the ability to access water. Typologies have been developed for water-system components; however, no classification has been devised for the recordation or study of water wells themselves. In many cases, the water well is the most essential component of the homesite and is one of the principal elements for making a successful land claim in the desert environment. While valuable information pertaining to wells and irrigation-related equipment has been overlooked by archaeologists, such historical artifacts and features have been able to yield important information with regard to themes such as chronology, subsistence, technology, settlement patterns, and economic activities. The placement of the well most often determined the location of the reservoir, any pumping equipment, field delineations or conveyance systems, and ultimately, the primary dwelling and its related outbuildings. The types of irrigation equipment identified at archaeological sites may provide insight into the quantity and variety of activities occurring at the homesite, such as farming or ranching. The types of drilling methods being employed, the types of equipment available, and the types of casing or lifting devices may also be revealed through the investigation of wells.

Perhaps the most essential component to any homesite in the desert is its water well. This is not to say that all homesites had water wells, but all successful homesites in the desert had access to water – be it via a well, or by having it transported onto the property. In general, the well was the preferred choice for providing water to the homesite and was one of the principal elements for making a successful land claim in the desert environment. The placement of the well determined the location of the reservoir, any pumping equipment, field delineations or conveyance systems, and ultimately, the primary dwelling and its related outbuildings.

Valuable information pertaining to wells and irrigation-related equipment typically has been overlooked by archaeologists; however, such historical artifacts and features may yield important information with regard to themes such as chronology, subsistence, technology, settlement patterns, and economic activities. Wells and irrigation-related artifacts and features have been well documented in the archaeological record at historic sites in the Antelope Valley. Further, numerous studies have been conducted with regard to California's water resources. Of special interest are the 1911 study by Harry R. Johnson of the United States Geological Survey (USGS), which recorded 352 wells, and the 1950s water resources division investigation conducted by members of the USGS (USGS, Water Resources Division 1954); both encompassed the Antelope Valley. In 1873 the Alexander Commission performed an investigation of irrigation in the Central Valley. Additional studies were undertaken seven years later by William Hammond Hall, State Engineer; Hall conducted a survey of developed regions of irrigated agriculture in 1880. Elwood Mead, of the United States Department of Agriculture, performed a national investigation in 1901; much of his research focused on California's water resources. During the 1920s, additional studies were conducted throughout the western Mojave Desert: the 1920 study of the Antelope Valley conducted by the J. B. Lippincott Engineering Firm and the 1929 study of the Mojave Desert by David Thompson of the USGS. In 1945, C. N. Johnston of the University of California at Berkeley conducted a study of wells in the Antelope Valley, San Diego and Orange counties, and the Central and Owens valleys. While references are also made (Bonner et al. 2003; Earle 1998; Foster et al. 1995; Johnson 1911; Puckett et al. 2003; Sill 1994; Sterner 1996) to irrigation-related artifacts and features observed in Riverside, Tulare, and Mono counties, California, and in Milford, Utah, these types of features and artifacts may be readily found throughout desert environments. Generally, wells and springs in California are designated or classified by their locations. Knowing the designation of the well may aid in locating archival research regarding a specific home site.

Suggested Typology

JRP Historical Consulting Services of Davis, California, and the California Department of Transportation Environmental Program/Cultural Studies Office in Sacramento, California (2000), have suggested a typology of water-system components

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including: diversion structures, such as weirs, tunnels or dams; conduits, including flumes and open canals; flow-control structures (e.g., gates or valves); and cleansing structures, such as traps or screens (Figure 1). However, no typology has been suggested specifically for water wells. As such, in order to accurately characterize how irrigation-related artifacts can address research questions, the following typology is recommended: types of drilling equipment available; types of casing; styles or types of lift; and other related items.

Types of Drilling Equipment Available

Three types of wells have been noted in the deserts of California, including: artesian wells; hand-dug wells; and driven wells. Artesian wells are naturally flowing water sources. Hand-dug wells are those which are excavated by means of hand tools such as shovels, picks, and other manual tools. Driven wells are those excavated with the use of drive points, portable drilling rigs, rotary drills, augers, or boring tools.

Types of Casing

Casing may be described as a conduit for which water traveled from beneath the ground to the surface. Four types of casing have been identified, including: seamless, single-seam, riveted, and concrete. The submersible portion of the casing was often chisel-slotted or drill-perforated to prevent siltation from extending into the water.

Styles or Types of Lift

At least six styles or types of lift are noted: artesian sources; pumping jacks and hand pumps; jet-powered pumps; above-ground centrifugal pumps; gasoline/diesel engines; and electrical pumps/engines. Readily available before the water table dropped throughout the desert regions of Southern California were artesian wells, which provide water by means of natural flow. Most popular, however, were windmills (Figure 2); note that more than 50 companies (in the United States) were manufacturing windmills in 1924, with more than 150 models available (Wendel 1997:290). Pumping jacks and hand pumps were also used, as were jet-powered pumps with above-ground centrifugal pumps; gasoline/diesel engines, popular after 1910, with shortages during World War II; and electrical pumps/engines, not common until the mid-1900s in California. The effectiveness of the well often depended upon the depth of the water table, the depth of the well, and the

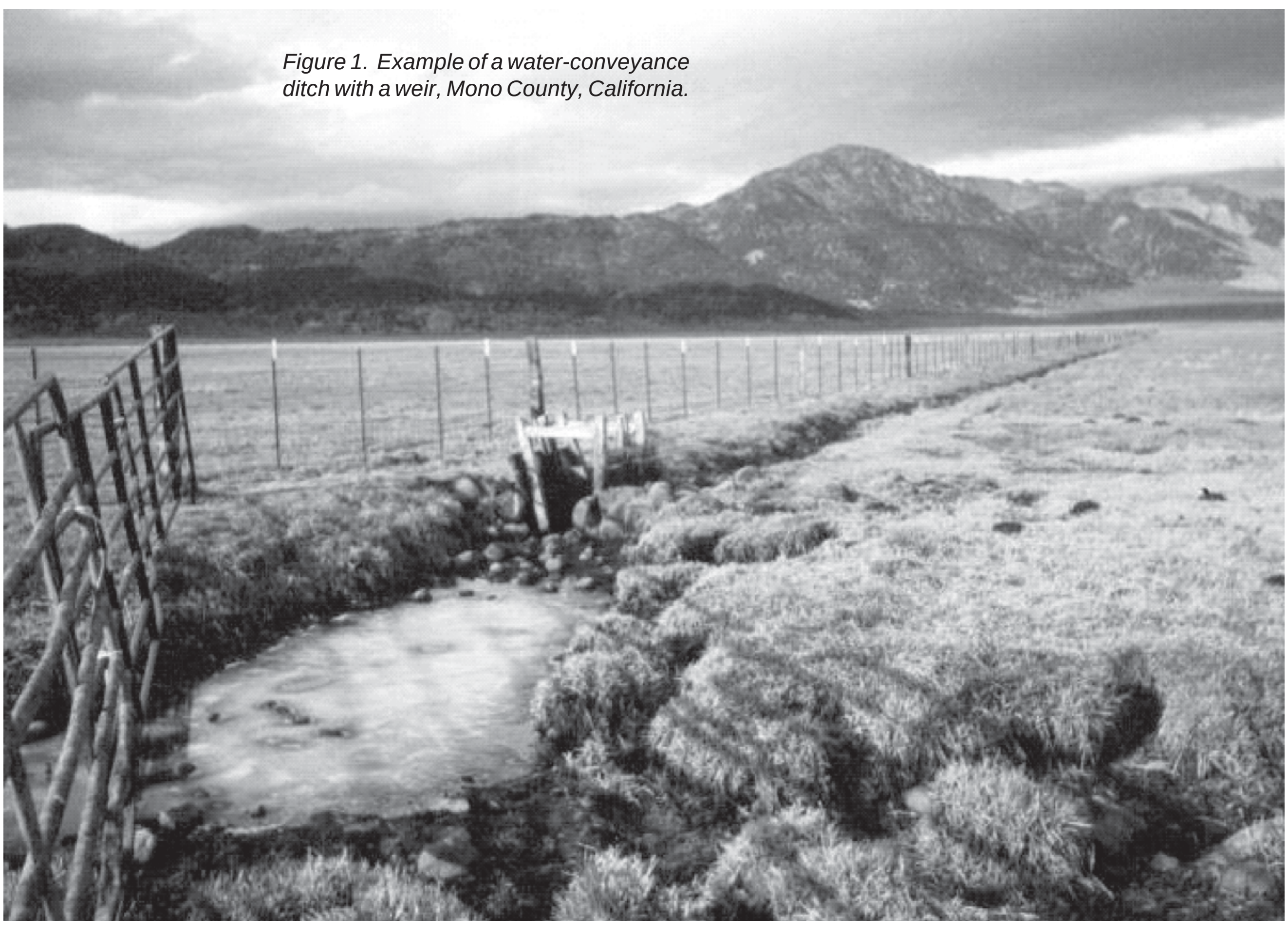

Figure 1. Example of a water-conveyance ditch with a weir, Mono County, California.

Figure 2. Windmill vanes identified at a homesite in Kern County, California.

type of lift required. Well-drillers' logs may indicate the types of wells, the depth of water, and types of pumps used to power the wells.

Other Related Items

Other related irrigation items include, but are not limited to, conveyance systems, surface irrigation equipment, boiler tanks, storage tanks, elevated tank houses, reservoirs, field delineations, and engine or pump houses.

The types of equipment selected by the occupants may be based upon the type of settlement they wished to establish; the length of time settlement is required; the types of subsistence they wish to pursue; technological advancements available at the time; the availability of products in their local area; or what may be available within their price ranges.

THE RESEARCH POTENTIAL OF WATER WELLS

Several research questions and/or research themes may be addressed by the presence of irrigation-related artifacts on a desert homesite.

Settlement Patterns

Research questions have been developed with regard to settlement patterns; for example: *How was the site settled and/or how was land claimed? Do features correlate with the settler's efforts at trying to "prove-up" his or her claim?*

Settlers flocked to California following the 1840s discovery of gold, the expansion of the railroads to the west, and the passage of federal land policies that allowed many to settle the West. Two of the land policies most often applied to settlements in the California deserts specified provisions for claiming land in the Desert West: the Homestead Act of 1862 and the Desert Land Act of 1877. Both acts required claimants to establish irrigation improvements on their lands, especially the Desert Land Act. During the yearly proofs, claimants often sketched locations of specific improvements, including the well, windmill, conveyance ditches, holding ponds, and field delineations or crops.

Water availability was an important factor in settling desert environments. Features associated with such development included wells, pumps, pump houses, engines, irrigation ditches, check gates or dams, cisterns, stand pipes, and earthen holding ponds. Artifacts, construction techniques, and features may be evidence of "proving up" the claim. Farming features such as cleared fields, tree stumps remaining from orchards, and irrigation systems and artifacts such as plows may indicate that settlers established a farm. Ranching features such as corrals, water troughs, and cattle guards may indicate that the settlers established a ranch. Farming and/or ranching items can also indicate how settlers acquired land. If the site has water-development features and agricultural features, but no evidence of a residence, then the site may have been a desert land entry instead of a homestead.

Johnson (1911) reported 72 wells excavated or drilled in the Antelope Valley between 1885 and 1899, and approximately 110 wells between 1900 and 1911. Spinney et al. (2004) note that, between the years of 1895 and 1945, several of the homesites in the Antelope Valley maintained more than one well within their boundaries. The evidence of these water resources is "reflected" or "represented" in the archaeological record by the presence of water-related artifacts and/or features. As such, the presence of pipe, well casings, pump or windmill parts, and other related artifacts may be indicative of settlement patterns that can be supported by the archival record (Figure 3). Examples of these are readily apparent in the California deserts, and much of the western United States.

Subsistence Patterns

The location of farming and/or ranching features and structures on the site may provide information about the type of economic activities that occurred there. The size or number of fields may indicate the number of crops, which may suggest whether the settlers grew cash crops or food staples. Research questions developed for subsistence patterns include: *Are wells, tool assemblages, machinery, or equipment associated with subsistence farming or ranching activities, a commercial operation, or both? How is the land irrigated?*

The quantity of irrigation improvements observed at the site may suggest subsistence patterns. Crops such as alfalfa, barley, wheat, corn, grains, beans, fruit trees, and vegetables were grown by settlers in the Antelope Valley. It should be noted that "a well yield of 22 to 28 miners' inches per minute was considered necessary to irrigate" a plot of land in this region, making it viable for growing such crops as these (USDA 1900). The diameter of the casing may suggest the yield, thereby determining the required use of the well — for example, use for irrigation versus domestic purposes.

Other features present in the archaeological record that are indicative of irrigation may include reservoirs or holding ponds, standpipes, field irrigation pipes or ditches, and water troughs (Figure 4). Fragments of terra-cotta, concrete, or steel pipe, and gate valve parts may assist in the locating of irrigated fields or orchards that are not otherwise physically visible at the site. These artifacts and features, coupled with the archival record, may assist in determining whether or not the claimant participated in large-scale subsistence practices, such as alfalfa farming or livestock ranching. Irrigation artifacts may also relate to other practices such as the operation of a duck club, mining enterprises, and oil exploration; such practices were used to supplement the income of the settlers, possibly to expand their irrigation improvements.

Of the 320 wells in Johnson's 1911 study, at least 37 were constructed for domestic use, 14 for stock, and 54 for the irrigation of fields. This can be compared to patent information to determine whether settlers irrigated for commercial crops or merely for subsistence. Other recorded uses included water for three stamp mills, one cyanide plant, three engine supply wells, a school, for the manufacture of plaster, and for two oil-exploration holes.

Technological Patterns

Research questions may be developed around technological themes. For instance, one might inquire: *What technology is indicated on the site: does it reflect dry-farming techniques, changes in farming technology, or any new or advanced irrigation methods? Do the features present on site reflect the types of drilling technology and pumping equipment available at a certain time?*

Based on the technology that was available to settlers, the irrigation-related artifacts may vary. Areas in artesian zones, generally below 2,400 feet sea level where water reaches levels that could overflow the ground surface (USDA 1900), were favored for irrigation purposes; in these artesian zones, settlers could hand-excavate a well. The earliest drill rigs were available in the 1870s, but were a costly venture. As the demand for water resources grew, settlers either transported water to the property from nearby wells or resorted to drilling. As scientific dry farming gained popularity in the California deserts, and public interest turned to water rights and the development of aqueducts and canals, technological advances were also apparent. These advances are reflected not only in the types of wells constructed at a particular home site or community, but also in their associated features and artifacts, including the engines, pumps or lifting devices, or associated plumbing. Therefore, the types of technology available at the time should also be considered; a shift in technology with regard to water wells may be as subtle as the addition of a diesel or gasoline engine to a well formerly powered by a windmill.

Johnson (1911) documented only 10 wells as being hand-dug. The majority of the wells noted in the Johnson study were, in fact, drilled or bored, with most being located along the artesian zone. The most popular lifting device noted by Johnson was that of the windmill. More than 50 companies were manufacturing windmills in 1924, with more than 150 models available (Wendell 1997: 290). Following 1908, Johnson noted that many wells were equipped with steam or gas pumps. There were shortages in these types of pumps during World War II, however, as many manufacturers

Figure 3. Overview of holding pond, conveyance pipes, and displaced wooden motor mount, Kern County, California.

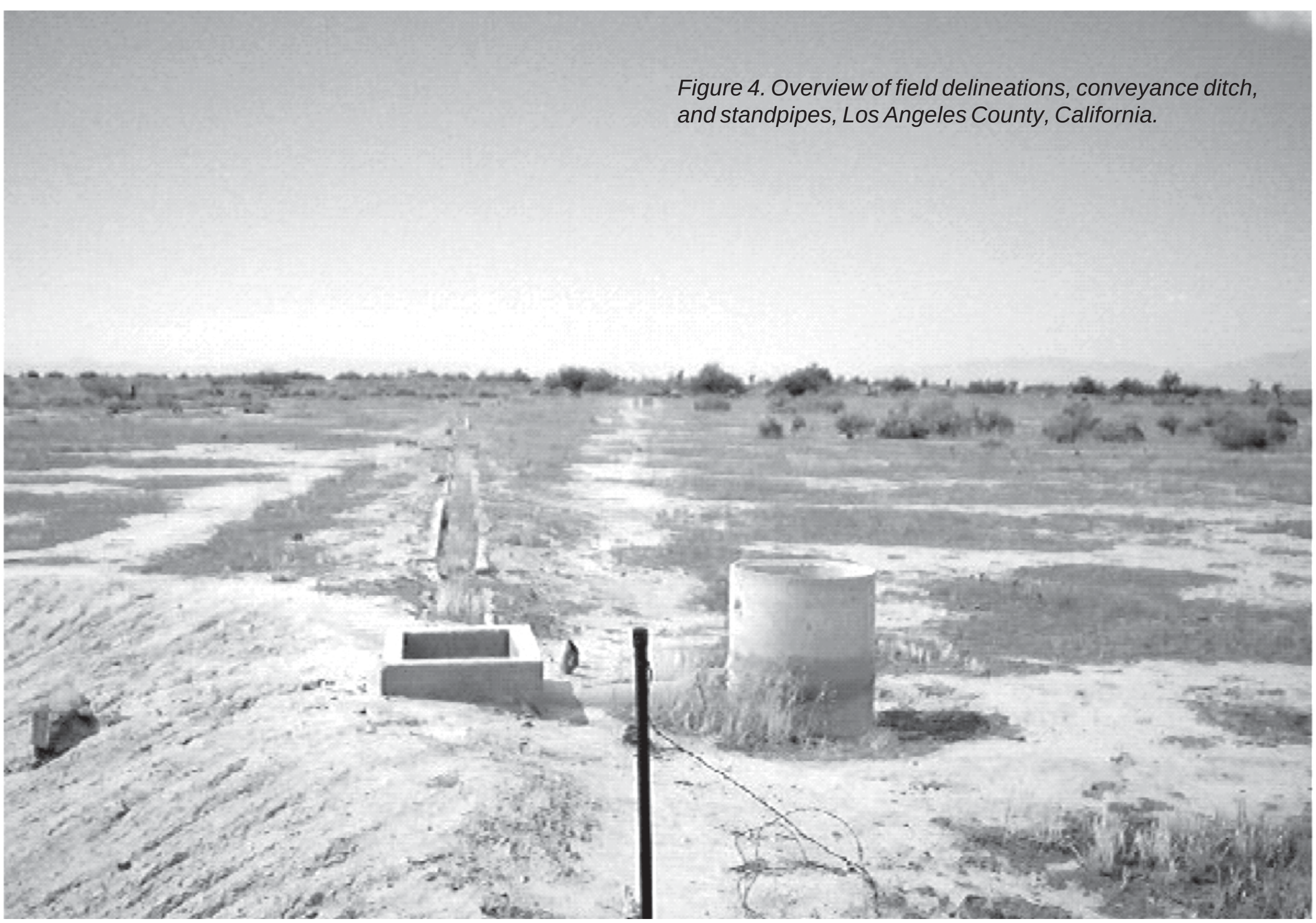

Figure 4. Overview of field delineations, conveyance ditch, and standpipes, Los Angeles County, California.

turned to war production. Only seven wells in Johnson's study provided water via hand pump. The presence of electrical engines was also notable, considering that electricity was not wide-spread in rural areas of California until the mid-1900s. Electrical power became more readily available to ranchers by the 1920s, and turbine pumps appeared more prominently in the 1930s (Sill 1994).

Irrigation ditches were also constructed as a means to divert water either from the well, or from existing stream channels, to farmlands. Such ditches may be earthen, stone-lined, or concrete-lined (Bonner et al. 2003; Bureau of Reclamation 1952); wood or metal-lined flumes, and/or canals also were used to transport water (Barrows 1934; Hatheway and Zimmerman 1989). Conveyance systems are noted not only in conjunction with alfalfa fields, but also with citrus groves and vineyards. Examples of these have been noted in Riverside, Kern, Tulare, and Mono counties in California, as well as in parts of southwestern Utah and Arizona (Bonner et al. 2003; Earle 1998; Foster et al. 1995; Johnson 1911; Puckett et al. 2003; Sill 1994; Sterner 1996).

Economic Patterns

Of particular interest in the desert environment is the level of affluence of the settlers; as a result, research questions typically evolve around a theme regarding economic patterns: *What economic activities can be identified on the site? Is there a relationship between water availability, cost of improvements, and the length of time sites were occupied (i.e., long-term versus short-term occupation)? Do the features present on site reflect the relative costs incurred by the settlers, or how much they expended to "prove up" their claims?*

In the Antelope Valley, settlers incurred costs of irrigating and improving their lands from $425.00 up to $11,800.00. Based on Johnson (1911), at least 68 settlers paid under $500.00 for irrigation equipment, while seven individuals paid over $1,000.00. Associated machinery most often ranged from $100.00 to $1,500.00 (Johnson 1911). Equipment was readily available in trade catalogs of the period such as Sears, Roebuck and Company; Merrill, Holbrook & Company; and Montgomery Ward & Company catalogs. By looking at trade catalogs, water-resources well logs, and patent information, it may be possible to determine the amount of capital the settler invested into improving the property.

Montgomery Ward & Company offered a minor selection of windmills, pumping jacks, and hand pumps in 1895. Similar products were offered by competitor companies, such as Sears, Roebuck & Company, at similar prices. For example, the Sears, Roebuck & Company's Agricultural Implement Department advertised Acme- and Sears, Roebuck & Co-brand power windmills. Prices for these items ranged from $60 to $190.00 in 1897. Pump attachments were sold separately for $10.00 (Sears, Roebuck & Company 1897:148). The same catalog advertised a multitude of pumps that were available via mail order. Included were stock pumps, farm pumps, and cistern pumps. The farm pump was described as a "General Purpose pump…6 inches square [with a] 3-1/2 inch bore, [and a] 9 inch stroke. Capacity, 60 gallons per minute. While this pump throws an ample supply of water, ladies and children can work the pump with ease" (Sears Roebuck & Company 1897: 53); such equipment sold for $2.25 to $3.60.

By 1908, the demand for well equipment had apparently increased, as did the prices. At that time, well equipment ranged in price from $12.92 to $97.40 (Sears Roebuck & Company 1908). Sears, Roebuck & Company catalogs from the 1920s provide a glimpse at the latest technology – gasoline engines, ranging in price from $6.50 to $74.95 (Sears Roebuck & Company 1923: 818). Windmill towers sold for $23.95 to $95.25, while the windmill bearings and vanes cost between $27.65 and $72.50.

Merrill, Holbrook & Company had locations in Los Angeles, San Francisco, Oakland, Fresno, and Sacramento. In 1928, this company offered various types of well casing from $1.21 to $12.55, depending upon the diameter and type of metal. Two types of hand pumps, including a pitcher spout and a cistern suction pump, were sold by them. Surface irrigation pipe and fittings, storage tanks, range boilers, and gate valves, pump cylinders, drive-well points, drive-well caps, couplings, and pump rods were also sold by the company. They did not sell windmills or windmill parts.

According to water-well logs from the US Geological Survey Water Resources Division (1954), settlers in the Antelope Valley relied upon equipment manufactured by various companies, not just those products mentioned in the trade catalogs. Most frequently noted in the logs are products manufactured by Fairbanks Morse & Company, the Byron Jackson Company, and the Peerless Pump Company. These companies often sold their products through their own trade catalogs, or via traveling salesmen.

The Byron Jackson Company was headquartered in San Francisco, California, in the early 1870s; by 1879, it introduced the first submersible pump and deep-well turbine pump (Figure 5). By the 1940s, the company had relocated to Vernon and Long Beach, offering a variety of pumps for multiple uses (Wallace 2001). Similar pumps have been identified at homesites in Riverside County (Foster et al. 1995), Tulare County (Sill 1994), and Kern County (Johnson 1911).

Fairbanks Morse & Company, formed in 1865, demonstrated the "Eclipse" windmill at the Centennial Exposition of 1876. In 1891, the company began producing steam pumps, and by 1893 turned to the manufacturing of gasoline engines. "Fairbanks Morse…built a wide variety of centrifugal pumps, and in fact, pumps of almost every style, size, and variety" (Wendel 1993: 137).

The Peerless Pump Company formed in 1923 near Los Angeles. It produced a variety of pumping devices for the irrigation of citrus groves (Figure 6). Between 1923 and 1946, they also produced horizontal end suction pumps in Ohio. In 1946, they purchased a plant from the US Army in Indianapolis, where they continue to manufacture pumps. Today, the Peerless Pump Company is one of the largest manufacturers of vertical-type pumps in the industry (Peerless Pump Company, Inc. 2003).

By looking at trade catalogs, water-resources well logs, and patent information, it may be possible to determine the amount of capital the settler invested into improving the property.

Implications for the Study of Water Wells

Although numerous studies have been made historically with regard to water resources in California's deserts, valuable information pertaining to the wells and irrigation-related equipment has been largely unreported or unrecognized by archaeologists. The presence of such resources should be further investigated in terms of identifying patterns of settlement and subsistence, technological change over periods of time, and economic investment. Typologies that have been developed for water-conveyance systems do not encompass or correlate specifically to water wells. Key to the understanding of such features is the refinement of existing typologies to encompass wells.

It is recommended that water wells be photo-documented, illustrated, measured, and mapped. The

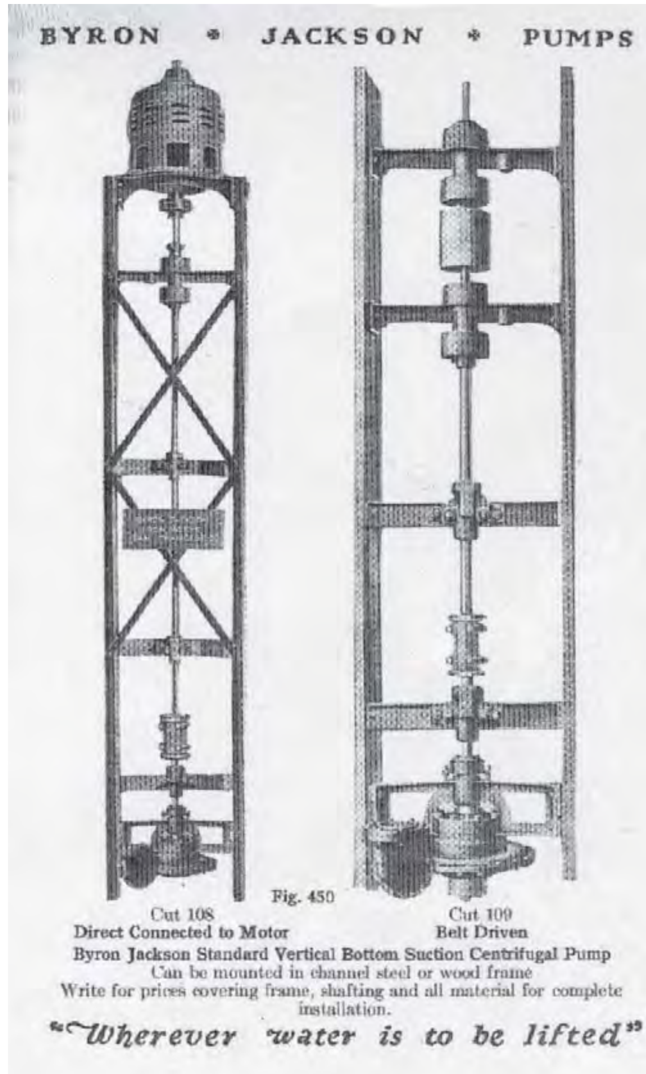

Figure 5. Submersible pump and deep-well turbine pump manufactured and advertised by the Byron Jackson Iron Works, Inc., Los Angeles, circa 1928.

photographic record or illustrations may be compared to depictions in well logs and materials sold in trade catalogs. Measurements of well casings may be invaluable for determining the types of materials used in the construction, in addition to determining the costs of improvements at the homesites.

Archival documentation such as patent information, water-resources well logs, trade catalogs, and oral histories may be compared to the archaeological record to glean additional information when recording and evaluating historic sites such as those found in the desert environments.

This is not to say that all water wells or irrigation-related features are eligible for the National Register of Historic Places; rather, these features may represent elements of an eligible site or contributors to a district

Figure 6. Electric-powered turbine pump observed in Los Angeles County; manufactured by the Peerless Company, Los Angeles, California, between 1923 and 1946.

or landscape. Such features warrant additional investigation in order to fully and accurately characterize the context of land use in the desert west, settlement, economic pursuits such as farming and ranching, technological developments and change, and subsistence patterns.

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