

Need for American Indian and Alaska Native Water Systems

The total 20-year need for the 884 American Indian and Alaska Native water systems is \$1.3 billion; \$0.56 billion for American Indian systems and \$0.77 billion for Alaska Native systems. Of this total, approximately \$1.1 billion is needed now to replace existing infrastructure or to extend a water system's service to nearby households that do not have safe running water. The survey of American Indian and Alaska Native water systems was conducted in consultation with IHS. American Indian and Alaska Native representatives participated in survey design and implementation.

This section of the report provides an overall picture of the needs of American Indian and Alaska Native water systems. The IHS Sanitary Deficiency System (SDS) provides information on specific needs and ranks communities' needs based on threats to public health.

Needs reported here for American Indian and Alaska Native systems are conservative. Projects solely for future growth were not included, nor were needs for non-community water systems. But more importantly for the American Indian and Alaska Native survey, only needs associated with existing water systems were collected. Data were not gathered for homes or

groups of homes that do not currently have running water and are too distant from existing water systems for interconnection. A greater proportion of American Indian and Alaska Native households lack running water than do households in the country as a whole.

Needs for American Indian and Alaska Native water systems are high, averaging almost \$43,500 per household for Alaska Native communities and over \$6,200 per household for American Indian systems for the 20-year period covered by the survey. These needs are high for a number of reasons. Many American Indian and Alaska Native people now carry their water from a public watering point at a community water system. Providing piped water to these households often involves substantial expansion and modification of existing facilities. This is especially true in Alaska Native communities.

The Drinking Water Infrastructure Needs Survey places the total 20-year need for American Indian and Alaska Native water systems at \$1.3 billion.

The remoteness of American Indian and Alaska Native communities often requires that communities bring in equipment and construction material by unconventional means.



Indian Health Service



Distribution mains in many arctic Alaska Native communities must be constructed above ground because ice-rich permafrost soils are often unstable. Water must be circulated and heated so that it does not freeze during arctic winters.

Because many American Indian and Alaska Native systems are located in areas remote from other communities, tying into a larger water system or joining with other communities to form a consolidated water system is often impractical. Some of these systems face significantly higher costs because of the difficulty in obtaining and transporting materials. American Indian and Alaska Native systems encounter additional problems because of arid or permafrost conditions, both of which make water sources difficult to find. Finally, like other small communities, they often lack economies of scale.

These problems are made worse by the fact that about 30 percent of American Indians and Alaska Natives have incomes below the poverty level. Many American Indian and Alaska Native people live through traditional subsistence farming, hunting, and fishing and do not generate significant cash income.

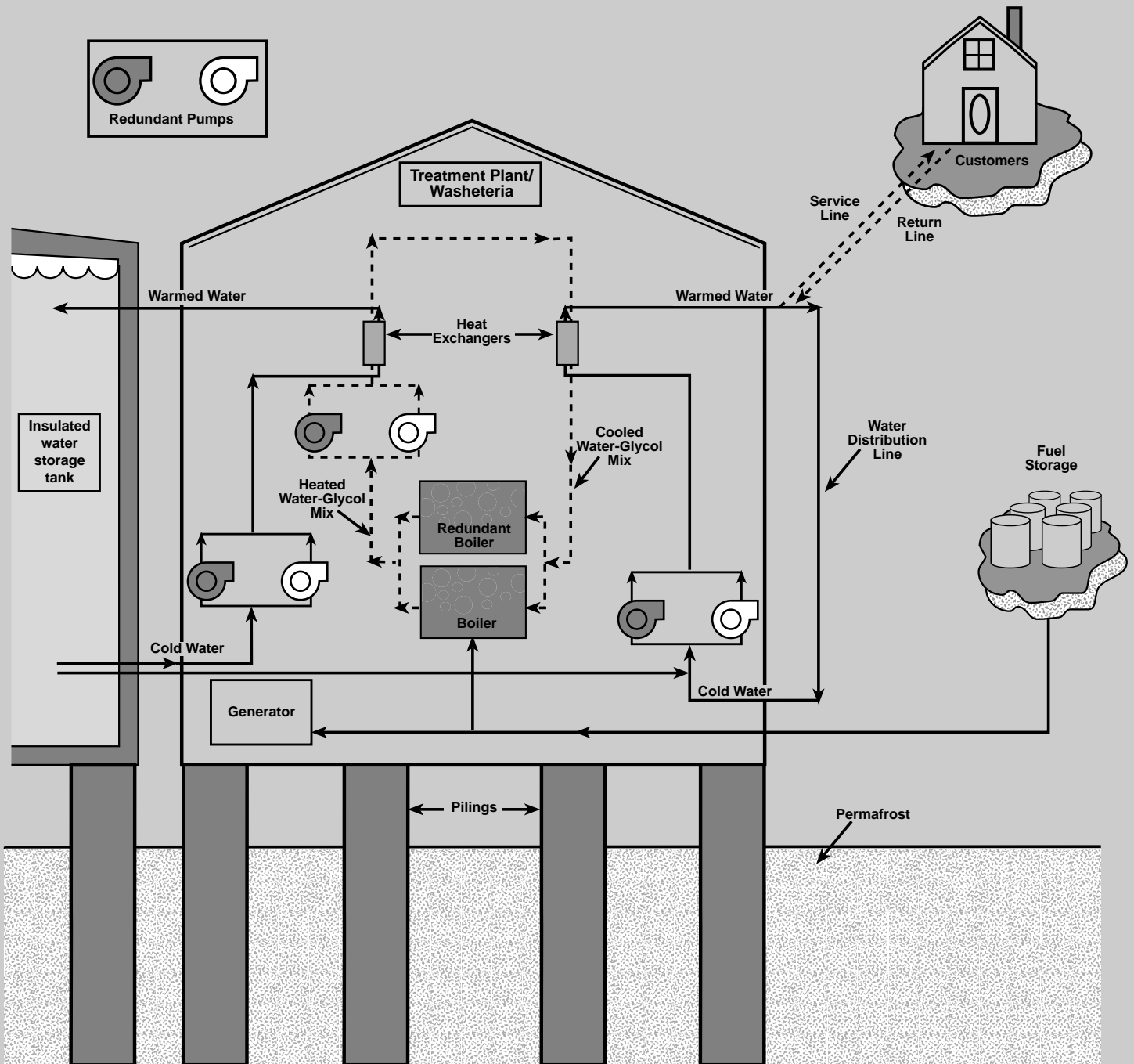
Like other systems throughout the country, most needs faced by American Indian and Alaska Native systems are associated with transmission and distribution and with treatment. Alaska Native systems, because of the limited availability of sources during the winter, also have high storage costs. These categories and unique aspects of the needs of American Indian and Alaska Native water systems are discussed in greater detail below.

Alaska Native Water Systems

Transmission and Distribution.

Transmission and distribution account for about half of the total Alaska Native water system need. Alaska Native communities often face unique challenges in constructing transmission and distribution systems. Because of freezing and structural stability problems associated with permafrost, they are frequently unable to use construction methods typical of the lower 48 States. This is particularly true for communities located near or north of the Arctic Circle. Often, the most cost effective construction method available to these communities is aboveground construction of housed and insulated mains called "utilidors." To be effective and reliable, mains must be constructed in "loops" so that water can be heated and continually circulated to prevent freezing. For the same reasons, water must be circulated to and from homes through looped circulating service lines. Many system components, including circulation pumps, boilers, and generators, must be paired to provide the redundancy necessary to minimize risk of failures that would result in frozen water lines and pumps. Such failures would be certain to cause extended loss of service and require extensive repair or complete replacement of the system.

Schematic of an Arctic Alaska Water System



Supplying water in arctic conditions presents unique engineering challenges. To be structurally sound, heated facilities such as the water treatment facility and storage tank must be constructed on pilings or large pads made of imported gravel. In addition to the components diagramed here, the water treatment plant often houses a washeteria with showers, toilets, and laundry facilities.

Treatment and Storage. Together, projects to install or replace treatment and storage facilities for Alaska Native communities represent over a third of their reported need. Approximately 80 percent of Alaska Native water systems have needs for treatment. Approximately 85 percent of Alaska Native water systems have needs for storage.

Approximately half of all Alaska Native communities rely on surface water sources; the rest rely on ground water. Treatment of ground water and surface water present very similar problems and expenses in arctic conditions. The limited ground water sources available are often of poor quality, containing very high concentrations of iron and manganese. These contaminants must be removed by techniques commonly associated with surface water treatment as practiced in the lower 48 States. As a result, the processes employed for treating ground water

and surface water sources, and the associated capital improvement costs, are very similar despite differences in the contaminants and associated health risks.

Treatment of surface water in arctic conditions can present unusual and difficult problems. Winter darkness, permafrost, frozen source water, subzero temperatures, and arctic weather conditions can make it impractical to pump water from a surface water source to the treatment plant. Some communities in Alaska's North Slope Borough have a "window of opportunity" for treatment which lasts only six to eight weeks during the summer. These communities treat a full year's supply of water in this short period of time. Successful operation of this type of system requires insulated and heated storage facilities with capacity of 365 days of water as compared to the one or two days storage common to systems in more

Atqasuk, an Alaska Native water system, is located north of the Arctic Circle. Water for the community must be treated and stored for the winter during a brief "window of opportunity" when ice melts each summer. The cartridge filters below cannot provide adequate treatment and need to be replaced with a conventional filtration plant. Also, the water system does not have adequate storage to provide the community with running water year-round. New insulated storage, like the tank shown, is needed.



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temperate climates. Compounding problems and expenses, facilities must be capable of treating and pumping water at six or more times the rate that would be needed if they could treat daily. Finally, paired components such as boilers, pumps, and standby generators are necessary to heat and circulate water to keep storage, treatment, and distribution systems from freezing.

The total capital improvement costs for Alaska Native communities are driven upward further due to the short construction season and the cost of transporting equipment and materials. In many cases, materials and equipment must be brought in on barges when summer temperatures make rivers navigable. In some cases, airlifting materials becomes necessary.

American Indian Water Systems

Transmission and Distribution.

American Indian water systems can also face problems associated with their location. Many American Indian communities are distant from other towns and communities, so they must construct and maintain their own water systems. The cost-saving option of connecting to and purchasing water from an existing system usually is not available for these systems because they are so remote. Because of the rural, widely-dispersed nature of many American Indian communities, more linear feet of water transmission and distribution line is necessary per customer served. Almost 40 percent of American Indian needs are for transmission and distribution.

Treatment. About a third of American Indian needs are for treatment. Water sources can be difficult to find in the arid country in which many American Indian communities are located and, when found, water is often of poor



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quality. American Indian communities frequently are forced to use sources that are expensive to treat. Over half of American Indian systems have needs for treating their ground water sources, while about 30 percent of similarly-sized ground water systems regulated by the States have treatment needs.

For many American Indian water systems, surface waters are the best sources available. Treatment of surface water is usually more expensive than ground water treatment and is crucial because of the potential health threat from microbiological contaminants. Seventy-five percent of American Indian surface water systems have capital improvement needs for treatment, compared to 50 percent of similarly sized surface water systems regulated by the States.

Exhibit 9 shows the location of American Indian Tribal lands and Alaska Native water systems. A detailed breakdown of American Indian and Alaska Native need can be found in Appendix B, Exhibits B-6 through B-8.

Pictured is a recently drilled well being tested and developed for an American Indian water system in Northeast Washington State. Previously drilled wells near the community have dried up. Several miles of transmission main are needed to bring water from this new well.



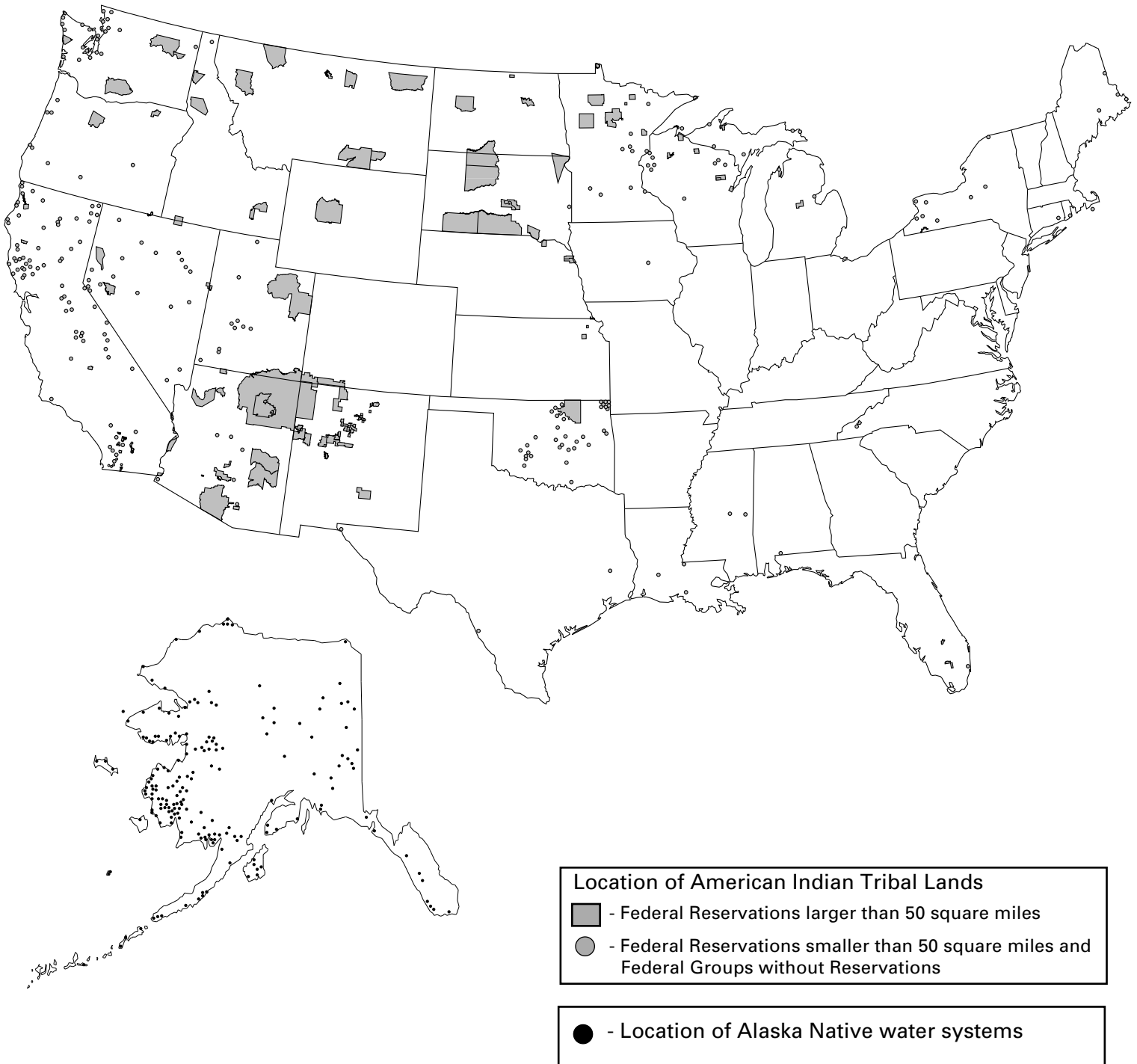
Top of mesa where the traditional community is located.

The Hopi Indian community of Polacca in northeastern Arizona provides water to traditional American Indian homes located on the top of a mesa. Provision of safe drinking water under these circumstances presents some unusual and difficult problems. Water from the town's wells must be pumped, via an aboveground transmission line, up the rock face of the mesa to the homes. The exposed transmission line is subject to breaks caused by freezing and corrosion. When the pipe breaks, water pressure in the mesa system can be lost, making the upper community vulnerable to contamination. In addition, the mesa community relies on a hydropneumatic tank to provide pressure in the water system. During power failures, water is pulled down the transmission main by gravity, causing negative pressure in distribution piping on the mesa and inviting contamination of the system. To prevent these health risks, the transmission main would have to be protected from freezing by being buried below the frost line or by other methods of insulation and/or heating. Also, standby power or an elevated storage tank would have to be provided on the mesa top.



Chuck Villa, water system operator, looking down at the exposed transmission main ascending the face of the cliff.

Exhibit 9: Location of American Indian Tribal Lands and Alaska Native Water Systems



Not to scale