Self-Performed Lift Station Assessment and Replacement - Managing Assets Through Tiered Standardization

[1]Bryan Phinney, P.E., Keller Associates
[2]Jon Brown, Fremont County (ID) Public Works
[3] Alexander Tabb, Smith & Loveless Inc.

KEYWORDS
Asset Management, Wastewater, Collection System, Lift Station, Operation and Maintenance, Standardization, Vacuum-Primed, Pumps, Clogs, Sewer, Collaboration

ABSTRACT
The paper demonstrates a streamlined approach by a county agency with its consultant and vendors to augment its collection system/lift station management program. With more than 45 lift stations in its system, of varying types, pump brands and configurations, Fremont County, Idaho, sought to reduce its part inventory management, improve operating efficiency, and lower operating costs by standardizing on three classifications of pumping systems depending on the application. The results demonstrate a simplified approach that yields positive returns for maintenance staff and the County's bottom line.

INTRODUCTION AND BACKGROUND

Successful operation of a wastewater collection system increasingly relies upon smarter asset management, particularly in light of agency resources. This paper reviews how one county agency is improving its collection system operation through tiered standardization of pre-engineered lift stations developed by its consortium of sewer staff, engineering partners and group of vendors.

Fremont County, Idaho, is a rural area located in the northeast corner of the state with a population of approximately 13,000 according to recent census data. Not far from nearby Yellowstone National Park, the area features a vast expanse of highly accessible forests, lakes and rivers, making it a popular year-round vacation destination for outdoor enthusiasts. Activities enjoyed in the region include fishing, camping, hiking, cross country skiing, mountain biking, horseback riding, and riding snowmobiles and ATVs.

Fremont County's Department of Public Works provides various services and utilities for its residents, including wastewater collection and treatment in the Island Park Region of the County. In the 1980s, two sewer and wastewater treatment systems were designed and constructed because of growing concerns over the impacts development, specifically septic tanks, were having on shallow ground water. The two lagoon-type treatment plants feature a combined capacity of 175,000 gpd, served by approximately 48 miles of gravity sewer lines and 22 miles of pressure sewer lines and 47 lift stations. This infrastructure is owned and operated by Fremont County because of the rural nature of the area. Table 1 summarizes the main attributes of the County's two wastewater systems.

Table 1 - Fremont County Island Park Wastewater Service Area Attributes

Treatment Scheme	Flow Capacity	Gravity Lines	Pressure Lines	# of Lift Stations
Mack's Inn Treatment Facility (est. 1982)	101,000 gpd	28 miles	14 miles	34
Last Chance-Pond's Lodge Treatment Facility (est. 1987)	76,000 gpd	20 miles	8 miles	13
Totals	**177,000 gpd**	**48 miles**	**22 miles**	**47**

The Mack's Inn Treatment Facility was commissioned in 1982 and today consists of 42 miles of gravity and pressure collection mains, 34 lift stations, and an aerated lagoon. Treated effluent supplies an irrigation system for land application during the summer. Conversely, there is a snow application system for converting treated wastewater to snow for land application during the winter. Total system capacity is 101,000 gpd.

The second wastewater system originally commissioned in 1987, Last Chance-Pond's Lodge Treatment Facility, is similar to Mack's Inn but slightly smaller. It consists of 28 miles of gravity and pressure collection lines, 13 lift stations, and an aerated lagoon. Likewise, it contains a snow system for winter application and an irrigation system for summertime application of treated effluent.

Combined, the entire wastewater service area contains more than 1,500 equivalent dwelling units (EDU) connected to the system.

DISCUSSION

Fremont County realized that its most significant system-wide operation and maintenance challenges did not originate from its two wastewater treatment facilities but rather from the 40-plus lift station assets within the collection system. This was the case for a variety of reasons.

First, the sprawling distance of the network complicated preventative O&M and repairs, as periodic inspection of every station was not realistic. The number of County Public Works technicians typically ranges between two and three to cover the entire collection system network.

Figure 1 illustrates the physical distances between its lift stations throughout the system, which comprises a coverage area more than 23 sq. miles covered by these technicians.

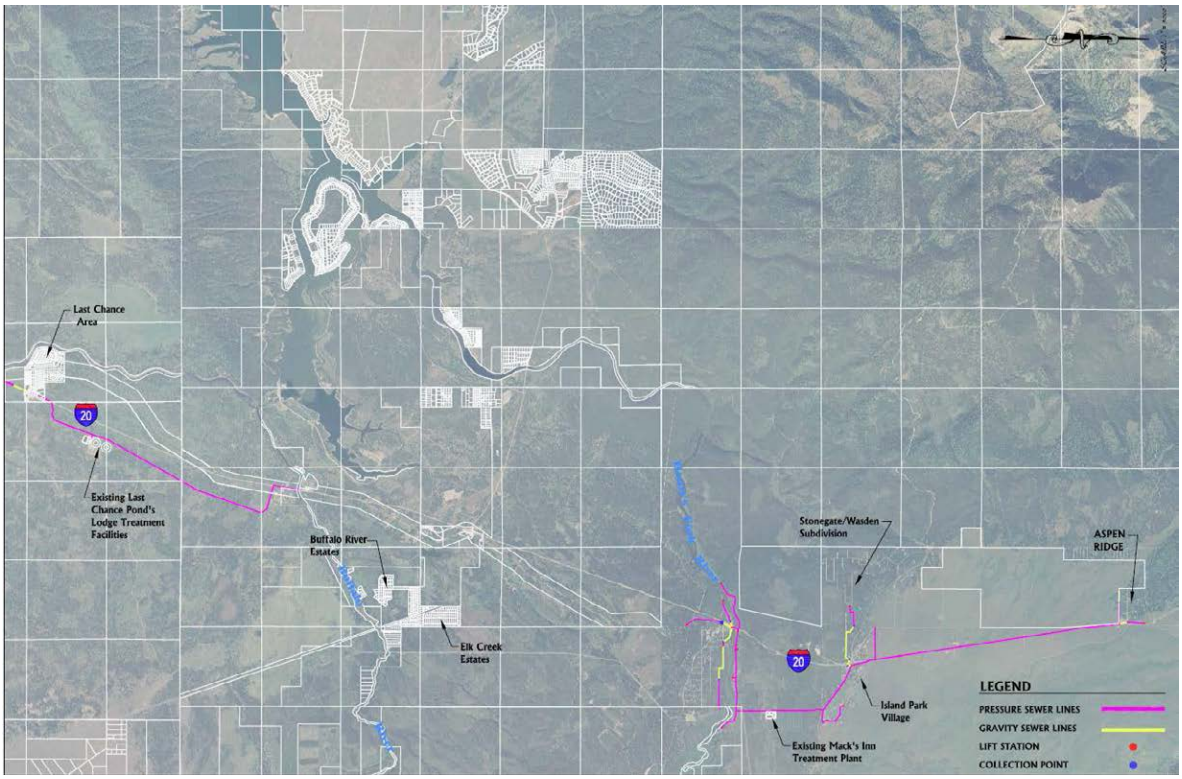


Figure 1 - Mapped Lift Station Locations, Aerial View

Furthermore, a relatively large variety of lift station types, system configurations and pump brands had been installed over time in the system. This variety made it difficult to apply common troubleshooting practices or anticipate problems. Additionally, the County had to maintain a large inventory of spare parts not to mention O&M knowledge from the various lift station / pump manufacturers. The stations were also running into issues with manufacturers no longer being in business or producing parts for the pumping systems.

These lift station varieties ranged from underground dry-pit lift stations, submersible lift stations, above-grade vacuum-primed lift stations, and small grinder stations. Most pumps are vertical centrifugal solids-handling pumps, but the system also included grinder pumps.

Finally, the increased flows generated from population surges in the area were creating a large number of pump clogs that required pulling and unclogging pumps. Already these seasonal surges were taxing the capacity of the system because peak flow volumes suggested that the average EDU connection was well above the typical number of planned individuals living or staying in a given unit.

The nature of the area, recreational, is a significant factor in pump clogging. The staff have removed clothing, bed sheets, wire reinforced RV hoses, rope, and many other items from clogged pumps. The frequency of pump clogging and lack of a remote monitoring systems meant that the County's Sewer employees would spend time patrolling on busy weekends and holidays rather than enjoying them with their families.
These recurring operation and maintenance challenges prompted Fremont County to consult its

long-time engineering partner, Keller Associates, about possible solutions to improve their operational efficiency. In particular they sought to address six key areas of its lift station operation and maintenance needs: preventative maintenance, reduction of pump clogging, valve repair, electrical component failure, increasing pump capacity, and pump or station replacement and repair, which also meant lowering the stocking requirements for spare parts.

METHODOLOGY

Beginning in 2010, Keller and the County evaluated the attributes of lift station application within its network. They determined that the wide variety of stations could be reduced to three different classifications, tiered by the flow range of each station. The three tiers established are deemed as (1) Large regional/influent lift stations (2) Mid-range Lift Stations and (3) Household pumping systems. These classifications were based on the critical nature of the station, regional influence, horse-power size of the station, and depth of the station. By establishing three classifications (just three standard lift station designs) the goal of parts inventory reduction would be achievable in time.

For each lift station tier, a specific standardized design has started to develop. This design standard establishes a system design template, and specifies particular manufacturers exclusively able to supply for the designs as well as establishing critical features each station must have.

The first tier is large, regional pump stations that have buildings constructed over them, and their flow capacities vary. These stations have the unique criteria of requiring components that comply with hazard classification installations (Class 1, Div. 1). These stations will remain stations that utilize submersible pumps but the manufacturer is standardized to minimize parts inventory.

On the other end of the size spectrum, the third tier of lift station types comprises very small and in most cases shallow individual home or business lift stations. Here the County standardized on a single manufacturer and common design that can be installed using County staff resources. Several of these stations are located in travel ways necessitating equipment that is located below grade.

The overwhelming majority of the lift stations are classified in the second tier as "Mid-range". The design template calls for a packaged duplex, vacuum primed lift station that mounts at grade level over the wet well, like those manufactured by Smith & Loveless Inc. (Certain deep wet well depths could limit the vacuum primed approach so a contingency template is in place). These lift stations primarily collect from subdivisions and pump the wastewater to the larger regional/influent stations.

The design range for this tier, mid-range lift stations, is 75 gpm to several hundred gpm with the location criteria and depth also becoming determining factors. The County has found such benefit (staff safety, maintenance) to the above grade station approach that each site is evaluated for appropriateness of this application. Through operational experience specific nuances with above grade stations specific to Island Parks conditions have led to the development of site-specific features. These site-specific features and options include standard integral freeze protection components and anti-clog options like single-vane pump X-PELLER® pump impellers and RapidJack™ quick-access check valves. Freeze protection is particularly important given the

freezing temperatures that are experienced in Fremont County so redundant heating is included as well as a unique prime release that is connected to a winter/summer operation selection switch. Other built-in options include stainless steel components and baseplate, touch-screen controls and remote monitoring. A depiction of this design, known commercially as an EVERLAST™ Wet Well Mounted Pump Station is depicted in Figures 2 and 3.

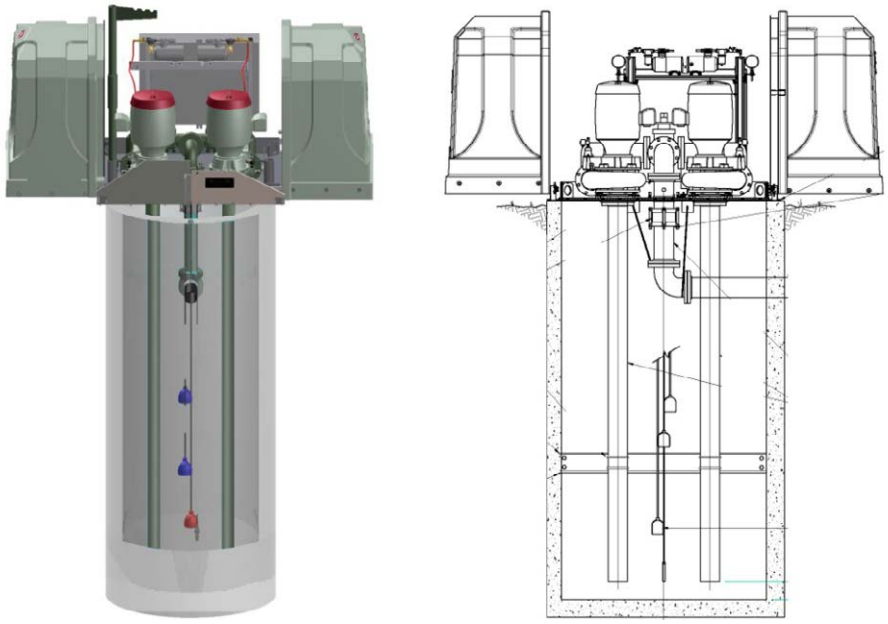


Figure 2: Mid-Range Lift Station Standard Template (Tier 2)

Figure 3: Installed Mid-Range Lift Station (Tier 2) at Grade Level

The selection of this particular lift station design addresses many of the operation and maintenance issues experienced by the County. First, the implementation of vacuum-primed pumps housed in a wet well mounted configuration means that maintenance access is immediate and safe at ground level, significantly reducing time and personnel required to perform regular inspection and maintenance. Confined space considerations are eliminated because wet well entry is not required to perform regular maintenance tasks, and the pumps can be pulled within a few minutes. A published comprehensive 12-year study has demonstrated that lift stations with vacuum primed pumps in this flow range will generally yield 50 percent less maintenance time, parts costs, and total O&M expense annually for periods of greater than 10 years versus a comparable submersible station.[1] Figure 4 demonstrates the published O&M cost differentials between these common types of lift stations.

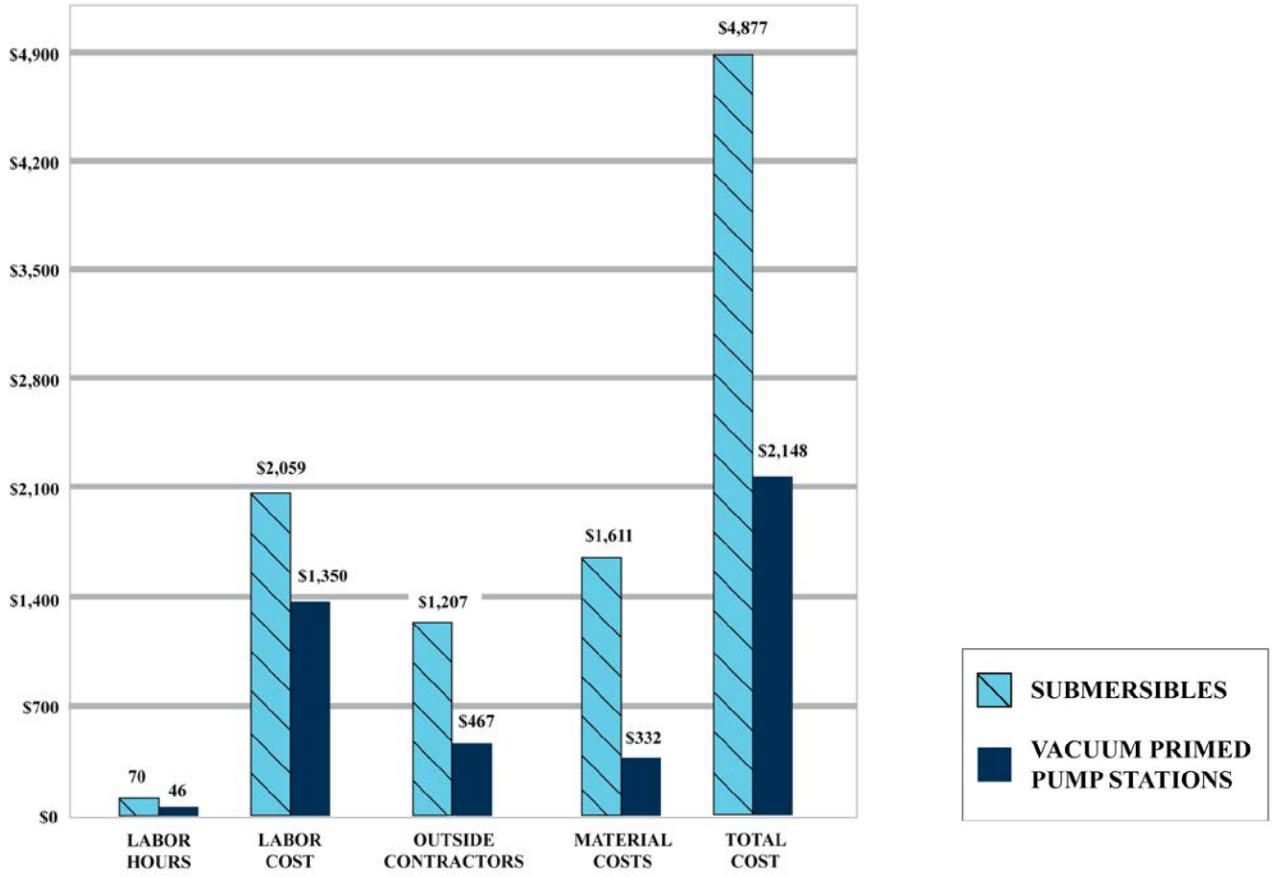


Figure 4: Annual Average of Cost of Lift Station Maintenance, By Type[2]

To address applications vulnerable to pump clogging, the tier 2 lift station design template calls for the optional selection of a specialized mono-port pump impeller and/or quick-access check valve designed to easily pass stringy and flushable material typical of today's national pump clogging epidemic. The impeller is customized for the application by the manufacturer while the

quick access check valve allows access inside the check in just a couple of minutes without ever having to pull apart the check valve. Therefore no specialized chopper pump is required for trash-heavy applications. Additionally, a simple text alert monitoring system can be selected for remote location stations for which the County technical staff can't reach as regularly.

When a need to replace or upgrade an existing lift station is realized, the streamlined lift station process begins with the County alerting its consulting partner, Keller Associates, which then undertakes a review of the lift station application's design and sizing. Plans and specifications are rapidly developed for the lift station based on the existing standards. Following the review of site specific design detail needs, such as freeze protection and pump clog prevention because of potentially heavy flushable and/or trash content, the developed plans and specifications are submitted to the Idaho Department of Environmental Quality (IDEQ) for review and approval to construct. After IDEQ approval, a bid package is released for station pricing by the standardized lift station vendor, and the quotation and submittal process begins.

Following the submittal phase, the packaged lift station is manufactured and shipped to the County. Once notified that the lift station is in transit, the County schedules its workforce to begin the demolition and replacement of any structural components that need to be replaced, i.e. wet wells, valve vaults, piping sections, etc. Because of significant snow fall during the winter and subsequent high ground water from snow melt in the spring and early summer, the County has found it easiest to construct the stations in the late summer and fall. By following this plan the County is able to install the new equipment without impacting the region during peak tourist season.

The County has preferred to install the packaged stations themselves. This construction approach gives its operators a strong head start into the future operation of the lift station. Operators develop a deep knowledge of how the station is assembled and how it operates through this installation method. Traditionally, a contractor would not receive the hands on training that comes with the commissioning and troubleshooting of a new piece of equipment.

Fremont County realized that this hands-on knowledge is invaluable and prefers that their lift station staff receive the manufacturer's training directly. While this approach initially requires additional County staff resources to handle installation, the costs are more than absorbed in other ways: reduced out-of-pocket expense for contractors and long-term gain in operation and maintenance costs because of the operators' increased ability to troubleshoot and anticipate problems before they become emergencies.

After moving through the design of the first lift station of this type, the County realized the benefits of the packaged lift station concept for site construction, namely self-performed installation. This self-performance approach was developed during three different installations; the first two were performed by contractors with county assistance, while the most recent was performed by County staff.

Figures 5 – 10 demonstrate the relative ease and short time frame required to install the vacuum primed station, which only takes a couple of hours once the site is ready.

Figure 5: Lift Station Arrives at Job Site with Lift Truck for Installation

Figure 6: Commencing to Install Suction Pipes

Figure 7: Completing Installation of Suction Pipes

Figure 8: Placing Lift Station over Wet Well

Figure 9: Awaiting Connection of Discharge

Figure 10: Installation Complete with Backfilling of Tied-In Force Main and Start-Up

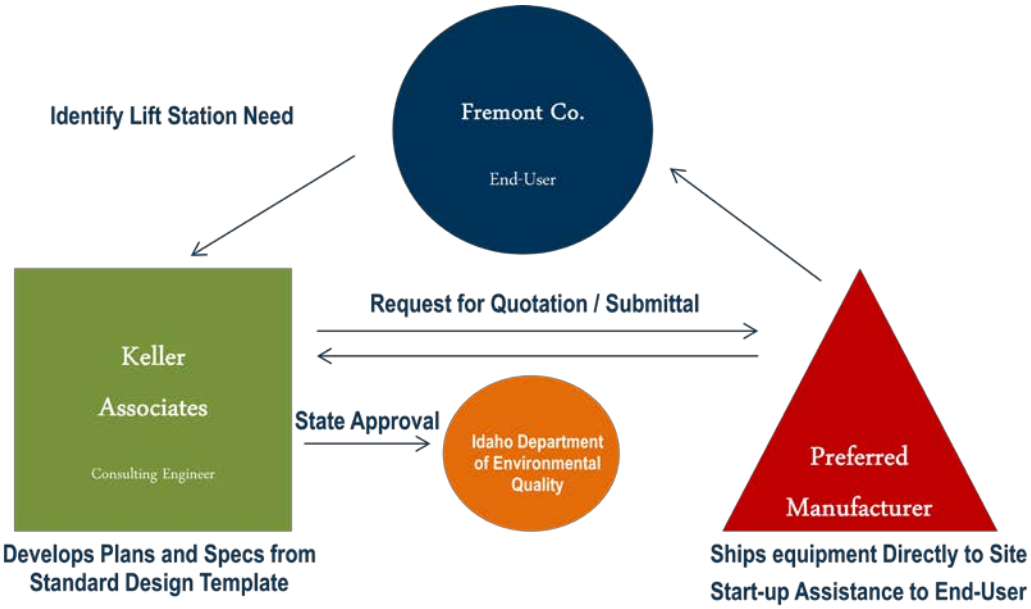
Because of the success of this approach with the second tier station, the County now applies this same approach to the third tier small individual residential stations as well.

CONCLUSION

Fremont Co., Idaho struggled for many years with challenging O&M for the lift stations in its Island Park wastewater system. The county partnered with consulting engineer Keller Associates to implement a Tiered Standardization Program, classifying all 47 lift stations and future stations

down to three general lift station types, each with a preferred manufacturer and base design template.

Establishing tiered standards eventually reduced the time the County needed to collaborate with its consulting engineer. Standard designs have accelerated State and local regulatory approval processes, while strengthening a relationship with the standardized vendor. Essentially, a symbiotic relationship is established by the necessary parties:



For the majority of its lift stations, the packaged wet well mounted pump station design and pre-purchase process yielded the ability to conduct all lift station installations with existing staff, improved staff knowledge of equipment, lowered overall O&M time and costs and reduced spare parts inventory. All of these results lead to improved operational efficiency and tremendous savings to the ultimate bottom-line.

ENDNOTES

[1] *"Tracking Pump Station Ownership Costs Generate Data for Optimum Asset Management", WEFTEC 2016, Alexander G. Tabb and Charles G. Miller, Smith & Loveless Inc.*