Extreme Lift Station Makeover: The Rehabilitation and Redesign of the Largest Wastewater Lift Station on Fort Bragg

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ABSTRACT

Fort Bragg, one of the largest and most well-known Army Posts in the nation, is home to more than 39,500 armed services personnel and their families and thousands more who work on the Installation. Located in four Counties (Cumberland, Hoke, Harnett and Moore), Fayetteville, and Spring Lake; the Installation is within the Sandhills region of North Carolina, encompassing more than 251 square miles. The water and sewer utilities on Fort Bragg are managed by Old North Utility Services (ONUS), a privately owned utility operator/management company.

In 2011, ONUS determined that the largest sewage lift station on the Installation, Lift Station #1 (LS1) was in dire need of review and some level of rehabilitation. LS#1 was originally a 40’ deep, dry pit/wet well configured lift station, with two wet wells, dual flow trains, 4 dry-shaft driven pumps, and a 16” force main carrying the wastewater more than 13,000LF. The original rated flow for the station is believed to be in the range of 14 MGD. URS was tasked with evaluating the condition of the total structural, hydraulic, mechanical, electrical, and I&C components of the station, with the goal of rehabilitating LS#1 for another 50-years of reliable, safe, and modern service to the Fort Bragg community.

The condition assessment concluded that LS1 was at the end of the station’s usable life, with most systems partially or fully failing to perform as intended. The grinder systems were completely in-operable and a source of constant leakage. Multiple valves and sluice gates were not functioning or leaking. The electrical and control system was less than what ONUS needed to safely and efficiently operate the station. However, the ray of sunshine was that the structural envelope to lift station was in relatively good condition.

The approach taken by the Design Team and Owner was to do a complete lift station renewal and redesign within the existing structure, or as the famous ABC TV Network show says, “Extreme [Lift Station] Makeover.”

This paper and presentation will highlight the many design and construction challenges, as well as the improvements necessary to modernize operation and maintenance of LS1 at Fort Bragg. Annual Conference attendees will benefit from a thoughtful and engaging look at this unique Rehabilitation and Re-Design of the Largest Wastewater Pump Station on Fort Bragg.
INTRODUCTION

American States Utility Services, Inc. (ASUS) and the United States of America (represented by the Defense Energy Support Center) entered into Contract No. SP0600-07-C-8258, under which ASUS was required to own, operate, maintain, repair, and improve the water distribution and wastewater collection systems at Fort Bragg, North Carolina. In connection with the execution of the prime contract, ASUS incorporated Old North Utility Services, Inc. (ONUS), a wholly owned North Carolina corporation, for the purpose of assuming all of the rights and obligations of ASUS under the prime contract. The US government subsequently approved the transfer. On March 1, 2008, ONUS acquired and initiated operation of water and wastewater systems at Fort Bragg (including Pope Air Force Base and Camp MacKall), North Carolina, pursuant to the terms of contract number SP0600-07-C-8258 with the US Government.

Fort Bragg is located in the Sandhills Region of the south-central portion of North Carolina, 10 miles northwest of downtown Fayetteville. The Fort Bragg complex, including Pope Air Force Base and Camp MacKall, encompasses over 160,000 acres, and extends across portions of four counties, Cumberland, Harnett, Hoke, and Moore. Camp MacKall consists of an airfield and training areas of 7,91d7 acres and is located about 0.6 miles west of Fort Bragg.

ONUS has contracted with the government as the exclusive owner and operator of the water distribution and wastewater collection systems. The Fort Bragg cantonment area and the Pope AFB water distribution system are supplied with water through an interconnection with Harnett County and the Public Works Commission for the City of Fayetteville (PWC), which is normally closed. Wastewater treatment is provided by Fort Bragg through a wastewater treatment plant with ultimate disposal via a surface discharge into the Little River.

Water for Camp MacKall is provided through an interconnection with the Town of Southern Pines. Wastewater treatment is provided by Moore County. While ONUS has the exclusive right to own and operate the water distribution and wastewater collection systems in the Cantonment Area, the Northern Training Area (NTA) water and wastewater utility systems are operated by Harnett County.

Ownership of the Fort Bragg Wastewater Treatment Plant and the Fort Bragg Water Treatment Plan remained with Fort Bragg because the plants are slated for decommissioning with the first three years of privatization of the water distribution and wastewater collection system. The Master Plan for Wastewater Treatment will be provided by Harnett County at a date in the near future.

ONUS’s contract with the government includes provisions for purchase, ownership, operation, renewals and renovations, initial capital upgrades and design and construction of water and sewer infrastructure for MILCON and OMA projects.

URS Corporation – North Carolina (URS) was retained by ONUS to complete preliminary engineering of lift stations 1 and 5 located at Fort Bragg Army Post, North Carolina. The preliminary engineering included site visit and evaluation of existing lift station structures and force main routes, development of rehabilitation or replacement alternatives for each lift station and force main, and preparation of a...
Preliminary Engineering Report (PER) with alternatives analysis and recommendations. Based on the recommendations, URS was to complete a design, acquire any necessary permits, assist in bidding, and provide construction administration services, including furnishing a resident project representative. The focus of this paper is Lift Station 1, the largest wastewater pump station on Fort Bragg.

Lift station 1 (LS1) (Building J-1824) is located off of Knox Road and is a dry pit/wet pit station. The lift station was constructed in 1993 to replace a previous station. This replacement station consisted of four, shaft driven centrifugal pumps, hydraulic grinders and check valves, and 14-inch suction and discharge headers. Two of the pumps were recently replaced (sometime in 2007) with Flygt dry pit submersibles. The remaining shaft driven pumps are inoperable.

LS1 is connected to the original force main (FM), believed to be a 16-inch, asbestos cement (AC) line. The force main appears to primarily follow the adjacent railroad tracks and discharges to a manhole within the Corregidor Courts military family housing (MFH) neighborhood.

**METHODOLOGY OF EVALUATION**

Flow enters LS1 through two 24-inch gravity sewers. Each gravity sewer was connected to one side of a split wet well. The wet well included three sluice gates that allowed each side of the wet well to be isolated. Wastewater is drawn through two in-line hydraulic grinders to a 14-inch suction header. The two suction lines from the wet well was isolated by knife gate valves on the pipelines from the wet well and a knife gate valve in the suction header. Each raw sewage pump was connected to the suction header by a 14-inch knife gate valve, a 14-inch flexible, single expansion joint, and a 14” x 12” eccentric reducer. Flow was discharged from each pump through a 10” x 8” concentric reducer, a 10-inch flexible, single expansion joint, a hydraulic check, a 10-inch knife gate valve, and a 14” x 10” concentric reducer connected to the discharge header. The 14-inch discharge header connected to a 14-inch force main which flowed upward to a surge relief valve and then a 16-inch x 14-inch reducer connecting to the 16-inch force main outside of LS1. The discharge header was isolated by a 14-inch knife gate valve. This knife gate valve is mounted approximately 8 feet above the finished floor and was operated from a temporary ladder in the dry pit.

Four raw sewage vertical dry pit centrifugal pumps were installed at the lowest level of the dry well. These pumps were connected by drive shafts of approximately 27 feet in length to motors mounted on the ground floor. Two of the shaft driven pumps were replaced with Flygt dry pit submersible pumps in 2007 according to ONUS. The dry pit submersibles are rated at 3,375 gallons per minute (gpm), 4.8 million gallons per day (mgd), at 134 feet of total dynamic head (ft TDH). The two shaft driven pumps were inoperable and were locked out. The hydraulic grinders were also inoperable. It should be noted that a preliminary hydraulic analysis of the lift station and force main indicates that flow would be limited to the 9 mgd to 10 mgd range. There appeared to be a discrepancy between the assumed design point of the pumps and theoretical flow capacity of the force main.

The hydraulic check valves were operable on the Flygt pumps, but ONUS personnel report that the hydraulics leak. Observations by URS personnel noted that many of the knife gate valves were leaking. The surge relief valve appeared to have been replaced recently. The sluice gates in the wet well were inoperable.

The dry pit included two sump pumps, one in the sump and another located on the floor. ONUS personnel reported that a problem recently occurred in LS1 resulting in approximately six feet of water in the dry pit,
damage to some equipment, and an intense maintenance activity. The floor in the dry pit had several inches of standing water, likely wastewater from the leaking valves.

The surge relief valve discharged to a pit outside of the building, and a connection is provided for temporary pumping.

The lift station site had sufficient space for any activity associated with the lift station, and a security fence is provided.

LS1 is an above ground concrete masonry control building and a below ground cast-in-place concrete structure constructed in 1993. A visual structural assessment of the lift station was conducted by URS on December 8, 2010. The structure dry well consisted of three below grade cast-in-place concrete stories that were 13'-0" high for a total below grade depth of 39'-0". The slabs are 10" thick, and a stairwell for all floors is located in the northeast corner of the building. The above grade story has concrete masonry walls (22 rows high) with steel bar joists (6 total) supporting stay-in-place metal forms. The roof was not inspected from above. The floor plan of each story is 32'-0" long x 26'-0" wide. A wet well was located to the west of the structure, and the inside of the wet well could not be accessed and was not evaluated during this assessment.

- **Ground Floor** - The ground floor had a 4'-3" wide x 11'-3" long hatch that was original to the building construction located near the center of the floor plan. A second hatch was saw cut through the concrete slab 1'-4" to the north of the original hatch, and its size is a 4'-0" wide x 7'-0" long. Reinforcing was visible at the edge of the saw cut, and appeared to be #6 bars spaced at 1'-0" in each direction. To the south of the original hatch were two 1'-3" diameter openings for drive shaft connections from the pumps at the basement level to the motors on the ground floor. The ground floor was equipped with a 2 ton monorail crane.
- **Level 2** - The floor below the ground floor (Level 2) has a 24'-0" long x 10'-0" wide opening in the center of the floor plan.
- **Level 3** - Level 3 (two floors below ground and one floor above the basement) has a 32'-0" long x 18'-0" opening on the west side of the floor.
- **Basement** - The basement contained four pumps and has 3'-0" wide x 3'-0"long x 2'-0" deep sump pit in the southwest corner. Two older pumps were on the south side of the basement, and they had drive shafts up to motors on the ground floor. Two newer submersible pumps were on the north side of the building.

The structure was in good condition. Most of the problems observed in the structure were related to the intrusion of ground water through the walls in the below grade portions of the structure. As previously discussed, it was the understanding of URS that the basement had up to six feet of water inside during a recent event. This flooding was likely caused by a breakdown in the sump pump system which has been remedied. Water was still coming in through the walls, however.

Efflorescence present on the inside surface of the concrete walls indicated the infiltration of water into the structure. As cracks developed in the structure, water flowed through the cracks and dissolved minerals present in the concrete. When the water reached the inside of the structure, it evaporated and deposited the minerals as efflorescence on the walls. This process caused a gradual structural degradation of the concrete and rust in the reinforcing steel. Efflorescence was observed around many of the utility conduits penetrating through the walls and at the ends of beams at connections to the walls. Three 10'-0" long horizontal and diagonal cracks with efflorescence were observed on the walls 12'-0" above the basement slab. Eight other patches of efflorescence were noted in the walls at the basement level, ranging in size.
from 1'-0" x 1'-6" up to 4'-0" x 3'-0". The efflorescence was measured up to 1-inch thick from the face of the wall.

At the sump pit, clear water was observed flowing into the pit through an opening in the wall.

The surface of the basement slab is weathered with exposed aggregate, and puddles were observed in various locations.

Due to the location of the ventilation equipment on top of the roof, an inspection was unable to be performed. Due to the age of the ventilation equipment, it is likely that the normal operating life had been reached, and replacement of the equipment was necessary. ONUS personnel have reported that leaks in the roofing system have been noticed, and the roof replacement was necessary.

The main door was replaced when the monorail system was modified, and was good condition. The monorail appeared to be in good condition.

Electrical Power and supervisory control and data acquisition (SCADA) equipment were located on the grade level of LS1. The station power distribution equipment appeared code compliant and showed minor signs of corrosion. The pumps were controlled by motor control center mounted starters. The starters appeared to be two speed starters or partial winding starters, but this could not be verified at the time of visual assessment. Two of the four starters were locked out of service. There is a SCADA panel that appeared to be less than 10 years old. This panel contained a micro-programmable logic controller (PLC) and data radio. There was a Yagi directional SCADA antenna mounted on a mast pipe attached to the station structure. This antenna appeared to be 10’ above the roof of the station building.

It was recommended to retain the existing structure and rehabilitate the equipment and piping. ONUS personnel desired to match the replacement of the shaft driven pumps with dry pit submersible pumps like the recent replacement of the other two pumps. With these two conditions, alternatives available for rehabilitation of LS1 were limited. The alternatives for rehabilitation involved the timing and the extent of the rehabilitation. The discussion below will provide information on the various items to be considered for rehabilitation.

- **Pumping Equipment** – The limited information available seemed to indicate a somewhat lower pump capacity than that claimed by Flygt, but since these pumps seem to be providing the capacity needed, the replacement pumps will match these two newer pumps. Since the shaft driven pumps are inoperable, they were replaced with the same dry pit submersible pumps as recently installed. These pumps are Flygt dry pit submersibles, model No. C3231/665, rated at 3,375 gpm and 134’TDH.

- **Valving** – Many of the knife gate valves were leaking and were replaced. The hydraulic check valves for the inoperable pumps were replaced. ONUS personnel desired to replace the hydraulic check valves with a less maintenance intensive system. Electrically operated check valves were considered as an alternative.

- **Sluice Gates** – The sluice gates were replaced to allow of isolation of the two different sections of the wet well. or an alternate method of providing separation needs to be provided.

- **Grinders** – The hydraulic grinders were removed. Grinders were installed in manholes outside of the station to provide grinding of the wastewater to protect pumping equipment. The sluice gates were removed, and plug valves installed external to the wet well to isolate the two chambers. It should be noted that LS1 had been operating without the grinders for some time, and serious problems have not occurred.
- Ventilation System – Replace the ventilation system with more ductwork to better distribute fresh air and provide the necessary air changes, and include new handrail on roof to comply with code.
- Roofing System – Replace the roofing system in kind.

Structural recommendations are as follows:
- The inside walls of the structure were cleaned of efflorescence.
- The cracks and openings in the structure were injected with epoxy grout to prevent the infiltration of water through the walls.
- A topping was placed on the basement slab to provide positive drainage to the sump.
- The structural steel remaining in place was cleaned and painted.
- The ductile iron pipe remaining in place was cleaned and painted.

LS1 remained operational during construction. There were periods of construction when complete station shut downs were required. These shutdowns were minimized as much as possible. Bypass pumping were required during these outages. Electrical/Instrumentation equipment and work proposed is as follows:

1. Replace automatic transfer switch and power service entrance with a new automatic transfer switch and main service disconnect. Status and alarms from automatic transfer switch were tied to SCADA system for monitoring with programmable timers.
2. Replace motor control center with new motor control center. Pump controllers were variable speed frequency drives. Status and manual override control of pump starters were tied into SCADA system.
3. Replace power distribution equipment; power distribution panel, step down transformer, lighting panel board.
4. Replace interior and exterior lighting. New interior lights low pressure sodium light fixtures. Lighting design will provide 30 foot candles of light to facilitate operations and maintenance.
5. Add new exit and emergency egress lighting. New emergency lights were battery backup to provide lighting for egress from the building if the generator fails to start. Exit lighting was LED low power with battery backup. Exit lighting provided per code requirements.
6. ONUS SCADA contractor provided and programmed SCADA panel. URS worked closely with ONUS SCADA contractor, during design, to determine exact needs for SCADA work. URS proposed that electrical contractor will install wire and conduit from equipment and instruments to location of new SCADA panel. ONUS SCADA contractor tested wiring or observed as electrical contractor performed testing. ONUS SCADA contractor made all final terminations at SCADA panel.
7. Provide new wet well level sensor. URS proposed a new radar level sensor at the wet well. Radar level sensor has all hardware mounted at top slab of wet well. This reduced required maintenance of level sensing.
8. Provide new wet well float backup level sensing system. URS proposed a backup level sensing system consisting of floats. This system can be activated automatically or manually at ONUS’s discretion. The manual activation of the backup level sensing is available locally at the station or across the SCADA radio.
9. Provide miscellaneous instrumentation per ONUS direction. Miscellaneous included pressure sensing of the force main, dry pit leak detection, intrusion alarm for station, valve actuation and status, HVAC monitoring and control, etc.
10. Provide miscellaneous power connections to station equipment. Miscellaneous power connections included HVAC equipment, receptacles, lights, control panels, etc.
RESULTS

Overall structural condition of LS1 was good, and allowed for the continued use of the structure for many years as a lift station. Two of the pumps in LS1 were inoperable. Both the grinders were inoperable; much of the valving was leaking, or in the case of the sluice gates, inoperable; the hydraulic check valve system leaked; the heating and ventilating system was at the end of service life; and portions of the electrical system were experiencing corrosion. LS1 can be rehabilitated to provide many years of dependable service.

LS1 rehabilitation was recommended to include the following:

- Replace inoperable pumps with two, new dry-pit submersibles matching the pumps installed in 2007.
- Remove two in-line grinders, and replace with wall mount grinders in wet well.
- Replace knife gate valves.
- Replace hydraulically operated check valves with electrically operated check valves.
- Replace sluice gates in wet well to provide for isolating sections of wet well.
- Repair leak in sump.
- Install topping on dry pit floor to provide positive drainage and resolve standing water.
- Waterproof the structure.
- Clean walls.
- Replace heating and ventilating equipment.
- Replace roof.
- Replace electrical and instrumentation components.
- Add a magnetic flowmeter.
- Clean and paint exposed steel and DIP.
- Remove unused pipe hangers and patch resulting holes in walls.

Subsequent discussions with ONUS resulted in one of the proposed dry-pit submersibles replaced with a diesel powered above grade self-priming centrifugal pump nominally rated at 3,375 gpm. Self-priming pump varied in capacity from 2,400 gpm to 4,500 gpm, depending upon suction lift and total dynamic head. The decision to substitute the diesel powered pump was the result of numerous instances of shut downs of the station for various maintenance activities that required the rental of bypass pumps. The proposed diesel powered pump is tied into the electrical system of the station and will operate off of signals from level measurement in the wet wells. However, the diesel powered pump can also be operated independent of the LS1 electrical and instrumentation controls during an emergency event. The suction piping is separate from the remaining pumps at the station and the discharge piping is also separate and ties into Force Main 1 outside of the structure. The suction pipe is installed with separate piping to each of the dual wet wells.

It was determined that the existing roof and wall structure could not support new HVAC equipment that was required to meet new codes. Structural reinforcement was added to the roof trusses and the concrete block wall cavities were filled with structural concrete. The provided the necessary additional structural requirements to support the roof mounted HVAC equipment.

Subsequent discussions also proposed that a new roadway be installed to allow complete drive through of vehicles. This facilitates the delivery of fuel oil for the diesel powered pump and the emergency generator.
ONUS concluded to not replace the standby generator at this time as the engine, generator, and fuel oil storage tank was reasonably good shape.

Odor control was not installed, and ONUS concluded to not install odor control on the completed facilities as the station is in a remote location and no odor complaints have ever been recorded for this station.

It should be noted that permitting was not required from NCDENR on the replacement of items in LS1, as the station capacity remained the same from the original design through the replacement of the four shaft driven vertical dry pit pumps by three dry-pit submersibles and one diesel powered self-priming centrifugal pumps. All work was considered maintenance since replacement was generally in kind and in the same location. Additional redundancy in the control system was provided, but was not considered significant. The project was discussed with NCDENR to confirm the maintenance view of the proposed work.

Rehabilitation of LS1 was phased at direction of ONUS. Force Main 1 was installed first. Then, Force Main 1 was tied into the LS1 structure along with a portion of the discharge line for the diesel powered pump. This work also included the construction of the vault for the new magnetic flowmeter. Next, the replacement of the electrical and instrumentation and control systems occurred. This included replacement of starters, controls, interior lights, conduits, wiring, and other miscellaneous electrical items. The final phase is the replacement of the remaining pumps, grinders, piping, valving, sluice gates, sump pump, HVAC equipment and duct work, roofing, and lighting panel. The final phase also included the repair of leaks in walls, cleaning of walls and floors, patching of walls and floors, coating of all metals and walls, and the installation of the magnetic flowmeter. It should be noted that where possible the knife gates were replaced with conventional plug valves. The final phase also included the addition of the diesel powered pump, the new roadway, and relocation of some fencing.

At the time of the preparation of this paper, the first three phases have been completed, including the construction of Force Main 1, the tie-in of Force Main 1 to the existing structure, including the vault for the magnetic flowmeter, and the replacement of the electrical and instrumentation and controls systems. The final phase has been designed, and construction is anticipated in the near future.

DISCUSSION

The requirement to preserve the existing LS1 structure, but demolish all internal and some external components and replace in kind is an extreme makeover for a major pump station.

There were many items in the original design that were questionable and led to major maintenance issues. These maintenance issues and problems with the station were highlighted when ONUS assumed ownership and operation from the US Department of Defense. LS1 had major pieces of equipment that were inoperable, piping and valving was experiencing significant leaks. LS1 had ceased operation during events of power outages and equipment failures. This included the flooding of the dry pit by wastewater from the leaking valving and groundwater from leaking walls. The roof was leaking onto electrical equipment. Instrumentation and controls were not always dependable, and much of the equipment was antiquated by today's standards. Although HVAC equipment was operating, the equipment had reached the end of its normal service life. Access to site for delivery trucks for fuel oil was difficult.

In addition, the lift station had to be operable and maintainable for 50 years according to contract requirements between ONUS and Defense Energy Support Center. A major renovation of LS1 was
necessary if LS1 was to continue to provide dependable pumping of raw wastewater for the operations of Ft. Bragg.

This major renovation had several challenges and issues to be successful. These included the following:

- Keeping LS1 in operation during all construction activities.
- The poor condition of all equipment, piping, valving, electrical, etc.
- Fitting equipment into the envelope of the existing building.
- Performing construction activities within a small interior building with major equipment, piping, and valves.
- Complying with new code requirements.
- Record drawings were not available for any portion of the installation. This lack of information was especially acute with regard to the determining structural loadings for floors and roof.
- Shop drawings were not available for any portion of the installation.
- Flow metering data was not available.
- Working with the confines of a major military installation with security requirements.
- Providing a safe working environment for ONUS personnel.
- Complying with requests of ONUS operation and maintenance personnel.
- Changing project requirements.

Keeping LS1 in operation is a major issue due to the size of the station. The lack of flow meter information contributed to this challenge as the amount of flow that was required to be pumped was uncertain. This was overcome by timing the pumps and noting how many of the pumps would operate at one time. During monitoring of the pumps, it was observed that only one pump ever operated. Using this as a guideline, it was determined how much capacity of temporary pumping was necessary.

Due to the poor condition of equipment and facilities, items failed during the evaluation and design of LS1. This necessitated that ONUS purchase equipment and make repairs. This caused the project scope to be in a state of flux with constantly changing requirements.

Working at a major military installation requires that planning occur to overcome the time delays of accessing the base through security, and restricts the amount of information that can be shared such as pictures.

Selection of alternatives and approaches were limited due to the need to fit into the existing building. Because of the major structure costs and the good to excellent condition of the building, ONUS wanted all of its goals for the project to be fulfilled within limited space. Compromises were made in what was proposed to accommodate the space requirements. One example is the substitution of knife gate valves with plug valves. Not all knife gate valves could be replaced with plug valve due to lack of space. Another example was the location of new grinders. The new grinders were designed to be installed outside of the building, originally in the wet well, but finally in manhole structures.

URS along with ONUS was able to overcome all of these challenges and issues to design and construct a completely new pump station within the confines of the existing building and structure that resolved all of the previous shortcomings of the original design and construction. The new remodeled LS1 will provide a dependable pump station into the foreseeable future. It will be safe, easy to operate and maintain. Operating and maintenance personnel will be able to take pride in the facility, and will not be hesitant about working in or around the station.
CONCLUSIONS

LS1 was in poor shape when the project began, but was required to be improved to provide dependable raw wastewater pumping service for the next 50 years. This could only be accomplished by an extreme makeover of the pump station by demolishing all of the interior facilities and replacing them with new and improved equipment, piping, valving, sluice gates, sump pump, electrical, instrumentation and controls, HVAC, and roofing. Superficial work was also necessary to repair walls, floors, and coat all metals and walls.

The capacity of LS1 was maintained by replacing four shaft driven vertical raw sewage centrifugal pumps with three dry-pit submersibles and one above grade self-priming centrifugal pump. This approach provides for more flexibility and dependability during emergencies and any major maintenance activities requiring the shutdown of the interior portion of the station. This flexibility is increased through the continued use of the dual wet wells, which can be isolated. The new grinders were sized to accommodate the total flow, thereby also increasing the flexibility and reliability of the station.

Knife gate valves were replaced wherever possible with plug valves to reduce future maintenance and possible leakage problems.

Project phasing was accomplished to accommodate changing project scope requirements as some portions of the station experienced operating problems and premature failure of systems.

The project team from URS and ONUS experienced many challenges and issues to perform the extreme makeover, but with teamwork all of these were overcome. ONUS will have a pump station that provides them with the facilities that meets the requirements of their contract with the federal government, and ONUS personnel can take pride in. The rehabilitation and redesign of Lift Station 1, the largest on Fort Bragg, is an extreme makeover.