Old Fort Lewis Campus
Infrastructure Assessment and Report

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APRIL 25, 2011

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EXECUTIVE SUMMARY

There has been a feasibility committee established to review the future role of the Old Fort Lewis Campus to determine what potential uses the campus might have to work with Fort Lewis College, their programs and the needs of the local community.

The scope of this project is to assess the status of the existing infrastructure related to the water, sewer and gas services presently servicing the Old Fort Lewis Campus. The property is under the ownership of the Colorado State Land Board and operations have been transferred to the Fort Lewis College physical plant department. Previously, the campus operations fell under the Colorado State University system.

Future and existing uses will influence the infrastructure required to serve the campus. This report addresses the status of the existing infrastructure and the regulatory requirements governing the use of these facilities based upon the local, state and federal codes.

As the feasibility of the campus is determined, this assessment provides a tool for the College to plan for potential improvements necessary for the infrastructure to serve the goals as determined by the feasibility committee.

PROJECT OVERIEW

The Old Fort Lewis Campus has been in existence since the late 1800's. The property was originally the Fort Lewis Army post and the Federal Fort Lewis Indian Boarding School in the early 1900's. In the early 1900's the land ownership was transferred from the federal government to the State of Colorado. This property contains in excess of 6,300 acres located in the La Plata River valley south of Hesperus, Colorado. The campus evolved in the early 1900's to become the Fort Lewis Junior College until the existing location for Fort Lewis College moved to the mesa above Durango in the mid 1950's.

The majority of the present infrastructure appears to have been constructed in the mid 1940's through the 1960's. The last major utility infrastructure improvements were installed 1976 through 1984. This last sequence of infrastructure improvements involved a wastewater treatment lagoon, sewer mains, gas mains and separate irrigation and potable water mains. Upon completion of these improvements, only minimal maintenance was provided.

A site visit on February 7, 2011 was performed with the previous facility manager, Tom Campion, Chris Christensen of Fort Lewis College and Bruce Honisch of Goff Engineering & Surveying, Inc. The site visit was to review the available plans and determine if the plans depicted what was actually constructed. Since Mr. Campion had a long tenure of service at the campus, his memory of the system improvements has been extremely beneficial. He was present for the major utility installation work in the 1980's, but not for the sewer treatment system and sewer main installation. In addition, his history of the water collection, treatment and delivery

system to the campus is not available on any maps, but summarized following in the appropriate sections.

This report intends to serve as a guide for Fort Lewis College to assess the current infrastructure, prepare for future growth, maintain existing infrastructure and inform of potential deficiencies based upon age, use and current codes and regulations. Future desired uses for the campus will have an impact on what infrastructure improvements are warranted.

- **Base Map**

A project base map has been compiled to put the available water, sewer and gas utility information onto one master plan utilizing the La Plata County aerial mapping for the background image. This mapping includes aerial photographs, topography and structure features. This map provides a tool to assist in development of infrastructure maintenance and improvements warranted to meet the present and future needs for the Old Fort Lewis campus.

- **Goal**

The goal is to evaluate the campus infrastructure, collect field data, compile existing infrastructure components and analyze this infrastructure to determine the existing and future needs and deficiencies. The focus areas covered in this document are:

- Water Transmission and Distribution – potable and irrigation
- Water Storage, Metering and Treatment
- Wastewater Collection
- Wastewater Treatment
- Natural Gas Distribution System

- **Capital Improvements**

Deficiencies related to current regulations and deferred maintenance is listed. No capital improvements plan and or associated cost and period are included. This is beyond the current project scope, although this report will be the base for any intended capital improvement program planned for the campus.

REGULATORY REQUIREMENTS

Local, State and Federal Regulations

These regulations pertain to work within La Plata County, the State of Colorado and as required by the Federal government.

Operation and maintenance of the water, sanitary sewer and gas infrastructure is governed by various local, state and federal regulations, Based upon the current and intended uses for the Old Fort Lewis campus these regulations may or may not be in compliance.

Presently, it is our understanding that three residences are occupied (with only three people) and some daily use of the campus for the livestock facilities, shop, helicopter service personnel and the Fort Lewis Mesa Fire District station annex.

It has not been determined if Fort Lewis College holds any type of classes on the campus requiring campus services. An observatory exits on the campus used by students, but other uses have not been identified.

Thus at this time, the current number of people utilizing the facilities would not fall under the requirements for a community water system and waste water treatment facility governed by the State of Colorado Department of Public Health and Environment. The gas system is a private system (State owned), and was installed to codes applicable when installed in the early 1980's.

Since the campus is intended to be utilized for college activities and community events (public use), it is prudent to determine compliance with the following codes and regulations:

- San Juan Basin Health Department (SJBHD) – governs on-site sewage disposal systems for flows less than 2,000 gallons per day. They regulate systems within La Plata and Archuleta Counties.
- Colorado Department of Water Resources (CDWR) – governs the legal use of surface and ground water tributary to the waters of the State of Colorado. The legal rights associated with the various wells, ditches, springs, infiltration galleries is not a part of this scope, although Goff has reviewed the information pertaining to the campus on the Colorado Department of Water Resources decision support system data base. It is our understanding from our meeting with Tom Campion and the Fort Lewis College physical plant personnel that the campus owns senior water rights with the legal ability to the water. It is suggested that in the future a summary of the water rights associated with the campus be cataloged for irrigation, piscatorial, domestic and commercial uses.
- Colorado Department of Public Health and Environment (CDPHE) - this department has the responsibility to review, permit, monitor and enforce the regulations of the State of the Colorado and the regulations of the U.S. Environmental Protection Agency (EPA). The Water Quality Control Division governs Wastewater and Water Systems, specifically:
    - Sewer Collection systems – regulates size and type of pipe, minimum and maximum slopes, infiltration/exfiltration quantities.
    - Sewer Treatment systems – regulates all systems in excess of 2,000 gallons per day capacity. This includes approval of the site application process, location of systems, design standards, pump stations, treatment methods, monitoring requirements, permitting.
    - Wastewater Preliminary Effluent Limits – the division provides the discharge requirements to surface waters and ground water for all permitted systems. The permit limits are based upon the system design flow, the receiving watercourse, and the ability to assimilate the waste stream.
    - Wastewater Discharge Permits – discharge permits complying with the National Permit Discharge Elimination System (NPDES) are required for any system that discharges effluent to state waters.
    - Wastewater Non-Discharging sewer systems – systems are required to be analyzed to confirm the mass balance of inflow / evaporation / precipitation is provided. Performance parameters for liner permeability are a key component as well.

  - Community Water Systems – the CDPHE classifies community water systems based upon number of taps and population density. Systems that fall under this category are systems that generally contain 15 taps and/or 25 people utilizing the water system.
  - Water systems under the CDPHE regulations are classified as public water systems, community systems, non-transient community systems and transient community systems.
  - Water systems – all systems governed by the CDPHE require disinfection to be provided and chlorine residual present at the furthest points in the system's distribution mains. Treatment beyond chlorination only is based upon influent water quality, and what additional treatment is necessary to meet current regulations. All surface water and ground water under the influence of surface water requires direct filtration in addition to disinfection and other potential types of treatment.
  - Future long-term water quality standards have been identified by the CDPHE with the pending regulations requiring compliance by 2014.
- Colorado Public Utilities Commission (PUC) works closely with the trade organizations representing the pipeline industry and other State and Federal Agencies to carry out its mission of public safety. The PUC enforces the state's gas pipeline safety regulations.
- U.S. DOT, Pipeline and Hazardous Materials Safety Administration (OPS) regulate how natural gas pipelines are to be designed, operated and maintained. The Colorado PUC has an agreement with the OPS regarding inspection and monitoring activities.

Codes and Laws

Listed below are 'Codes and Laws' generally in use by Fort Lewis College for all work at their campus. This list should be included for any work involved at the Old Fort Lewis Campus as well for consistency.

All infrastructure improvements should be governed at all times by applicable provisions of the Federal Law(s), including but not limited to, the latest amendments of the following:

- Williams - Steigler Occupational Safety and Health Act of 1970, Public Law 91-596
- Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations
- Part 1518 - Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations
- Americans with Disabilities Act (ADA) Appendix B - 28 CFR Part 36
- International Building Code, latest edition
- International Plumbing Code, latest edition
- International Mechanical Code, latest edition
- International Fire Code, latest edition
- National Electric Code of the NFPA, latest edition
- National Board of Fire Underwriters, latest edition
- NFPA - latest edition

Standards

The following Standards should be included for all improvements to the Old Fort Lewis Campus. These are generally in use by Fort Lewis College for all work at their campus.

- American Concrete Institute Guide for Concrete Floor and Slab Construction, ACI-302, latest edition
- American Institute of Steel Construction, latest edition
- American Society for Testing and Materials, latest edition
- American Standards for Nursery Stock, current edition
- American Welding Society, latest edition
- Associated Landscape Contractors of Colorado Specifications, 1991 edition
- Fort Lewis College "Minimum Standards for Landscape Irrigation", latest edition
- Fort Lewis College "Sitework Construction Standards Manual", latest edition
- Manual on Uniform Traffic Control Devices (MUTCD), latest edition
- State of Colorado Department of Transportation Standard Specifications for Road & Bridge Construction, latest edition

Additional Standards

- Atmos Gas is the natural gas provider to the campus. Any special requirements they have should be included.
- Fort Lewis Mesa Fire Protection District is the fire district providing service to the campus. Any special requirements they have should be included. They do have a station located on the property, which greatly enhances response time in case of an emergency.
- The American Water Works Association (AWWA) has developed numerous standards related to water infrastructure. The standards address the infrastructure pipelines, disinfection, storage, materials and installation.
- The Water Environment Federation (WEF) has standards related primarily to treatment of wastewater. The federation is useful for additional information to assist in treatment of wastewater for the benefit of the public.

WASTEWATER COLLECTION SYSTEM

The current wastewater collection system was last upgraded in the late 1970's and early 1980's. Previously, the original community collection system had been installed in the 1940's to 1950's.

The original collection system generally included clay sewer mains and manholes constructed of brick with a a cast in place concrete manhole base. It appears from archive drawings that the sewage flows went to some type of septic system which has been abandoned. For the latest improvements, the sewer mains were constructed of plastic pipes (polyvinyl chloride pipe) and precast manholes set on cast in place manhole bases. A new sewer treatment lagoon system was also installed at this time.

The types of materials utilized between these two eras are quite different, although some of the older pipeline materials may be equal in condition with the newer materials if the original oakum and grout packing for pipe joints has not been compromised by tree root degradation. The new pipes installed have gasketed joints which greatly provides for a sealed system that can handle infiltration/exfiltration exceedingly well. Older manholes may have infiltration issues during periods of excessive rainfall and/or high groundwater levels.

Based upon review of the improvement plans, most active sewer mains appears to have been reconstructed during the last major improvements around 1977. The installed pipe sizes are 8 inch with 48 inch diameter concrete manholes. Future field inspection will ascertain if this is correct.

Sewer mains installed are all a minimum of 8 inch (assumed) in size with minimum/maximum installed slopes that meet current regulations. This is based upon review of the existing sewer plan and profile plans obtained from the campus archives, including 'as constructed' plans. Ultimate capacity of the sewer mains are based upon the installed grades with typical flow depths to be less than half full and peak flow to be aprroximately 2/3's to 3/4 of total pipe depth. Since peak flows would be higher than average flows due to the lower population density, peak flows amounts can be based upon a pipe 3/4 full. With only three residences currently on the system full time, flows are minimal.

Since the latest improvements were installed in the early 1980's, only very minor repairs and/or maintenance on the sanitary sewer system has been warranted. One manhole frame and cover was impacted during snow removal operations and once a service line became plugged with hay in the barn area. Besides these occurrences, no other system maintenance was performed based upon conversations with the previous facility manager. Additionally, is was reported to Goff that the northern half of the campus does experience high seasonal high ground water levels. Due to this information, verification of potential groundwater inflow through pipe joint and manhole seams is extremely important. An infiltration and inflow study is recommended during the seasonal high groundwater period.

An hydraulic analysis of the existing system has been prepared to determine system capacity. The capacity is:

> Average daily flow capacity in pipe system at critical slopes = 269 gpm.
> Peak flow capacity at critical slopes = 471 gpm. (assume peak flow factor = 5)

This amount of flow compares to an equivalent number of single family residences in excess of 500 units or for commercial/institutional buildings approximately 675,000 square feet of gross building area (based on 0.2 gpd/sq.ft. area). Thus it can be shown that the existing system has capacity for future growth so long as future inspections determine the lines to be in reasonable condition.

WASTEWATER TREATMENT

The current wastewater treatment system was designed in 1976 and constructed in 1977. This system was designed to perform as a non-discharging faculative lagoon system sized to provide a mass balance of sewage inflow to evaportion, including incidental precipitation. The inflow

average design volume has not been determined and the original calculations are not available. They may be available at the CDPHE, but this has not been determined. The construction appears to match the design drawings based upon field observations and comparision with the documents of record.

It is apparent the treatment system was designed for flows well in excess of what has existed since the facility was completed. The system was designed with a clay soil liner to contain the sewage effluent and provide a seal between the wastewater lagoon system and the underlying granular soils. However, over the years, the previous facility manager, Tom Campion, has informed us that the system has failed to maintain a reasonable liquid volume as purportedly designed. Additional water has been transferred to the lagoon system on occassions to attempt to fill the lagoon to a desired design level. This has been unattainble as reported by Mr. Campion.

During the current site visit, an existing culvert diverts ditch water into the lagoon in addition to the sewage flow. Based upon our observations, the system holds relatively little water thus confirming the comments from Mr. Campion about the liner integrity.

For any sewage system constructed under the requirements of the CDPHE, a liner must demonstrate the ability to have a permeability of less than 1/32 inch per day. This system cannot meet this requirement as presently constructed.

With flows being less than 2000 gallons per day, the current system would fall under the local San Juan Basin Health Department regulations and not the rules of the Colorado Department of Public Helath and Envirionment.

Remedial work is recommended for the wastewater treatment system to comply with the current regulations of the health department having current jurisdiction. It appears this system initally was sized to be a system regulated by the CDPHE. No discharge monitoring report would have been required since it was designed as an evaporation type of facility. To date no data is available to determine if the system is currently listed with the CDPHE.

Wastewater Facility – Note Culvert in foreground diverting irrigation water into lagoon.

Sewer outfall pipe beyond
Concrete catwalk support
in area of cattails.

POTABLE WATER SYSTEM

Potable Water Collection System

Presently, the existing number of taps and transients users would place the exisiting system as a non-community system since only three homes are occupied with a few visitors occassionally using the potable water system. It is apparent that the water collection system is a shallow infiltration gallery type of system that would be classified as ground water under the influence of surface water. Due to this fact, filtration and disinfection are recommended for the safety of the people using the potable water. Filtration and disinfection are required if this system is classified as a community water system.

During the site visit, the chlorination system was turned off and the solution tank was empty and the suction line was not even installed in the solution tank. Due to the limited water usage, the water will remain in the cistern for quite a period of time and could stagnate. The float valve to control the level of water in the system was malfunctioning with the system valve submerged.

In all probability, if a water test was performed, pathogens would be present in the water. The source water is shallow and subject to comtamination from wildlife and livestock. At a mimimum, the chlorination system should be placed back into service and the float valve on the cistern repaired to function as designed. The entire water system should be dosed with a high level of chlorine (25 ppm minimum for 24 hours). The system should then be thoroughly flushed and there needs to be a reasonable chlorine residual in the system (0.5 to 1.0 ppm). Water samples should be obtained and tested to ensure successful disinfection. The present users should be notified that the water is not deemed safe and a boil water order should be implemented immediately.

Prior to use by the College or the community regardless of the number of people, the system should be placed into compliance with the requirements of the CDPHE for a community water system (transient, non-community system). It was previously stated that vermin have been found in the cistern. This definitely suggests the requirement for proper disinfection and treatment.

Location of spring collection access at Edge of trees. Collection system follows draw for a few hundred feet with collection pipe and upper manhole. Total length of collection system unknown.

Clearwell with pump float well submerged.

Pump house w/ pressure tank, plumbing controls, chlorination system, pressure pumps in pit, with cistern adjacent to building.

Chlorination system in pump house. Note the system was disconnected and in need of repair.

Pump house pumps – one operating, one standby with alternating sequence. This is located in pit below the pressure tank system.

Pressure tank assembly with pressure switch and sight gauge.

Potable Water Distribution System

The potable water distribution system is pressurized at the water pump house via an hydropneumatic tank system to maintain pressures within the 40 to 60 psi range for the campus buildings. This pressure is standard and normal for 'in house' use. All irrigation water outside the buildings is via a separate irrigation system as noted below.

The combined irrigation/potable system was split into separate systems during the major infrastructure improvements installed in 1984. A new potable distribution system was installed to serve the existing residential units, library, barns and other service buildings requiring water service. The installed pipes are 4 inch ductile iron pipe. Service line size to the buildings were typically specified as 3/4 inch in size. The library service tap was stated to be 2 inch. Most of the older pipe has been abandoned (disconnected) and assumed remains buried in place. The main pipe line to the campus from the pump house is assumed to be 6 inch in size (part of the previous system), but the pipe type is undetermined at this time.

The pressurized system has functioned properly, with frequent cycling not mentioned during the site visit. This would confirm that the existing system is sound and without any major leakage issues. The installed system appears appropriate for the exisitng campus based upon domestic use with 'in house' service only. Any new pipe installations should be a minimum of 6 inch in size. The 4 inch size is not readily produced as much today and in fact, the cost for the 6 inch pipe is generally cheaper or equivalent to the smaller pipe size. Additionally, the flow capacity is approximatley twice the volume of the 4 inch size, providing better service for no increase in cost.

IRRIGATION WATER SYSTEM & FIRE PROTECTION

The irrigation water system as a 'stand alone' separate system was installed in 1983-1984. This separate system is served by the upper water storage reservoir located at the north end of the property. Refer to Figure 1 for the location of the storage reservoir. The system is gravity flow with static pressure on campus in the range of 55 to 80 psi. This pressure is sufficient for irrigation via yard hydrants which have been installed throughout the campus during the construction in 1984. How the water enters the pipe system is undetermined as well as what, if any screening exists at the pipeline intake.

The installed system also provides the addition of fire hydrants to serve the campus. This is the only nearby source of water on site for fire protection services. Pumper trucks can transport water from the river or other ponds/reservoirs near the campus, if required. This method of transporting water is common for the fire district since they are a rural district without the availablity of central water systems and numerous fire hydrants.

With this being the sole source for the fire protection system, an hydraulic model was prepared to determine what fire flows and pressure would be possible with the existing system. The software used to analyze this system is via the Water Cad software by Haestad Methods. The

results have determined that the maximum fire flow available at each hydrant is approximately 500 gpm with a 20 psi residual pressure. Refer to Figure 2 and the calcualtions included in the Appendix. This matches what was reported to be the general flow available from Mr. Campion during prior flow tests. Steve Ebner, Fire Chief of the Fort Lewis Mesa Fire Protection District was contacted to discuss his knowledge of the campus system. He told us that he has routinely used the campus system for training purposes. As recently as last year, his staff did operate and flush each hydrant on the campus during a training exercise. From the training operations, he feels that with drafting capabilities on the fire trucks, he can deliver upwards of 800 gpm from the hydrant system. Additionally, the department has dedicated transfer trucks for transporting water from the river and other ponds and reservoirs to assist with a fire. With this additional method of water delivery, a total fire flow of approximately 1,500 gallons/minute is possible. The district fully supports fire sprinklers for any building improvments and modifications. Based upon this information, our hydraulic model is deemed conservative and actual flows may be higher.

Typical Fire Hydrant Assembly with protective bollards. Please note access to the hydrants is not provided.

Typical Yard Hydrant for irrigation use. These are installed at each building and at other locations throughout the campus.

The irrigation reservoir has a capacity of approximately three million gallons, so storage volume is not a concern so long as the reservoir maintains a reasonable storage volume during the dry times of the year. Operation of the pond for other irrigation uses has not been identified. The intake assembly is unknown and from past flushing operations, small debris and sediment does enter the pipe syste. It is suggested to confirm if the reservoir contains sufficient water year round. Irrigation occurs during the late spring to early fall months, but fire protection is necessary and required year round.

The irrigation system and fire protection system appears to be in reasonable condition with some routine maintenance provided for the fire protection system. The campus system was installed in 1984. The age and status of the pipe from the pump house area connection to the reservoir should be investigated further.

NATURAL GAS SYSTEM

Natural gas is supplied to the campus from a master meter connection from theAtmos Gas Company main located along the southeast campus boundary at State Highway 140. The present campus private gas system (State owned) was installed in 1984. From research of the available plans, gas mains were in place prior to the new lines being installed. It is not known if the old lines still remain in place. It appears the new system served all the buildings on campus in 1984. We feel that the old infrastructure probably is abandoned in place. The system as installed was comprised of coated welded steel pipe, nominal size of 2 inch. Smaller lines were installed as service feed lines to the various buildings on campus. There appears to be no individual gas meters, except for the master meter and potentially one or two individual meter connections for some residences.

Typical Gas Service Connection with pressure regulator visible.

The gas services do have pressure regulators and appropriate shut off valves located at each building exterior prior to the service line entering the building.

Cathodic protection was installed on the main lines with a minimum of two locations noted on the improvement plans. The status of the anodes and existing pipe condition are unknown.

Only one leak was identifed by the facility manager about one year after construciton. The line was uncovered and the necessary repairs were properly completed. No other maintenance or problems have been noted since.

The pressure of the gas being supplied by Atmos Gas Company at the master meter is unkown. Goff contacted the area manager, Pat Maloney, of Atmos Gas Company. He was only able to comment that the gas company knows of the master meter location and service area, but no other information was available for their system at the campus meter location.

CAMPUS ACCESS

Campus access, though not requested for review should be mentioned. Presently there are two access driveways into the campus from State Highway 140. This state highway is classified as a major collector and in not listed on the National Highway System. If and when the daily traffic increases above 20 percent of the current level, a traffic analysis and/or impact study may be required per the Colorado Department of Transportation State Highway Access Code. Future improvements to the campus which significantly increases traffic (primarily peak hour trips) may require turn lane improvements. The highway background traffic is not very high, which benefits the campus accesses. This is an item that should be considered in planning. Once future uses are identified, trip generations can be provided and the design warrants can be reviewed to determine if in fact any improvements would be required for the future campus plans.

ASSESSMENT SUMMARY and RECOMMENDATIONS

Based upon the information collected to date and with the information obtained from various people and agencies Goff has listed the review summary and recommendations to assist the College with the tools to provide the necessary program planning for the Old Fort Lewis Campus.

Overall, the campus buried infrastructure appears to be viable and in reasonable condition. The infrastructure most pressing of further review and potential improvements relates to the potable water collection and treatment system. As the campus use increases, the sewer treatment system will also require improvements. Both of these components will require planning, design and significant funding to meet the requirements of the regulatory agencies.

Wastewater Collection System

The system was improved with 8-inch PVC pipe in 1977. New manholes were installed at that time as well.

Based upon the age of the system the following is recommended:

- Open each manhole, inspect condition, verify line sizes and type. Lamp the lines to determine if they appear clean, full circle. If lamping is problematic, the potential to camera the lines would be prudent.
- Flush and remove debris from manholes and lines.
- If inflow appears excessive, prepare for an Inflow and Infiltration (I and I) study. This will determine if additional flows not sanitary sewer related are affecting the capacity of the system.

Wastewater Treatment System

The non-discharging waste stabilization lagoon system is oversized for the current and prior campus use. It is recommended to attempt to locate the design data for the original design. This would assist in future planning to determine if this type of system should remain as designed.

Following are recommendations:

- The flows to the waste water system need to be quantified.
- Based upon flows, a determination of the system jurisdicition can be determined.
- Remedial work is warranted based upon jurisdiction and applicable regulations.
- Remedial work may involve partial lining and berming to contain the flows into an area commensurate with the current flows. Future improvements will require further system improvements and may include additional septic tanks or other tanks for solids removal prior to the wastewater lagoon.
- Options exist in the current sewage treatment area for treatment methods that will meet current and future requirements.

Potable Water System

Potable Water Collection

The potable water collection system is in need of immediate repairs and improvements. Following are the recommendations:

- Re-connect the chlorination system to the water system.
- Flush and clean the infilration gallery lines to remove sediment, roots, etc.
- Flush and disinfect the clearwell.
- Repair the clearwell float valve assembly.

- Disinfect the entire pipeline system.
- Obtain bacteria tests and provide a MPA test (Maximum Particulate Analysis) to determine what microspoic organisms are present in the raw water.
- If giardia/crytosporidium cysts or other organisms are identified, implement filtration to provide the necessary safe guards for safety.
- Direct filtration should be provided regardless of the MPA test results, since the test is performed once and can vary from day to day.
- Provide a water master meter.
- Determine a captial improvement plan to improve the entire collection, treatment and pressurization system.

Potable Water Distribution

The potable water system pipes are approximately 27 years old. This is not excessive, but without documentation the following is recommended:

- Locate all valves. Operate (exercise) valves.
- Pothole lines to determine type of pipe installed and exterior condition of pipes.
- Flush system with chlorinated water for disinfection and to remove sediment from lines.
- Confirm system leakage with pressure test (this can be timed at the hydropnuematic tank during off peak or no flow period).
- Verify if curb stops are provided for individual services and operate valves if installed.

Irrigation Water System and Fire Protection

The irrigation and fire protection system is generally is good condition. As above, the system age is approximately 27 years old from the water pump house loctation to and through the campus. The age of the line from the water storage reservoir to the pump house location is unknown. The following is recommended:

- Locate all valves. Operate (exercise) valves.
- Pothole lines to determine type of pipe installed and exterior condition of pipes.
- Determine how the pipe intake is contructed at the reservoir. Based upon findings, remedial work may be warranted to keep debris out of the pipes that may cause problems at hydrants, valves, fittings, etc.
- Verify flow and pressure at each fire hydrant.
- Operate individual yard hydrants to determine condition. Repair/replace as warranted.
- Determine the seasonal operation level of the reservoir and fire flow volumes available for each month of the year.

Natural Gas System

The existing natural gas system in the campus was upgraded and improved in 1984. Thus this system is 27 years old as well as the above infrastructure.

The following is recommended:

- Locate all valves. Operate (exercise) valves. Lubricate as necessary.
- Pothole lines to determine type of pipe installed and exterior condition of pipes.
- Pothole to locate the anodes installed for cathodic protection. Determine condition of anodes and replace if warranted.
- Determine status of service lines to all buildings and where buildings have been removed after the system has been installed. Verify all abandoned service lines are properly capped and marked. Some buildings that were shown in 1984 have been subsequently removed.
- Verify gas pressures in system to ensure proper flow and pressure are avaiable for equipment utiltizing the gas.
- Provide pipe to soil potential readings.
- Perform regulator maintenance.
- Provide leak detection survey to confirm system integrity.

Overall the infrastructure pipelines for all utilities installed are in good condition, so long as future pothole operations do not depict exterior deteriorations beyond normal age. The water collection system will require major cleaning, overhaul and future review. Since this is paramount for basic services at the campus, this should have the highest priority. The wastewater treatment facility also will require further assessment as stated above. Regardless of future campus plans, futher assessment of the potable water collection system and wastewater treatment system are highly recommended and need to be performed to meet current regulations.

The ‘in ground’ infrastructure appears to be able to accept new services and expansion of service to accommodate future demands for the campus.

Implementation of the above recommendations should be an overall priority for the Old Fort Lewis Campus in concert with any building renovations and improvements.