MORRISON HERSHFIELD

Kaliti Wastewater Treatment Plant and Sanitary Sewer Trunk Main

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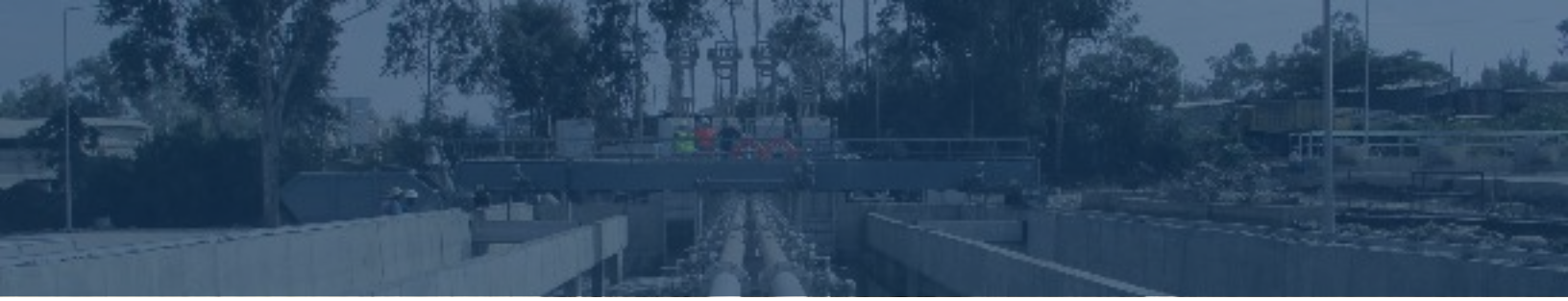
PROJECT HIGHLIGHTS



KALITI WASTEWATER TREATMENT PLANT AND SANITARY SEWER TRUNK MAINS

Location: Addis Ababa, Ethiopia

Completed By: 2018

To Be Entered in Category: H. International

Firm Name: Morrison Hershfield

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Role in the Project: Client's Engineer, Design Review & Construction Administration

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>> Mechanical Screens

SUMMARY

Morrison Hershfield was Client's Engineer for the Addis Ababa Water and Sewerage Authority (AAWSA), helping to solve the City's lack of proper sewage collection and treatment. A new 100,000 m^3/d maximum day demand Wastewater Treatment Plant (WWTP) was designed and constructed, and the existing trunk main was twinned, adding 18 km of pipe. The result is a new, client managed and operated system contributing to improved effluent quality and health for over two million people.

Water and wastewater infrastructure is a top priority in Addis Ababa, Ethiopia.

Q.11
SOCIAL AND ECONOMIC BENEFITS

Addis Ababa is the capital and largest city in Ethiopia. It is located on a plateau in the centre of the country, at an elevation of 2,200 metres and forms part of the watershed for the Awash River. The city is the seat of government of Ethiopia and the country's financial, commercial, educational, and media centre. Addis Ababa is an important administrative centre not only for Ethiopia but the whole of Africa and includes the headquarters of the African Union and the United Nations Economic Commission for Africa. The population was estimated at 4.4 million in 2017.

WASTEWATER HISTORY

Water and wastewater infrastructure is a top priority in Addis Ababa, Ethiopia. For years the City has survived with a small percentage of its area and population served with a piped sanitary sewer system. The balance of the residents is served by septic tanks, latrines or the "bush".

Rapid development and increased density resulted in numerous problems. The existing lagoon treatment system was operating beyond its design capacity, resulting in less effective treatment with the potential of a release downstream of effluent that did not meet treatment standards. Under capacity, sewers were overflowing in the streets and into the city watercourses and streams. Local rivers were biologically "dying" and turning into open sewers, creating negative perceptions of the city's aesthetics. All of this resulted in an extremely unhealthy situation, increasing the City's risk for a major disease outbreak.

Prime Minister during VIP tour at the WWTP.

THE PROJECT

The World Bank and the government of Ethiopia entered into an agreement for loans to construct a Wastewater Treatment Plant (WWTP) at Kaliti and expand the existing trunk main piping to provide 18 kilometers of new trunk main from the heart of the city to the treatment plant. The goal was to improve the standard of living in Addis Ababa by improving the overall level of sanitation and meet World Health guidelines for sewage treatment.

The project included the design and construction of a new WWTP, sized for a maximum flow rate of 100,000 m^3/d. The process consists of a UASB (Upflow Anaerobic Sludge Blanket) front end, trickling filters, secondary clarifiers, and chlorination/dechlorination for disinfection before disposal in the river. The catchment area to the plant was modeled and the construction of 18 km of new sewer trunk mains was added.

BENEFITS

The modernized system offers numerous benefits to the community. The health and livelihood of city residents, as well as the agricultural communities downstream of the Akaki River, will improve as water becomes safer for consumption and the risk of water-borne diseases is reduced. The improved quality of rivers and streams flowing through the city will transform 'Dead' rivers to ones where the biodiversity and ecosystem can be re-established and maintained. It enabled the reuse of treated wastewater for agriculture and industrial purposes. Construction, operation, and maintenance of the system have created both short and long term employment. Finally, education programs have increased public awareness of the need and the benefits of a properly functional wastewater treatment system.

>> Secondary Clarifier - Rotating Arm

>> Training AAWSA Staff

Q.12
TECHNOLOGY TRANSFER

Morrison Hershfield provided innovative, cutting edge treatment technology and training to a country desperately requiring these resources, resulting in an improved level of quality to the treatment process and sewage collection system.

The client was engaged in the decision-making process throughout the project. Various WWTP treatment processes were discussed and a decision matrix was set up with them. Goals and evaluation criteria were discussed during the preliminary design stage.

Key elements of the wastewater treatment system design incorporated the ability to improve treatment over time at the operator skill level and maximizing the use of locally available and supported equipment, the provision of formal training and reference manuals to AAWSA staff on the operation and maintenance of the system and the development of quality control practices.

The two major activities required during the design of the new sewer trunk were to expand the existing trunk system and provide designs to rehabilitate the poorly constructed siphons at several river crossings that had become an ongoing maintenance issue.

Three trunk mains were prioritized for expansion, with the highest priority given to the eastern trunk which was experiencing frequent sewage overflow. Significant efforts were required both prior to and during construction, to deal with encroachment issues into the existing sewer trunk right-of-way, and to establish a new right-of-way and provide sufficient space for construction and future operation and maintenance access.

Throughout the project, Morrison Hershfield worked closely with local consulting partner ARMA Consulting PLC. to compile pipe routing options and oversee survey of key points of river crossings and locations of conflicts. ARMA completed the design drawings for the trunk main under our guidance and review.

Modeling of the catchment area was completed as part of the preliminary and design stages for the trunk main. Morrison Hershfield modeling specialist met with the client's staff to demonstrate the new model and provide insight into new modeling software and techniques.

Reviewing Sewage flow through grit chamber.

Following the delivery of the final design report, Morrison Hershfield arranged and accompanied staff from AAWSA on a technical trip to Ghana and Brazil to tour existing WWTPs that had a similar process to the proposed Kaliti plant.

The client was provided with background information on Canadian (Calgary and Edmonton) sewer bylaws, highlighting the advantages of establishing testing of industrial sewage to maintain a healthy treatment plant.

Following construction of the plant, the client was provided with performance testing results and commissioning and operational plans and reports along with coaching by our process engineer on the process and operational requirements.

>> Man hole drop structure

Morrison Hershfield's Resident Engineer.

Akaki River and squatter homes at proposed crossing.

Q.13

ENVIRONMENTAL BENEFITS

Addis Ababa was facing a health crisis due to serious sanitation issues. The health of the public was at risk, as was the health of local waterways severely impacted by industries discharging untreated wastewater, or wastewater with limited pre-treatment, directly into nearby streams and rivers. Two of the major rivers draining Addis Ababa, the Little Akaki and Greater Akaki, are significantly polluted and considered to be dead rivers as a result of these discharges and runoff issues.

Primary, secondary and tertiary treatment of wastewater removes harmful contaminants, such as bacteria and pathogens, and allows the safe disposal of the treated effluent. The new WWTP and sanitary sewer trunk main expansion is anticipated to have significant environmental benefits.

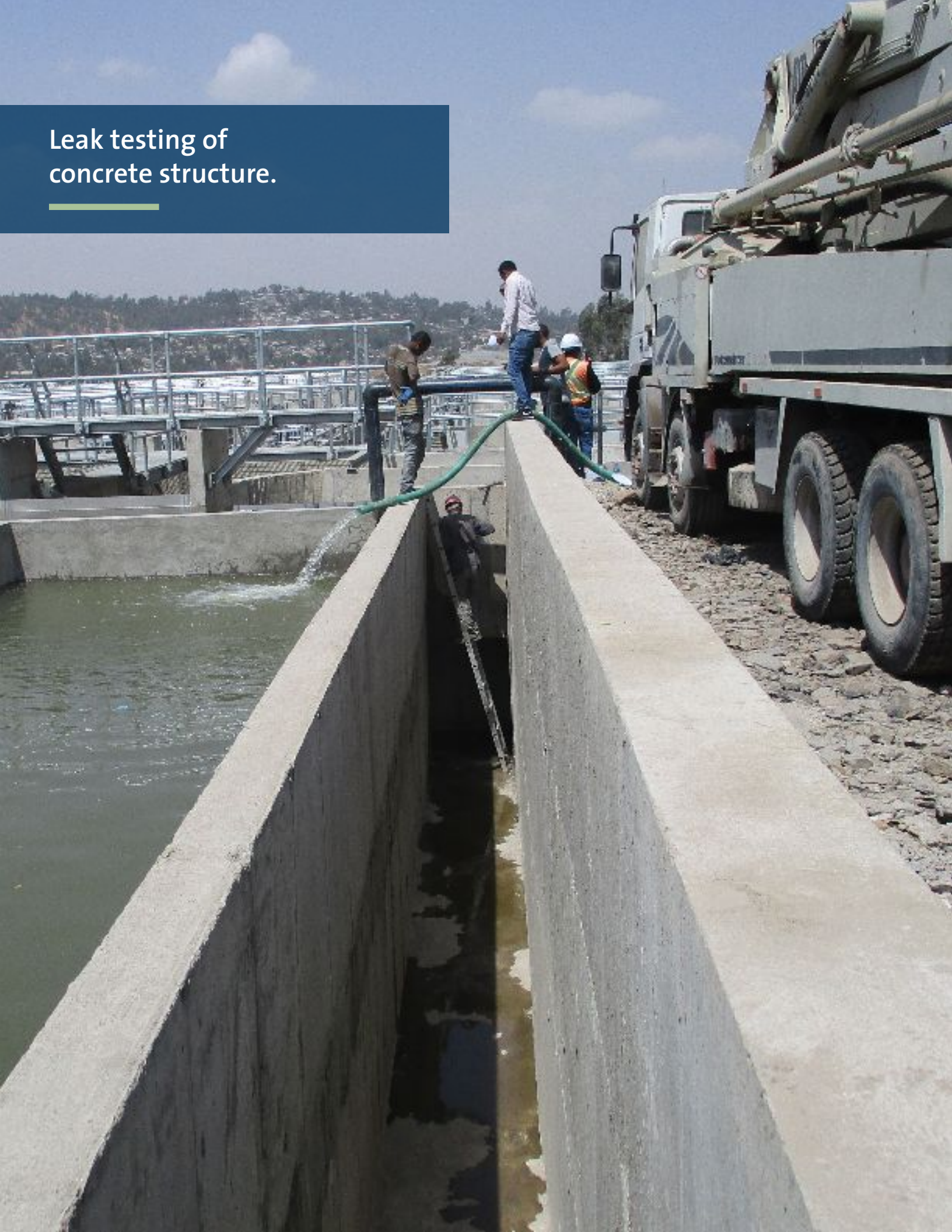
Reducing the amount of waste previously released into the environment will reduce the health risks of environmental pollution, particularly for those using the river water for agriculture and household consumption.

Improving the quality of rivers and streams flowing through the city will facilitate their transformation from 'dead' waterbodies to ones where the biodiversity and ecosystem can be re-established.

Producing clean, reusable water will also offer a sustainable short and long term source of irrigation water.

The UASB reactors at the WWTP collect the biogas from the digestion process which could be harvested for fuel to generate electricity. And, biodegradable materials removed in the process can be given to the agricultural sector for natural fertilizers to be used in place of other products that may be more harmful to people and the environment.

>> Trickling Filter - Filter block placement



Leak testing of
concrete structure.

Q.14

COMPLEXITY

This wastewater project was the largest ever taken on by the AAWSA who had no previous experience with treatment other than lagoons.

Morrison Hershfield first became involved in 2010, for the WWTP and sewer system design and tender process, and to prepare the sewer master plan for the Kaliti catchment area. In 2015, we returned to the project as the Client's Engineer to provide a review of the design-build drawings of the WWTP and to finalize the construction drawings for the trunk mains. Morrison Hershfield also provided project management and resident engineering services for construction, and commissioning and testing for the systems. Constant communication and collaboration with the AAWSA has been a priority over the years.

CHALLENGES

The construction period was originally estimated to be 18 months but eventually took over 3 years. Construction delays resulted from complex government processes and approvals, custom approvals, weather delays, and social issues.

Morrison Hershfield worked with the client and the contractors to ensure that import permits were requested in a timely manner and pressed follow-up with the appropriate stakeholders.

Geotechnical issues arose during construction because of hard rock in areas of the WWTP and the trunk main. The contractor brought in additional equipment to remove it, adding to the construction time. Trunk main routing was redesigned to reduce the depth of the pipe installation.

Social issues arose during the trunk main installation, involving squatters on land along the route. They had not been cleared by City administration and the client. Crews were moved to other areas to minimize construction delays while the shacks and people were relocated.

Following construction of the WWTP and during the pre-commissioning and commissioning of the plant, AAWSA provided staff training to facilitate the take-over of operations and maintenance. The Contractor trained 35 of the client's staff members, however, when the time came for the takeover only 18 of the trained staff showed up. Meetings with AAWSA management were held to stress the importance of maintaining and operating the plant and emphasize the importance of having enough staff available 24/7.

Installing bend on Eastern Trunk

Aeration operation in grit and grease removal chambers.

Q.15

MEETING OWNER'S NEEDS

The goal of this project was to improve the standard of living in Addis Ababa by improving the overall level of sanitation. Morrison Hershfield assisted AAWSA with planning and managing the future expansion of its sewerage system in the Kaliti catchment area and expanding and improving the level of wastewater treatment serving the Kaliti Basin. Solutions also contributed to the goal of reducing overflows of raw wastewater into local streams and rivers in Addis Ababa.

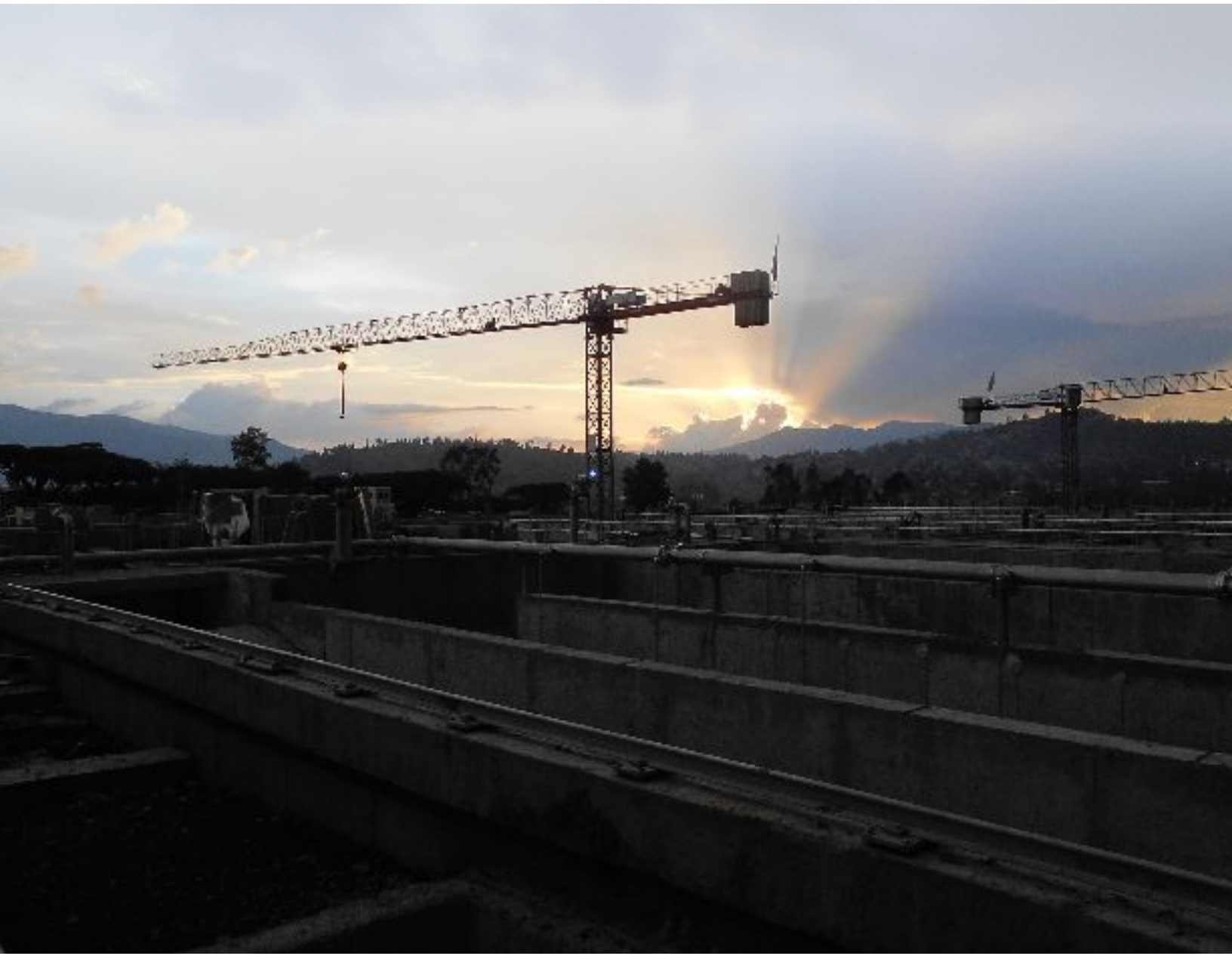
Morrison Hershfield developed a sewer modeling and concept plan including an update to AAWSA's 1993 Wastewater Master Plan. Design and tender packages were produced for the trunk mains and WWTP, and Morrison Hershfield reviewed the Contractor's designs, approved shop drawings and oversaw construction, commissioning and client take-over of the plant as well as construction completion of 18 kilometers of the truck main.

The new tertiary treatment plant can handle 100,000 m^3 per day of sewage flows, vastly improving the effluent to the river system. The new trunk main eliminates some siphons in the existing trunk main which were prone to backup and overflow into the river.

Commissioning and performance testing for the WWTP at Kaliti was completed in mid-August 2018, with trunk main installation wrapping up in December 2018. Lab results during the performance testing showed that all effluent quality goals exceeded Contract parameters.

AAWSA is using this project as a model for other related construction projects. They have already begun projects to tie residential and industrial areas to the expanded trunk main.

Pipe Bridge Structure -
Goats enjoy new way across.



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