2 PROJECT BACKGROUND AND DESCRIPTION

2.1 Introduction

2.1.1 Project Description Contents

This section describes the components of the EACOP System in Uganda for the export of crude oil (Figure 2.1-1) and includes information on the:

- project design:
  - project design overview
  - typical pipeline section
  - international standards
  - pre-front-end engineering and design (FEED) and FEED studies
- project components:
  - pipeline
  - aboveground installations (AGI) including pumping stations (PS), electric substations and mainline block valves (MLBV)
  - construction facilities
  - access roads
  - land requirements
- project activities:
  - feasibility studies
  - construction
  - soil management, erosion control and reinstatement
  - pre-commissioning, commissioning and start-up
  - operations
  - decommissioning
- associated[1] facilities
- schedule.

This project description, including FEED and subsequent design optimisation information, has been used in the development of an environmental and social impact assessment (ESIA) of the EACOP System in Uganda. An information cut-off date of 15 March 2018 was implemented. It is recognised that some design refinements may be made during the detailed engineering influenced by site-specific conditions.

If design changes are made and the effects of these changes require assessment by NEMA then an ESIA addendum will be submitted to NEMA.

[1] Associated facilities are those facilities that are not funded as part of the project (funding may be provided separately by the client or third parties including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project (IFC Performance Standard 1, Social and Environmental Assessment and Management Systems)

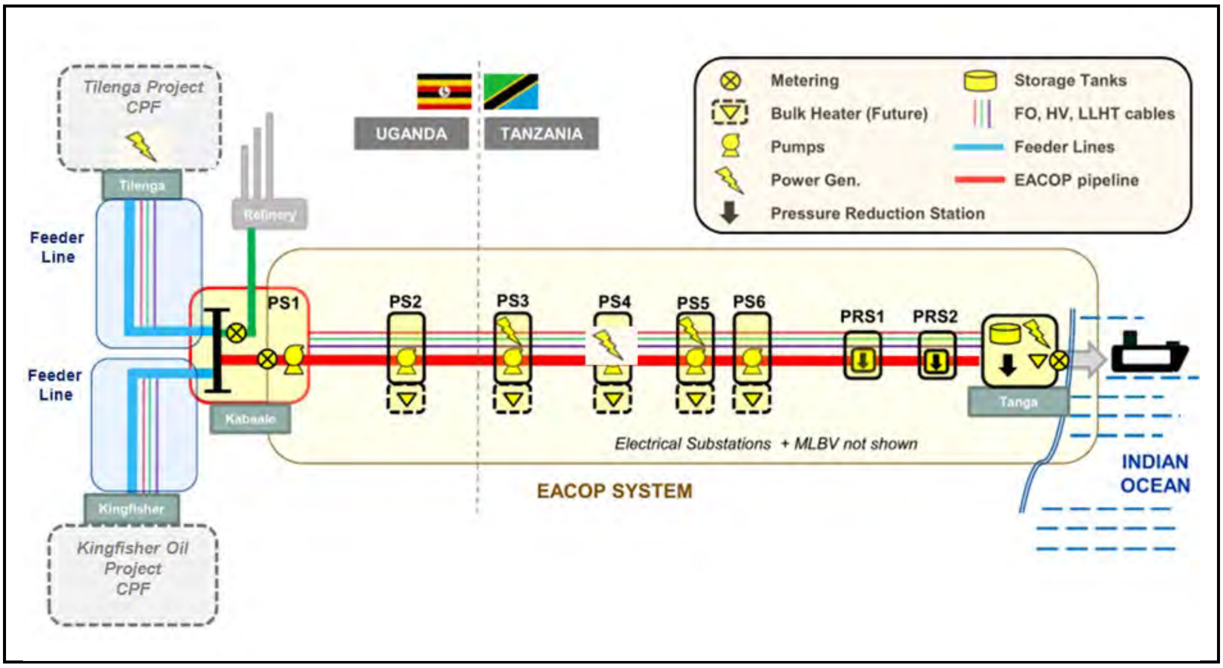

Figure 2.1-1 EACOP System Components[2]

2.2 Project Design

2.2.1 Project Design Overview

The characteristics of Albertine Graben oil, particularly the pour point and wax appearance temperature require a fit-for-purpose pipeline, storage and loading project design. Table 2.2.1 includes some of the key design basis parameters.

Table 2.2.1 Project Design Basis

Parameter	Value
Design flow rate	216,000 barrels per day
Pipeline diameter	24 in. nominal
Pipeline minimum operating temperature	50°C

The pipeline will be buried, thermally insulated with polyurethane foam (PUF) and electrical heat tracing (EHT) will be installed for the entire pipeline length.

The EACOP System consists of a 1443-km long, carbon steel pipeline of 24-in. outside diameter, designed to American Society of Mechanical Engineers standards with design pressures varying between 9.46 MPa, 14.97 MPa and 16.7 MPa. The pipeline system will cross Uganda and Tanzania, with 296 km in Uganda (see Figure 2.3-1).

[2] Central Processing Facility (CPF), Pumping Station (PS), Pressure Reduction Station (PRS), Main Line Block Valve (MLBV), Fibre Optic Cable (FO), High Voltage Cable (HV) and Long Line Heat Tracing (LLHT) thermal Insulation with polyurethane foam (PUF)

A key design element is to maintain the crude oil above its pour point and, as much as possible, above its wax appearance temperature. The project components responsible for this task are:

- EHT
- pumping station bulk heaters (potentially used later in the project life).

During pipeline commissioning, the EHT will continuously heat the crude oil to maintain an internal pipeline temperature above 50°C. At plateau production, pipeline insulation will maintain crude temperature above 50°C without any additional heat supply. As production begins to decline, the transit time of the oil through the pipeline will increase and thus the crude oil will have more time to cool. Then, crude oil temperature will be maintained above 50°C using EHT and, potentially later in the project life, bulk heaters.

Figure 2.2-1 provides an overview of the thermal, hydraulic and power design principles.

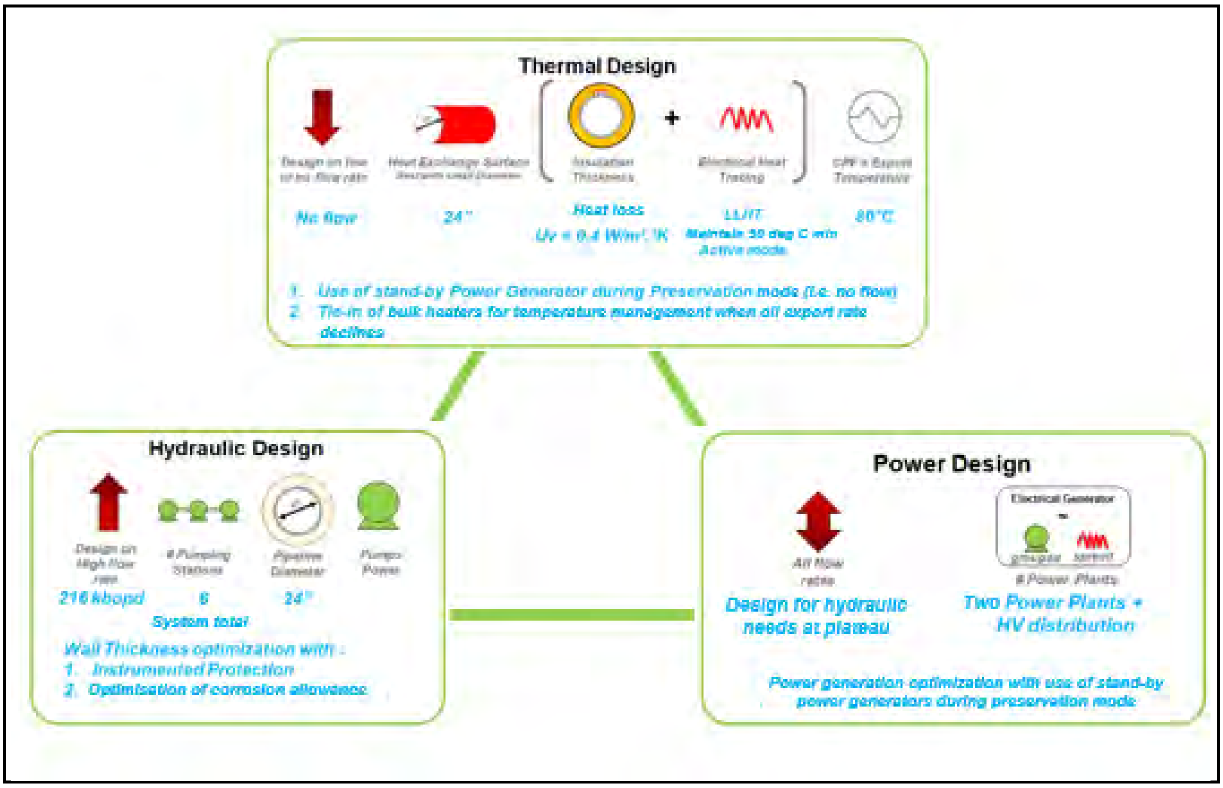

Figure 2.2-1 Design Principle Overview

NOTES: EHT – electric heat tracing, HV – high voltage, CA – corrosion allowance, Uv – ultraviolet

The base case operating philosophy for the pumping stations (PS) 1 and 2 is that they will not be manned. Due to the distance between AGIs, a design principle is that operations can be managed remotely from either of the two control rooms (CR) located at the entrance and exit of the pipeline.

2.2.2 International Standards

The pipeline technical design has been primarily based on the following industry standards:

- ASME B31.4 – 2016 "Pipeline Transportation Systems for Liquids and Slurries"
- ASMEB31.3 – Gas Transmission and Distribution Piping Systems (US/International Standard).

2.2.3 Pre-Front-End Engineering and Design, and Front-End Engineering and Design Studies

The completed early stage studies (feasibility and concept) and pre-FEED study scope of work included:

- a study to identify several potential corridors for a pipeline that would terminate at a port on the Indian Ocean where tankers could be loaded
- a high-level evaluation and identification of 11 potential 50 km-wide corridors
- further evaluation resulting in a reduction from 11 to 3 corridors
- several helicopter flight trips (2016) to support selection of the final route and reduce the 50-km-wide corridor to a 10-km-wide corridor
- an initial ground truthing site visit (2016) to identify a 2-km-wide corridor that would be suitable for a light detection and ranging (LIDAR) survey and collection of aerial imagery
- assessment of oil export technology including flow assurance and thermal management.

Section 3, Alternatives, describes the pipeline route selection and optimisation process, AGI siting, fixed facility technologies and construction technologies.

FEED was undertaken during 2017 with input from disciplines including environment, social, health and safety, and engineering specialists. It consisted of:

- project optimisation with upstream project facilities in Uganda
- refinement of the pipeline route
- refinement of AGI locations and concepts
- civil works design
- development of a project logistics philosophy plan.

FEED optimisation was undertaken for:

- centralised power generation to be provided by the Tilenga Project CPF for PS1 and 2, resulting in no additional equipment for power generation required for the Uganda section of the EACOP pipeline[3]
- the number and layout of AGIs including PSs, electric substations and main line block valves (MLBV).

[3] Details for power generation architecture for the Lake Albert development are provided for in the Tilenga Project ESIA.

2.3 Project Components

2.3.1 Pipeline

Route identification began in 2012 with participation of the Government of Uganda. The final route was selected in 2016 with participation of the Governments of Uganda and Tanzania. The routing included technical, environmental, social and security considerations. The initial technical considerations used to evaluate the constructability of the route were:

- pipeline hydraulics (topography, friction related to oil flow and pipe size)
- remoteness from infrastructure
- topography
- road and watercourse crossings
- flooding and landslide hazards
- seismic activity
- shallowness of bedrock
- geohazards.

The initial environmental and social considerations used to evaluate the proposed route were:

- cultural
- environmental
- populations
- security
- tourism
- infrastructure
- crossings
- land use (such as urban centres, protected areas and intensive agriculture)

The initial security considerations used to evaluate the proposed route were:

- potential risk associated with criminality, including organised crime, and separatist groups and radical groups operating in eastern Africa
- risks for host communities.

The EACOP project considered alternative routes from the Kabaale area, Uganda, to potential deep-water ports on the East African coast for year-long uninterrupted loading operations to the large ‘Suezmax’ tankers that are essential for the EACOP operability. Multiple port and loading locations were screened with a few identified as providing the necessary characteristics (water depth and favourable weather conditions) and resulting in the potential 50-km-wide pipeline corridors evaluated (see Section 3.5 Alternatives). Secondary information, including remote sensing, was used to assess potential corridors from Uganda through Kenya and Tanzania. Using a geographical information system (GIS), quantitative and qualitative considerations were identified and weighted.

The Government of Uganda selected the Kabaale Uganda to Tanga Tanzania pipeline corridor option (see Figure 2.3-1). A description of the route selection process is provided in Section 3.5, Alternatives. The portion of EACOP that is in Uganda is shown on Figure 2.3-1.

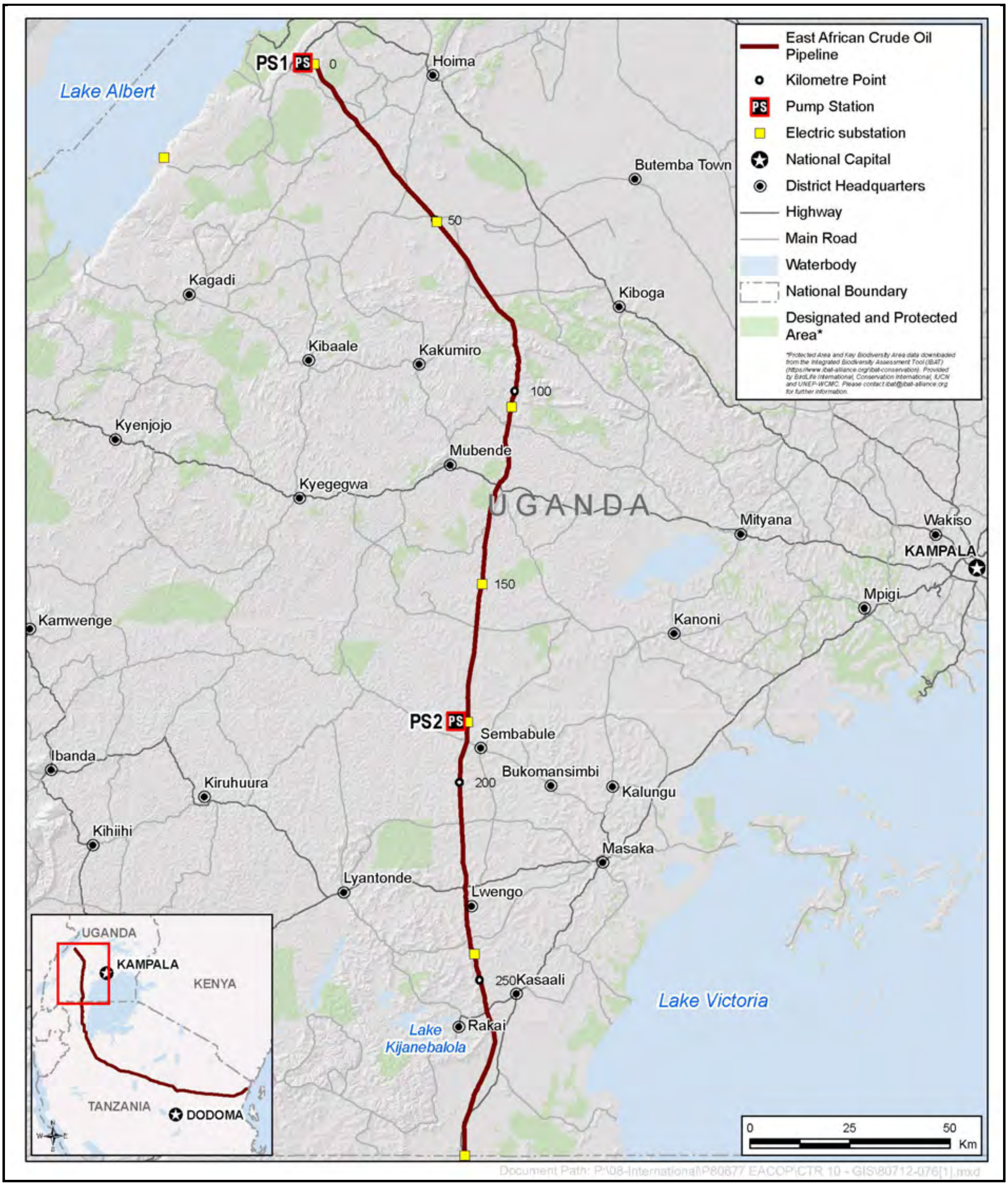

Figure 2.3-1 EACOP Corridor and Aboveground Installations

The export pipeline corridor in Uganda originates at PS1 at the future Kabaale Industrial Park, in Hoima District. Initially, it crosses relatively low terrain with undulating topography characterised by widespread cropland, settlement and transport infrastructure between Hoima and Mubende districts. The right-of-way

(RoW) also traverses gently undulating grass and farmland, hills with open plateaus, open grassland, wetlands in Gomba and Sembabule districts and a relatively flat landscape toward Mutukula near the border with Tanzania.

In Hoima district, the corridor passes between the Wambabya and Bugoma Forest Reserves (FR), and traverses through a modified section of Taala FR in Kyankwanzi district, and crosses near the eastern border of Kasana–Kasambya FR in Mubende district. There are watercourse crossings including the Kafu River between Hoima and Kakumiro districts, Nabakazi River between Mubende and Gomba districts, Katonga River between Gomba and Sembabule districts, and Kibale and Jemakunya Rivers in Kyotera district.

On the approach to the Tanzania border, and the northwestern corner of Lake Victoria, for approximately 90 km the corridor crosses a substantial zone of wetlands in a high average rainfall zone. This section is also characterised by almost unbroken crop land (a substantial proportion of which is under rice cultivation), cattle grazing land and settlement. The main RoW alignment broadly follows a ridgeline that defines a watershed for the many watercourses and wetlands of the Victoria basin. The corridor nearly clips an abandoned airfield in Kyotera district and the former Sango Bay refugee camp close to the Tanzania border. The corridor avoids the large local settlement of Mutukula at the border as it progresses into Tanzania.

2.3.2 Typical EACOP Section

For precautionary purposes, the pipeline is specified with a fusion-bonded epoxy anticorrosion coating applied to protect the pipe over the course of its operational life against external corrosion. This fusion-bonded epoxy coating will act as a second barrier in case of water ingress below the bonded thermal insulation system. To provide additional corrosion control, cathodic protection measures may be implemented.

As described in Section 2.2.1, temperatures will be maintained by a combination of PUF insulation and an EHT system. Bulk heaters may be installed later in field life to manage the temperature losses in the pipeline. The EHT system consists of three heat tracing electric cables inserted through three dedicated aluminium channels within the typically 70–80-mm thick PUF insulating material which is protected by a high-density polyethylene extruded covering. The EHT system and bulk heaters will only need to operate for flow conditions lower than the design capacity and, as required, start-up, during maintenance or when there may be no flow.

The EHT system will receive power from three high-voltage electrical power cables buried in a dedicated trench, parallel to the pipeline trench. Power will be supplied from the Tilenga Project CPF. Electric substations will be installed at 50–60 km intervals along the route to transform electricity from the high-voltage power cable to the voltage required by the EHT system. The electric generation and distribution system is described in Section 2.3.3.3.

A main fibre-optic cable will be laid in the same trench above the pipeline over the full distance (see Figure 2.3-2). This cable is designed for communications and transmitting control data between AGIs. The fibre-optic cable will also be used for pipeline leak detection and, as an option, intrusion detection. In areas prone to faulting or risks of landslides, a second fibre optic-cable cable will be installed for strain detection.

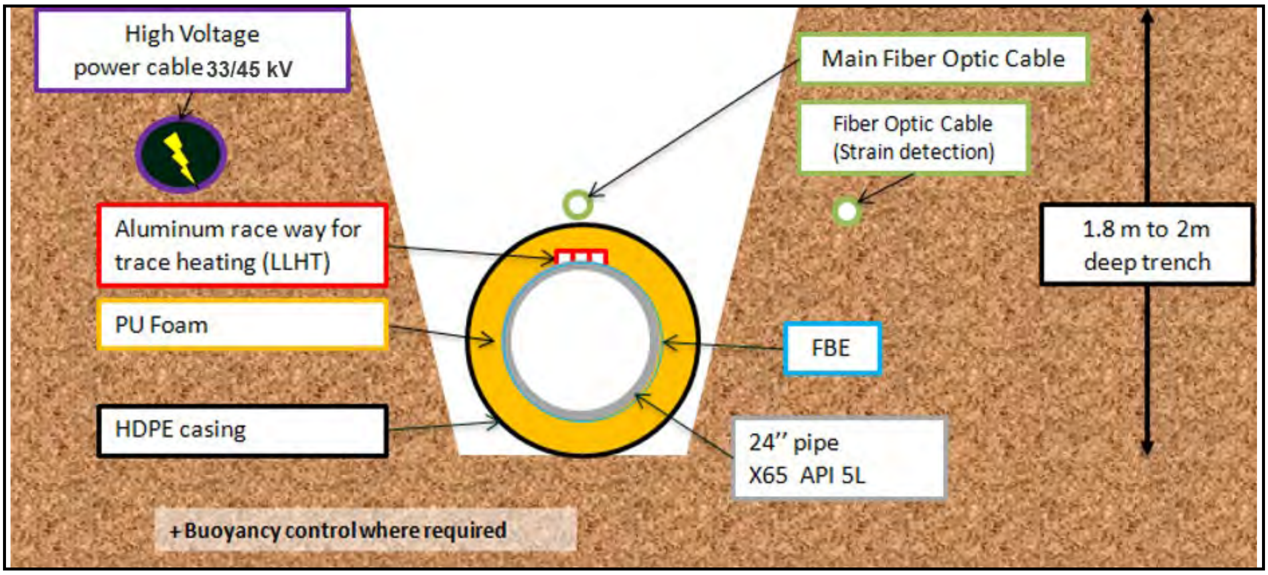

Figure 2.3-2 Typical EACOP Pipeline Cross-Section

NOTES: Material X65 as per API5L (65000 PSI specified minimum yield strength); EHT – electric heat tracing

2.3.3 Aboveground Installations

2.3.3.1 Introduction

Table 2.3.1 lists the AGI components of the EACOP System in Uganda.

Table 2.3.1 Components of the EACOP System in Uganda

Component	Aspect
PSs	PS1 – KP0 (Kabaale Industrial Park) PS2 – KP186
MLBV stations	15 in the operational RoW
Stand-alone electric substations	1 in the operational RoW
Electric substation combined with a MLBV station	4 in the operational RoW
Electric substation combined with PS	2 at PS1 and PS2
New or upgraded permanent access roads to PSs	6.8 km
New or upgraded construction facility access roads	2.4 km new access roads 5.9 km of upgrades to existing roads
Main camps and pipe yards (MCPY)	MCPY1 – kilometre point (KP) 39.3 MCPY2 – KP124.6 MCPY3 – KP191.2 MCPY4 – KP282

2.3.3.2 Pumping Stations

Function

The function of a PS is:

- pressurisation for the transport of crude oil through the pipeline
- crude oil temperature management (power supply for EHT and for bulk heaters).

Power required to operate PS1 and 2 will be supplied by the Tilenga Project CPF which includes an integrated power and heat generation system. The impacts associated with the power generation package at Tilenga Project CPF are the subject of a separate ESIA (refer to Section 2.5 Associated Facilities).

Locations and Size

PS locations are determined by pipeline hydraulics, taking into account factors such as pipe size, topography, frictional losses related to oil flow and location of other pumps in the system. The selection of PS locations also considered proximity to roads, power lines, land use and environmental characteristics.

Based on these criteria the final locations of the EACOP project PSs were selected; see Table 2.3.1 and Figure 2.3-1. Figure 2.3-3 depicts a typical PS layout without power generation.

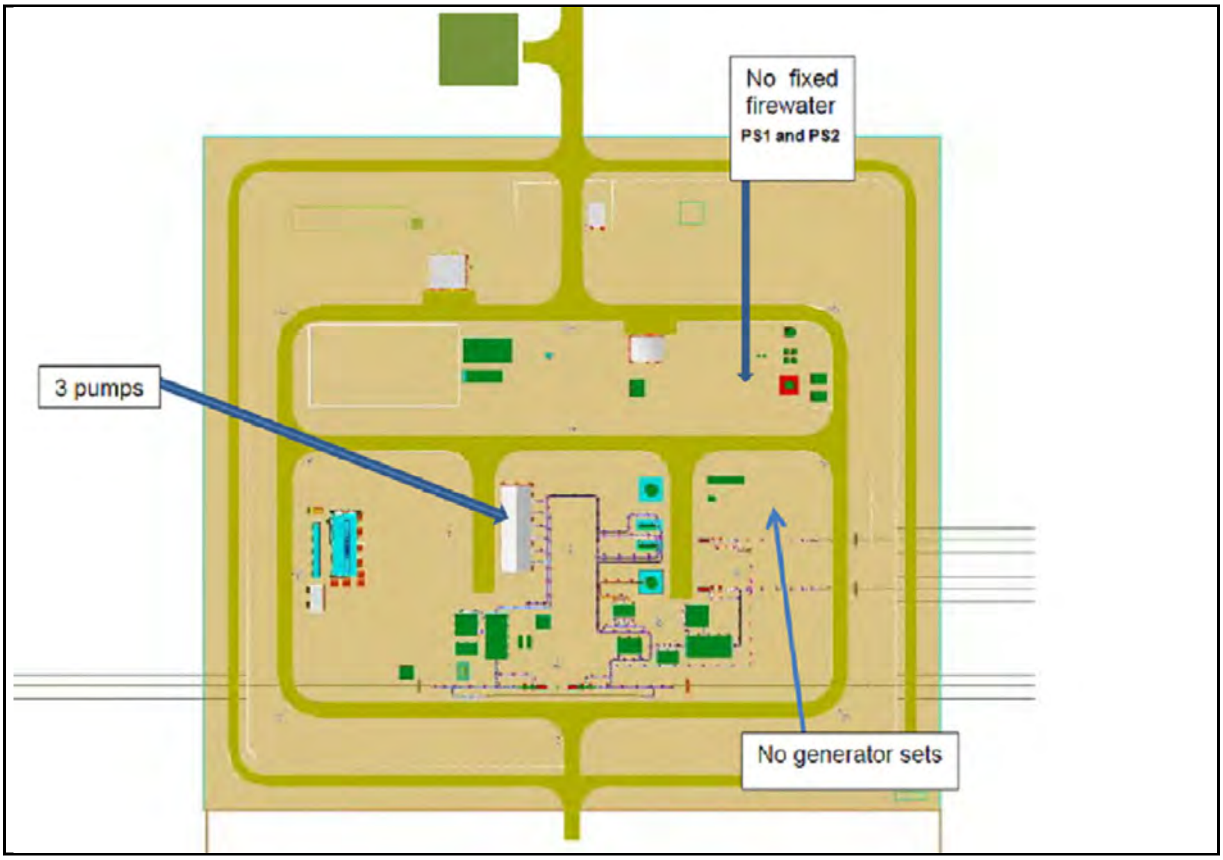

Figure 2.3-3 Typical Pumping Station

PS1 will require an area of 277 × 320 m while PS2 requires an area of approximately 277 × 277 m. During FEED, the footprint of the PS1 and 2 were optimised with the removal of power generation and one pump from each facility. For the construction phase, a temporary worksite will be established that accommodates a storage area, workshops and construction workforce camp.

Security facilities and an emergency evacuation area will be established outside the PS fence.

The emergency pipeline repair system (EPRS) described in Section 2.4.5.6 may be at one of the PSs, most likely at PS1 or close to existing industrial activities near the EACOP route (the exact location of the EPRS centres will be defined in a later phase).

Layouts and Components

The design basis for the PSs is as follows:

- pumping:
  - the PSs will be self-contained and independent of any locally supplied electricity, water, and waste or sanitary treatment (with the Tilenga Project CPF acting as the power generation centre and distributing the required power to PS1 and 2)
  - each PS will have three electrically powered pumps, based on the 216,000 barrels a day flow rate
- power generation:
  - PS1 and 2 power requirements will be serviced, as mentioned above, entirely by the Tilenga Project CPF, but with an emergency diesel generator supporting activities during commissioning, start up and for emergency and planned shutdown activities
- temperature management:
  - the EHT will provide heating during reduced flow rates, shutdowns or when maintenance is required
  - when the upstream production declines, the Tilenga Project CPF will continue to provide power to the PS1 and 2. However, an option will be retained to install a crude oil bulk heating system at each PS to provide intermediate heating of the crude oil and to reduce the use of the EHT for operating cost efficiency. Space and tie-in points for future bulk heaters will be provided at both PSs.
- other facilities:
  - fire protection pumps and fire-water storage tanks will be sized according to applicable national and international codes and standards.
  - all PSs will include operator facilities and an office building
  - diesel storage will be provided for the emergency generator
  - at PS2, a surge relief skid will be included for over pressure from closed valves at PS1. The surge relief will be directed to a surge relief tank.

- o pig[4] launchers and receivers will be installed at the inlet and outlet. Collected wax will be reinjected into the pipeline facility (see Section 2.4.5.1).
- o one communication tower (approximately 100 m high will be subject to optimisation during detailed design).

The PSs will be fenced.

2.3.3.3 Electric Substations

Function

The electric substation houses transformers and switchgears for power transmission through a high-voltage cable and step-down transformers to provide the required voltage for the EHT system.

The high voltage cable is installed underground next to the pipeline.

Figure 2.3-4 depicts the power generation and EHT supply architecture.

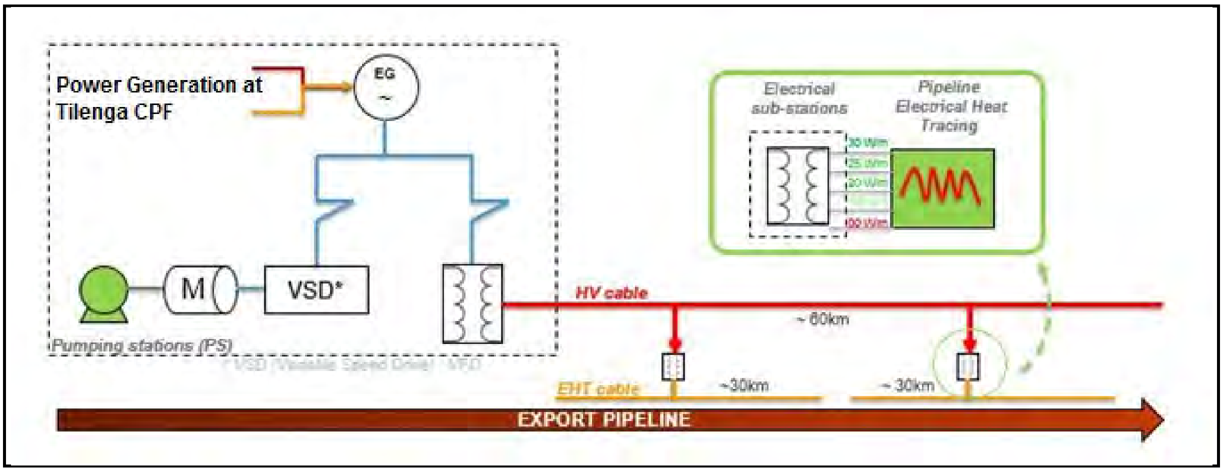

Figure 2.3-4 Power Generation Architecture

NOTES: M – motor; VSD – variable speed drive; EG – electrical-driven generator

Locations and Size

Figure 2.3-5 depicts the electrical distribution system for the entire EACOP System, with power provided in the EACOP System in Uganda by the Tilenga Project CPF, at a distance 50–60 km between electric substations.

There will be seven electric substations associated with the Uganda EACOP project (Figure 2.3-1). All but one will be co-located with other AGIs. The independent substation (ST-31) will occupy an area of 24 × 18 m. The four electric substations combined with MLBV stations have a footprint of 24 × 28 m. The other two electric substations are included in the footprints for PS1 and 2.

[4] Pipeline intelligence gauging system (pigs) for integrity testing and maintenance introduced into the line via a pig trap, which includes a launcher and receiver. Without interrupting flow, the pig is then forced through or towed by another device or cable. Pigs sweep the pipeline by scraping the sides of the pipeline and pushing debris ahead of the pig to the pig receiver where the debris and the pig are recovered without interrupting the flow. Smart pigging for pipeline Integrity purposes will be conducted periodically.

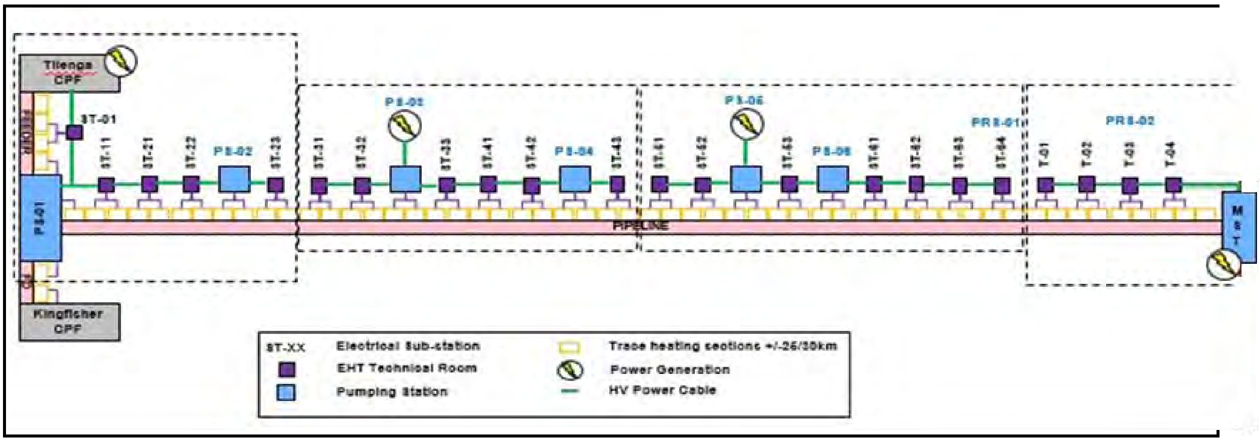

Figure 2.3-5 Electrical Distribution System

Layout and Components

The layout of the electric substations, depicted in Figure 2.3-6 consist of:

- a building that houses the electrical and instrument technical rooms with associated heating, ventilation and air conditioning
- a voltage-regulating transformer that reduces the voltage provided by the high-voltage cable to the voltage required to power the EHT
- transformers that power the EHT
- a fibre-optic system for intrusion and leak detection.

Each substation will be fenced. A workstation desk will be available for personnel during maintenance visits.

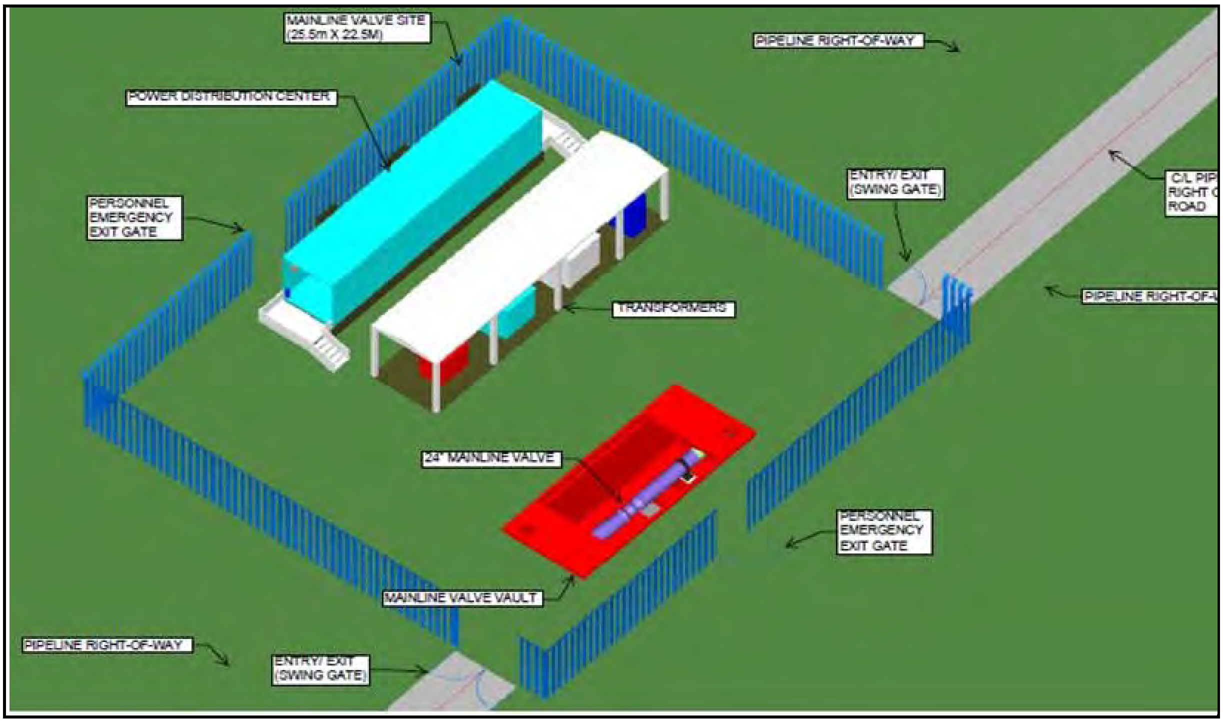

Figure 2.3-6 Typical Electric Substation with Main Line Block Valve

2.3.3.4 Block Valves

Function

MLBV stations will be installed with the pipeline to prevent oil from flowing into a damaged pipeline section and to isolate the damaged pipeline section. In addition to the MLBVs, the pipeline design includes a fibre-optic-cable leak detection system for the entire pipeline.

Locations and Size

The number and locations of MLBVs was determined by environmental considerations and access for repair and regular maintenance. The environmental considerations were based on crossing points of critical areas such as major rivers, roads crossings and active geological fault zones. MLBVs are installed:

- at each PS
- along continuously ascending or descending elevation profiles
- on each side of wetlands
- at each watercourse that is more than 30 m wide, and at each watercourse that is less than 30 m wide if it meets one or more of the following criteria, having direct or downstream flow to:
    - a populated area
    - a reservoir holding water intended for human consumption
    - a navigable waterway
    - an environmentally sensitive area.

Fifteen MLBVs will be within the permanent RoW, four of which will be combined with electric substations.

Layout and Components

The pipeline enters the MLBVs, as depicted in Figure 2.3-7, where the block valve is installed inside an underground reinforced concrete vault or directly buried and supported by a slab in a pit. A leak detection system and emergency flow restriction device reduces the probability and quantity of spills. Emergency flow restriction devices are either check or ball valves that are activated remotely from the CR (see Section 2.4.5.2).

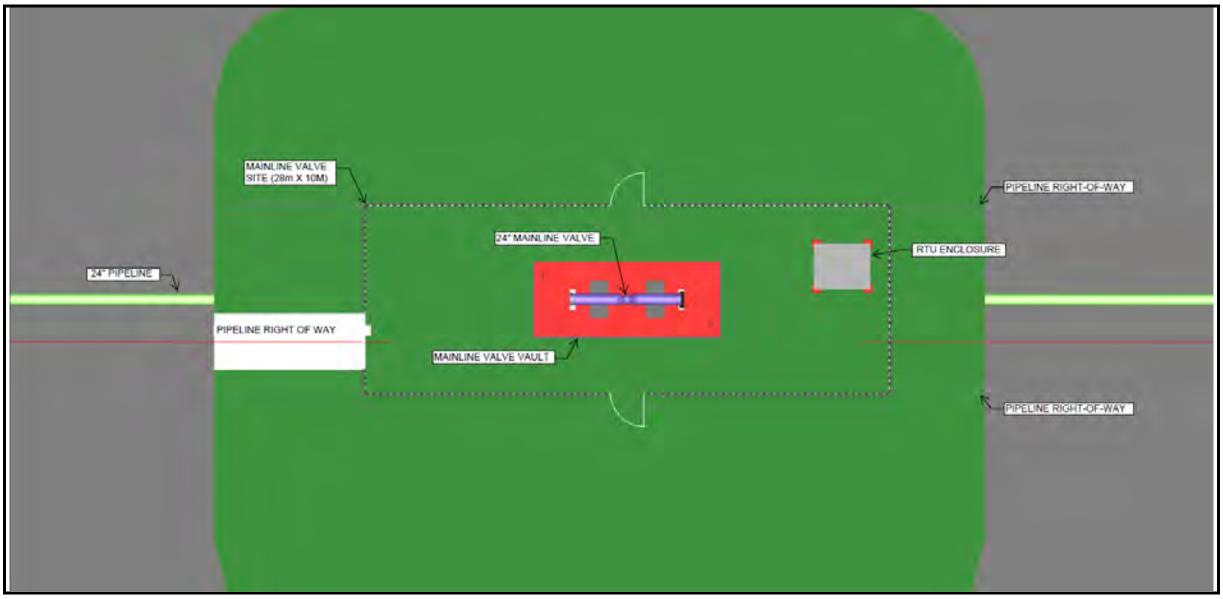

Figure 2.3-7 Typical Main Line Block Valve

A series of photovoltaic solar panel arrays, depicted in Figure 2.3-8, and batteries with six days autonomy, will provide the low power supply required at the MLBV, with a 1.1 kV total power consumption estimated (ICSS, telecom and electro-hydraulic actuated valves).

Leak detection is part of the operational monitoring system described in Section 2.4.5.6. Each MLBV will be fitted with a remote terminal unit controller for block valve protection. All MLBV station process and safety signals will be directly connected to the remote terminal unit via telecommunication system. Synchronisation of these terminal units is required for accurate leak detection and location. The remote terminal unit is within the MLBV footprint (see Figure 2.3-7) and is in direct communication with the CR. In the event of abnormal pipeline operation, block valves can be closed from the CR.

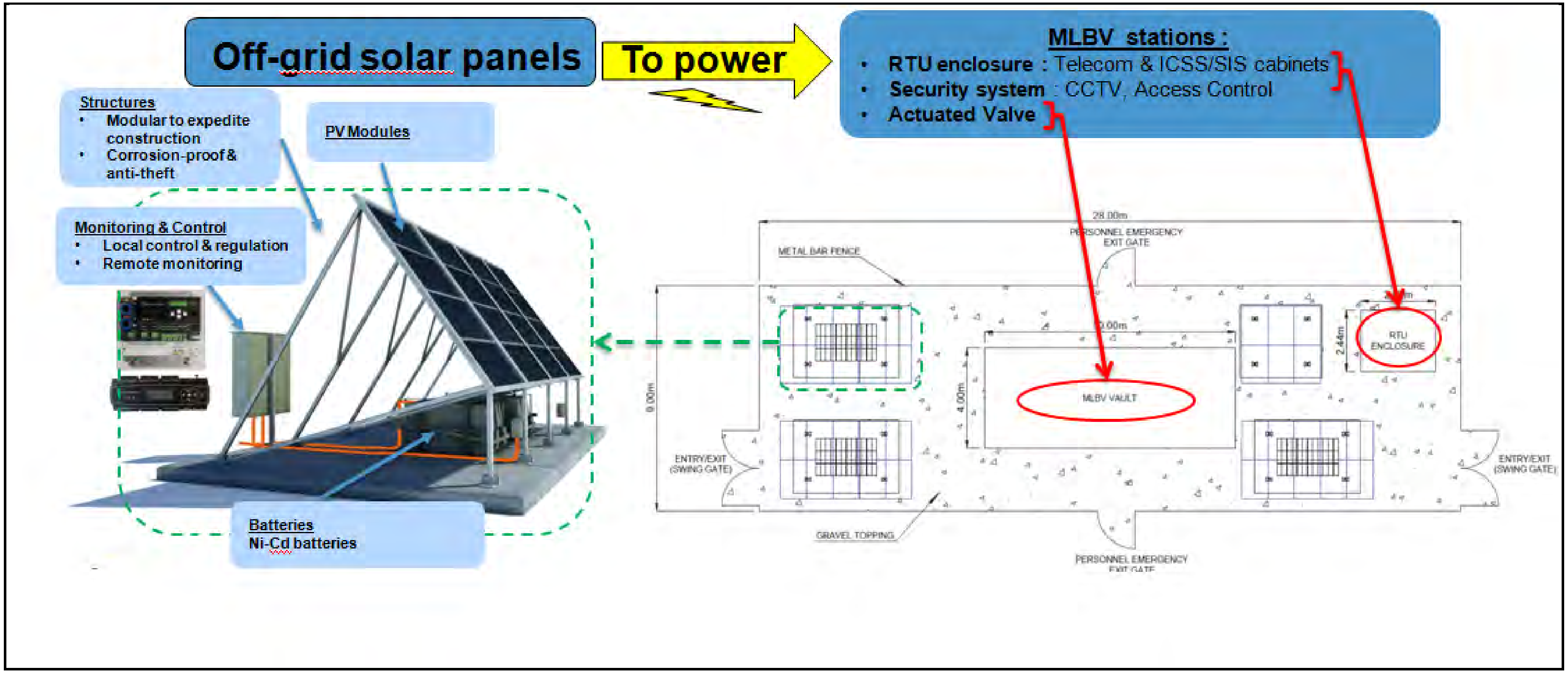

Figure 2.3-8 Typical Solar Panel Array at Main Line Block Valve Stations

2.3.4 Construction Facilities

Facilities will be required to support pipeline construction and will include MCPYs (Figure 2.3-9).

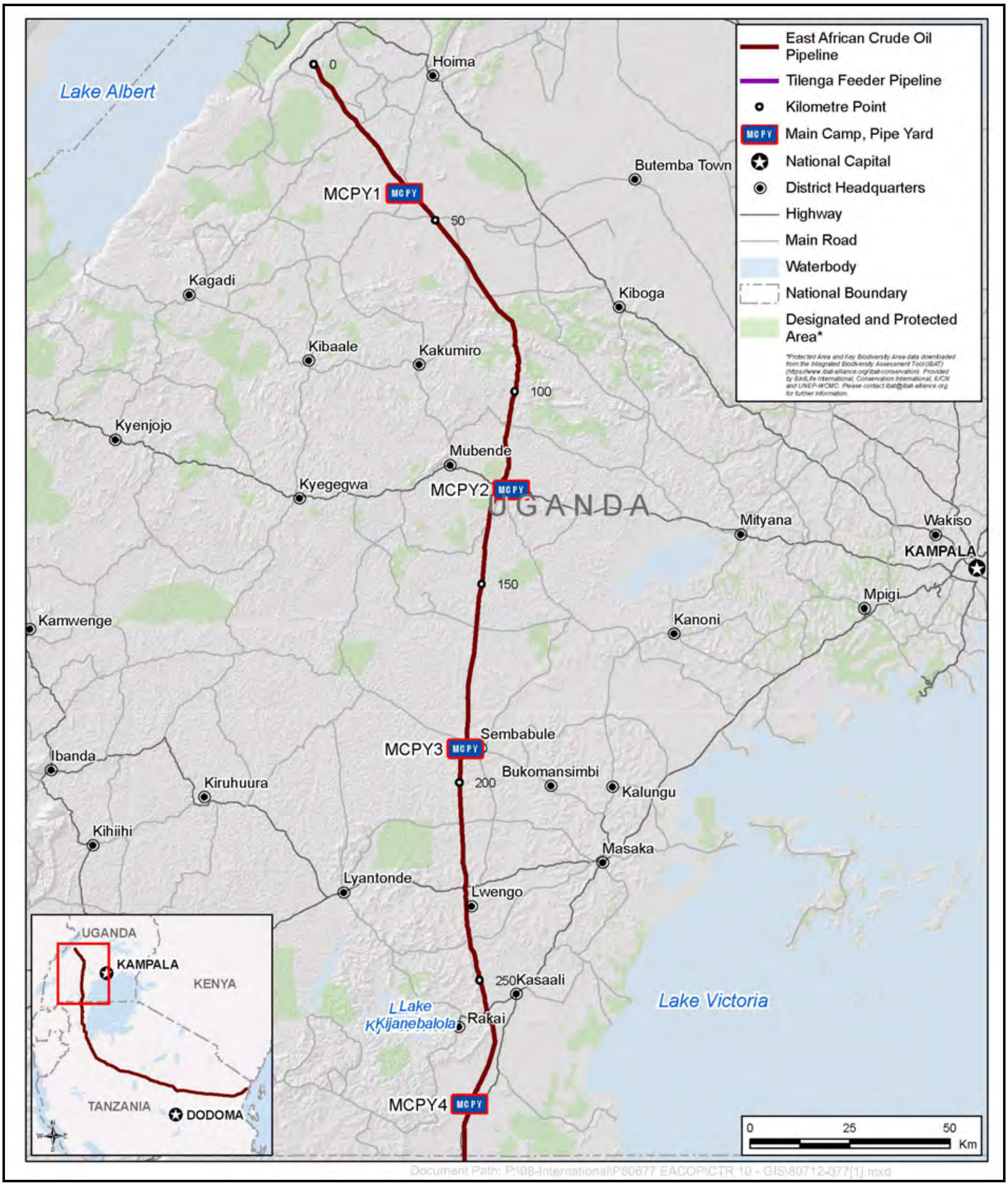

Figure 2.3-9 Construction Facility Locations

2.3.4.1 Camps

Function

Four MCPYs will be established along the pipeline corridor to accommodate workers and store line pipe before distribution along the RoW.

The camps have been designed to accommodate 800–1000 people. Among the criteria for identifying camp locations was the requirement to minimise the daily commute from the camp to the work site. Depending on where the work will be conducted, it may be possible for local workers to commute from their homes. The construction of these campsites will require a temporary workforce, which will be accommodated where possible using local infrastructure and, where infrastructure is not available, small fly camps at the MCPYs and AGIs. (The scale and duration of fly camps is such that the impacts are not substantive enough to require assessment. However, the same level of mitigation will be applied to the operations of these camps as the rest of the project.)

Locations and Size

MCPY locations are based on site selection criteria (see Section 3.6.4) that include being sited within approximately 50 km of the most remote work site, minimising the land required and distance from existing road networks, and avoiding populated and protected areas. MCPY locations are provided in Table 2.3.2.

Table 2.3.2 Main Camp and Pipe Yard Locations

MCPY	KP
MCPY1	39.3
MCPY2	124.6
MCPY3	191.2
MCPY4	283

A footprint of approximately 350 × 500 m will be required for each MCPY. The camp section of an MCPY will be approximately 350 × 220 m and the pipe yard 350 × 280 m. All MCPYs are on agricultural land.

Camp Layout and Components

The shape and extent of the camp footprint will vary with consideration of local, environmental, social and cultural features, and will contain the following components:

- accommodation and sanitary facilities
- recreation facilities
- a kitchen and canteen
- offices
- workshops
- a first aid post
- water supply and treatment

- a sewage treatment system
- waste storage and processing
- power generators
- fuel storage
- an emergency evacuation area.

MCPYs will have a non-electrical wire perimeter fence with entrance control gates and a security post. A typical MCPY layout is depicted in Figure 2.3-10.

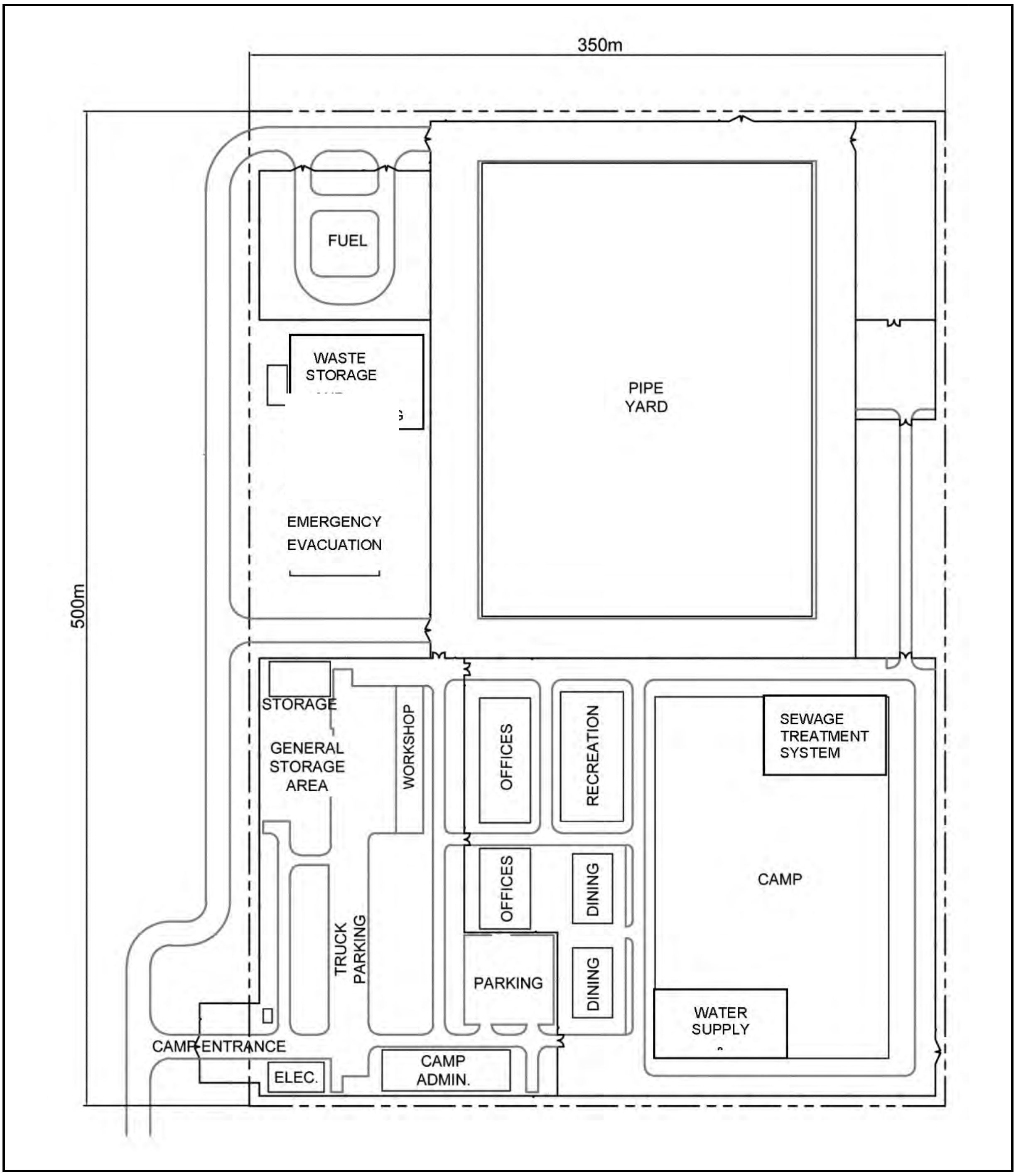

Figure 2.3-10 Typical Main Camp and Pipe Yard

2.3.4.2 Pipe Yards

Pipe yards can store up to 7000 sections of 18-m-long coated pipe. Pipe yards, depending on their locations can store pipe for direct transport to the RoW. MCPY1 and 2 are marshalling yards for both the distribution of line pipe to the RoW and other MCPYs, thus optimising transportation requirements.

Other material and equipment will be stored in the pipe yard storage areas before being dispatched to the RoW, including high-voltage, EHT and fibre-optic cable drums, MLBVs, and electrical and instrumentation shelters. Coated pipe will be transported to the marshalling yards and MCPY by truck from the coating facility in Tanzania.

2.3.5 Access Roads

Two types of access roads will be constructed by the project:

- permanent new and upgraded existing access roads to PS1 and PS2
- new and upgraded existing access roads to construction facilities.

The location of the facility dictates the route selection for each type of road. The selection process aimed to optimise the use of existing roads that could be upgraded to meet project requirements, taking into consideration affected communities. For example, the main access road to a pipe yard will avoid, as far as practical, passing through a community. The length of access roads required for AGIs and construction facilities is provided in Table 2.3.3.

Table 2.3.3 Access Roads and Approximate Lengths

Facility Type	New Access Road (m)	Existing Road Upgrade (m)
Permanent Facilities (AGIs)		
PS1	5625	0
PS2	0	184
Construction Facilities		
MCPY1	558	0
MCPY2	560	0
MCPY3	738	1710
MCPY4	535	4148

All roads will be surveyed, designed, constructed, repaired and maintained to Uganda National Roads Authority (UNRA) standards, with the cooperation of UNRA.

Permanent access roads will be 8 m wide and construction access roads will be 5 m wide. Unless otherwise specified, the roads will have a design speed of 40 km/h.

All access roads to construction facilities will have a murram (laterite) surface while permanent facilities will have sealed tarmac access roads. During the construction phase, when the roads will be used extensively, graders will be used for regular maintenance. After completion of the construction phase, road maintenance will be supplied by the Government as part of its regular road maintenance programme.

Access to the stand-alone electric substations and those associated with MLBVs will be, as a base case, via the permanent RoW. Their access requirements will be reviewed during the detailed design to ensure practical access from the nearest existing infrastructure. When the locations are identified environmental and social evaluation will be undertaken.

2.3.6 Land Requirements

2.3.6.1 Area Requirements

There are two categories of project land requirements:

- construction phase only for the camps and pipe yards
- construction and operation of the EACOP System.

All land required for the project in Uganda, summarised in Table 2.3.4, will be acquired on a permanent basis, even for construction facilities. Land will be acquired and consolidated on a permanent basis, by the Government of Uganda, and provided for use through a lease arrangement with the Uganda Land Commission.

Table 2.3.4 Land Requirements

Phase	Estimated Affected Area
Construction Facilities	
4 MCPYs (marshalling yards)	74 ha
Hydrotest water storage	To be confirmed
Construction and Operation	
New access roads to construction facilities, pipeline RoW and AGIs	74 ha
Operational Facilities	
Export Pipeline	
30-m-wide construction corridor	889 ha
Estimated additional temporary work space (crossings)	333 ha
Permanent AGI	
2 PSs (includes buffer, additional construction worksite and helicopter pad)	30 ha (2 ha additional temporary workspace)
MLBV stations and electrical substations	Constructed within pipeline corridor, no additional land required
Total project land requirement[5] (construction and operation)	1402 ha

[5] This excludes "orphaned land" where the pipeline corridor dissects a field, leaving small portions which are no longer viable to cultivate or use and are classed as "uneconomic".

Land will be required for construction facilities such as MCPYs and associated access roads. On average the lifespan of these facilities will be three years, with the land leases being up to five years, after which they will be decommissioned (see Section 2.4.6) and returned to the Government unless otherwise negotiated and agreed between the project and third parties or the Government.

During the construction phase, the pipeline RoW will mostly be kept within a width of 30 m. On completion in agricultural areas, the corridor will be reinstated with commercially available seed of local species, potentially supplemented by locally collected seeds, and maintained as grassland. In areas previously categorised as reserve land and designated as protected and or designated area (e.g., Forest Reserves, Game Reserves, Wildlife Management Areas, Game Controlled Areas and Open Areas), land cover will be restored and land use managed to achieve equivalent biological capability.

During operations, in agricultural areas, crossing of the corridor by pedestrians and livestock will be allowed, with provision for vehicle crossings at existing roads. During operations the pipeline RoW will continue to be 30 m.

Land will be required for the AGIs that will also remain operational over the lifespan of the project, after which these facilities will be decommissioned (see Section 2.4.6) and the land returned to the Government unless otherwise negotiated and agreed between the project and third parties or the Government.

2.3.6.2 Land Acquisition

A resettlement policy strategy (Appendix K) has been developed for the project in Uganda that sets out the principles and methodology for land acquisition, which are consistent with national and IFC requirements (see Section 8.15.3). Community-based social, land and environment teams will provide oversight of the land acquisition process to ensure that a fair and transparent process is implemented for land acquisition and reinstatement for the construction and operational facilities.

Land additional to that required for operations and construction facilities, such as borrow pits, will be temporarily secured by contractors. EACOP will require contractors developing new borrow pits on the project’s behalf to assess and mitigate potential environmental and social impacts consistent with regulatory, legal and IFC requirements and manage associated land access in compliance with national and international standards, as described in the project’s resettlement policy strategy. Where an existing borrow-pit is used, EACOP will conduct due diligence of the operator to ensure that all legal and regulatory requirements are met.

2.4 Project Activities

2.4.1 Feasibility Surveys

Pre-construction feasibility surveys were undertaken to confirm the feasibility of the pipeline corridor. The results of these studies will inform the detailed engineering phase.

2.4.1.1 Geological, Geotechnical and Geophysical Survey

Geological, geotechnical and geophysical surveys are being undertaken to:

- identify potential geological hazards in the pipeline route corridor
- determine the need for rock blasting, fault-line crossing, engineered retaining structures and unrestrained pipe sections
- develop site-specific mitigation strategies to be implemented during construction.

Geological and Geophysical Surveys

Geological and geophysical surveys are being undertaken to evaluate soil conditions and to assess potential geohazards (e.g., faulting) on the pipeline route.

The geological survey team walked the pipeline route to record the geology and conduct geological mapping. Based on the maps, the most suitable construction methodology for each geological group will be established.

For sections of the pipeline route where there is uncertainty on the soil and ground conditions, geophysical seismic data will be acquired. The data will provide information on subsurface conditions, which will support identification of potential constraints for the construction of the pipeline and other installations.

Geotechnical Survey

The physical (geotechnical) properties of subsurface soils have been established by geotechnical surveys. These surveys require drilling of boreholes to sample and test subsurface geological layers.

The geotechnical study scope includes:

- boreholes drilled to extract cores of soils, rocks and water for sampling
- trial pits dug to expose the soil layers for easy visual examination.

The soils, rocks and water samples will be analysed in a laboratory to determine structure and characteristics.

Piezometers have been installed in some of the geotechnical boreholes to measure groundwater levels and fluctuations.

2.4.1.2 Water Supply Study

Permits for surface and groundwater abstraction will be acquired and permit conditions complied with by the EACOP project.

A study to identify and evaluate potential water sources to support construction, commissioning and operations is being undertaken in stages in collaboration with the Directorate of Water Resource Management. Thus far, the project has completed some preliminary studies including:

- a study of potential existing and new water supply sources for construction facilities, AGIs and hydrostatic testing. In addition, Uganda and international potable water standards, effluent discharge standards, and Uganda abstraction and discharge permitting requirements were evaluated.

- field investigations to evaluate the availability, quality and local community use of the potential water sources previously identified. These investigations were conducted to provide data on:
  - water resource availability for engineering studies and discharge requirements
  - water resources to support permit applications
  - community water source baseline conditions.

New water supply sources for the project will be required as existing water sources are considered inadequate. A third stage that will be implemented before construction starts, will include aquifer testing, borehole siting and production well drilling. Potential water sources for the construction facilities are shown in Table 2.4.1.

Table 2.4.1 Potential Construction Facilities Water Sources

MCPY	KP	Potential Water Source	Borehole, New/Existing
MCPY1	39	Groundwater	New
MCPY2	124	Groundwater	New
MCPY3	191	Groundwater	Existing/new borehole
MCPY4	283	Groundwater/surface water (Kibale River)	New/direct river abstraction

Water will be required for hydrotesting of the pipeline and a hydrotest management plan will be prepared, both described in Section 2.4.2.2.

The hydrotest management plan will include hydrostatic test water abstraction quantity and quality requirements and procedures to avoid harm to the environment or adverse effects on downstream users.

Surface water will be the primary source of water for hydrostatic testing. Where surface water is not available to make up losses incurred during testing, groundwater, if permitted, and without causing impacts to local groundwater resources, may be used to make up losses.

2.4.2 Construction

2.4.2.1 Strategy and Logistics

Overview

EACOP construction will be primarily influenced by logistics, the mobilisation of materials and labour to the remote portions of the pipeline corridor and AGI sites, rather than by construction processes.

Early Works

For construction work to begin, some preparatory activities, commonly referred to as early works, are required. Early works provide the required facilities needed for construction to start in locations where there is no existing infrastructure.

Spread Strategy

The export pipeline is expected to be constructed in one spread in Uganda, as shown in Figure 2.4-1. The direction of construction is expected to be from east to west. Each spread's location, length and major components are described below. The plans will be progressed after the pipeline laying contractor is confirmed.

Construction from the Kabaale Industrial Park (KP0) to the Uganda–Tanzania border (KP296) will be undertaken as Spread 1, which will include:

- 296 km of 24-in. pipeline
- fifteen MLBV sites
- four MLBV sites co-located with electric substations
- one standalone electric substation
- two electric substations, one each at PS1 and 2.

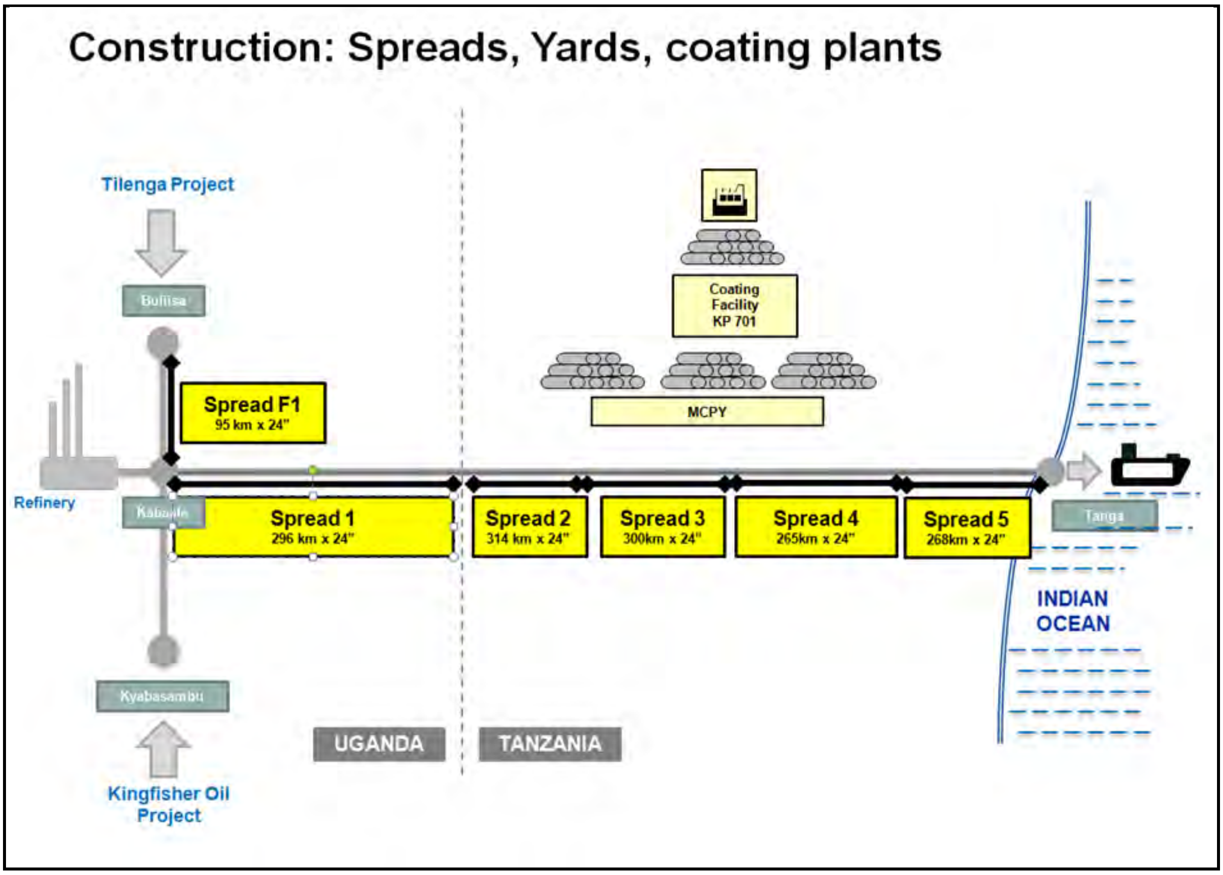

Figure 2.4-1 Construction Spreads

Pipe and Material Transportation

The project has undertaken an evaluation of logistics options and developed a strategy for the delivery of supplies and construction materials to predetermined locations on schedule.

Transportation requirements for approximately 17,500 × 18-m-long pipe sections, and associated infrastructure constraints and opportunities, were considered to identify the optimum logistics strategy. Section 3.8.2, Alternatives, addresses the logistics strategy selection process.

Imported construction materials will enter Tanzania via the ports of Dar es Salaam and Tanga. From there, the pipe (only via Dar es Salaam) will be transported to a coating plant in Nzega district, Tabora region Tanzania. AGI components and construction materials will be transported to Uganda and between storage facilities and construction sites.

Construction materials sourced domestically will be delivered through a combination of local and project suppliers.

Payload will be recorded at the start and end of journeys and monitored.

Road

The insulated and coated pipe will be transported from the pipe coating plant by road to the EACOP MCPYs and, in some cases, despatched directly to the work sites. The road network used by the trucks transporting pipe and construction materials is mostly in good enough condition to permit trucks to travel 320 km per day at an average speed of 40 km/h.

Trucking requirements are summarised as:

- one driver per truck
- driving between 06:30 and 18:30
- 2 hours maximum continuous driving
- 10 hours maximum driving per day.

Project traffic information is included in Section 8.16.2.1, Tables 8.16-1 and 8.16-2.

Maintenance and Upgrades of National Roads

The Government of Uganda through the UNRA has an ongoing road maintenance and upgrade programme. The project will work with the UNRA to have planned road maintenance and upgrades sequenced to facilitate project logistics.

Permanent and construction access roads required by the project are addressed in Sections 2.3.5, below in this section, and in Section 2.4.2.1.

Rest Stops

Drivers will be required to take day rest stops every two hours of driving and overnight rest stops every 10 hours of driving. A survey of suitable rest stops along the proposed routes has concluded that existing facilities are sufficient.

Labour Transportation

Buses and four-wheel drive vehicles will transport personnel from the MCPYs to the different construction locations. Local hires from the surrounding areas who live outside the camps will travel to work by shuttle bus service.

Construction Facilities

The fundamental aspects of the construction philosophy for MCPY and access roads include:

- the sequential use of construction crews contributing to a smaller construction footprint, as fewer construction personnel require less camp facilities
- modularisation and commonality leading to assembly instead of “stick-building” on site, which reduces construction time and construction waste generated at the sites
- the close coordination of construction, and the supply and delivery of pre-purchased equipment to reduce construction time.

An associated advantage of this construction philosophy is that the facilities will be constructed with a high degree of safety and reliability.

Aboveground Installations

The fundamental aspects of the AGI construction philosophy are similar to those for construction facilities and include:

- the sequential use of construction crews, starting near major AGI equipment and material supply laydown areas, contributing to a smaller construction footprint, as fewer construction personnel require less camp facilities
- modularisation and commonality leading to assembly instead of “stick-building” on site, which reduces construction time and construction waste generated at the sites
- the close coordination of construction and the supply and delivery of pre-purchased equipment reduces construction time.

An associated advantage of this construction philosophy is that facilities will be constructed with a high degree of safety and reliability.

Crossings

One of the pipeline route selection considerations was that the selected route should have a minimal number of crossings (see Section 2.3.1). Even so, owing to the relative long distance traversed, the pipeline will require 222 crossings of the various types described in Section 2.4.2.5.

When the pipeline corridor crosses large infrastructure or watercourses, special construction methods (see Section 2.4.2.5) will be employed to reduce the effects on road and rail use, resource users and biodiversity. These crossings will be managed as separate construction activities, which can be completed independently to the main pipeline construction sequence.

Roads

Access Roads Philosophy

The creation of new access roads will be required in some areas of Uganda. However, because the pipeline has been routed as much as possible near existing infrastructure, the need for new access roads has been reduced.

AGI and construction facility selection criteria included minimisation of their distance from the national road network and optimisation of existing roads that can either be used directly, or that will need an upgrade to accommodate project traffic volumes.

National and District Road Upgrades

The Government of Uganda through the UNRA is currently upgrading key road networks required for oil activities. Planned upgrades, shown in Table 2.4-2 and Figure 2.4-2, will support project logistics.

Table 2.4-2 Road Upgrades

Road Section	Length (km)	Type
Kyenjojo–Kabwoya	69	Murram road to be converted to sealed tarmac
Kabwoya–Hoima–Bulima	66	Murram road to be converted to sealed tarmac
Bulima–Masindi–Kiguma	107	Murram road to be converted to sealed tarmac
Mubendi–Kakumiro–Kabaale–Kagadi	159	Murram road to be converted to sealed tarmac
Hoima–Butiaba–Wanseko	111	Murram road to be converted to sealed tarmac
Buhimba–Nalweyo–Bulamagi and Bulamagi–Igayaza–Kaumiro	93	Murram road to be converted to sealed tarmac
Lusalire–Nkonge–Lumegere–Ssembabule Roads	97	Murram road to be converted to sealed tarmac
Masindi–Biiso, Kabaale–Kizirafumbi and Hohwa–Nyairongo–Kyaruseha	106	Murram road to be converted to sealed tarmac
Kabwoya–Buhuka and Ntoroko–Karugutu	98	Murram road to be converted to sealed tarmac

SOURCE: UNRA presentation at 4th annual O&G Convention, 28 April 2018

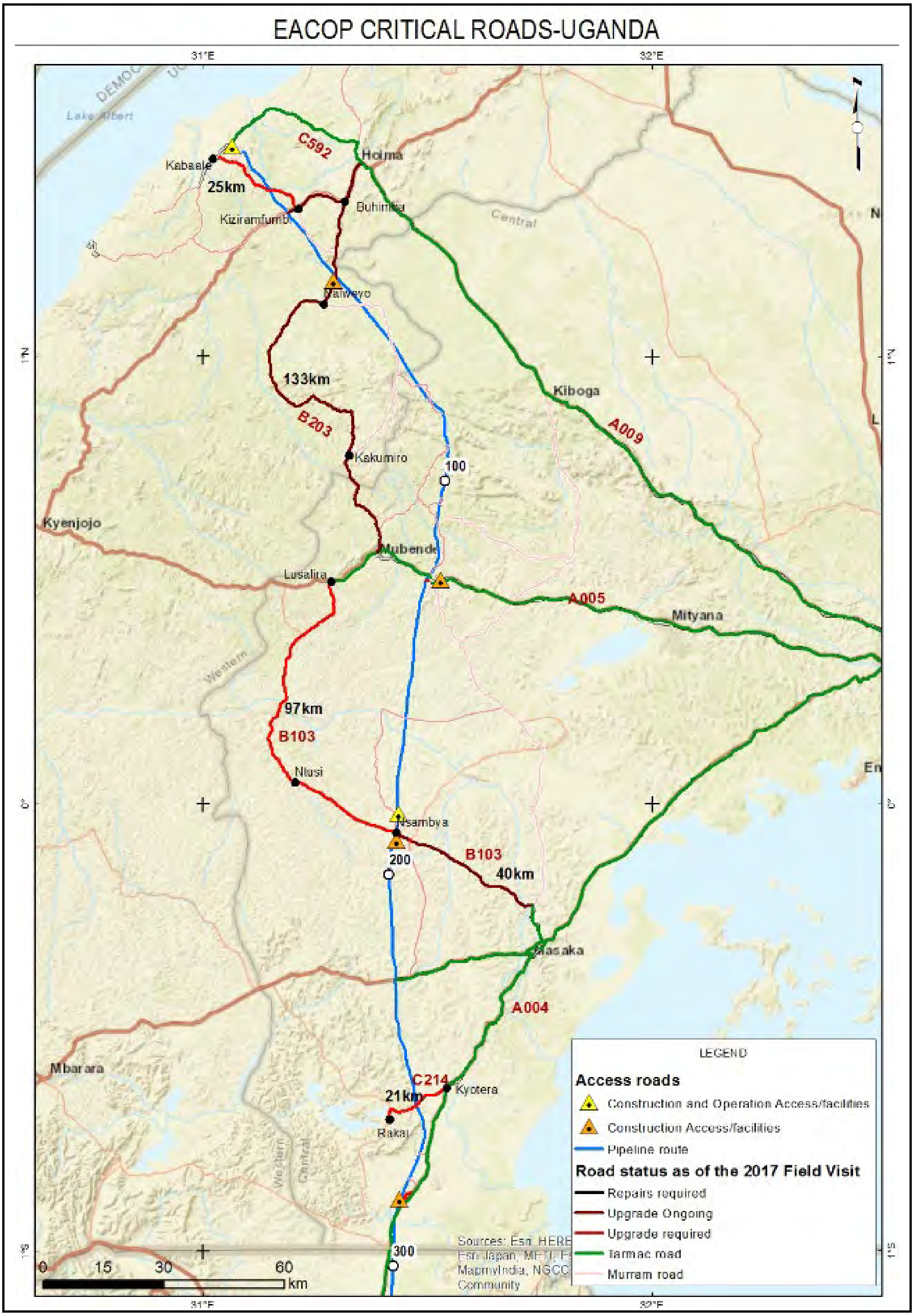

Figure 2.4-2 Road Upgrades

Resources and Local Resourcing

Construction Materials

Construction materials will be sourced from inside and outside the country.

The project has undertaken preliminary resource abstraction studies that require the following guiding principles to be implemented by contractors:

- local resources will be sourced in a way that limits impacts on local use
- sourcing will be as close as possible to the locations requiring the resource
- sourcing from resource locations should be minimised and sustainable.

The sources of materials from Uganda will be identified in later project phases. One of the EACOP project objectives is to optimise the use of locally available materials.

Estimated quantities for the primary construction materials required are:

- gravel – 44,000 m^3
- sand – 52,000 m^3
- cement – 4400 m^3
- murram – quantities will be identified during construction.

In addition, the following materials will also be sourced locally:

- concrete blocks
- engineered backfill soils
- fencing
- rebars
- geotextile materials
- lumber
- tarmac asphalt.

Materials Sourced Abroad

Materials sourced outside Uganda and that will be assembled or installed at site include, but are not limited to:

- pipe
- high-voltage cable for power distribution
- heating equipment including 888 km of heat tracing cables
- fibre-optic cables
- valves and metering equipment.

Water Requirements

The estimated project water requirements are:

- construction camps – potable water 200 m^3/day at maximum occupancy (up to 1000 people)
- construction activities – 100–200 m^3/day
- hydrostatic testing 16,000 m^3 per test section required, see Section 2.4.4.2.

A water study is being undertaken and is described in Section 2.4.1.2.

Construction Equipment

Construction will require equipment including, but not limited to:

- trucks to transport pipe
- bulldozers and graders for site preparations
- tippers for materials
- backhoes for excavation
- trenching machines
- cold bending machines
- welding and weld testing equipment
- side boom cranes to lift pipe string
- cranes, forklifts and cement mixers.

Labour

A labour management plan will be prepared that will set forth the policies, objectives and procedures to maximise local content employment for the project, including relevant training and job-readiness support for host communities. Direct recruitment for suitable positions to support the development and indirect recruitment of Ugandan nationals by contractors and suppliers supporting the development will be targeted.

As well as technical and commercial criteria, contractors will be evaluated based on their commitment to local content and on their training and capacity building plan. The contractors will be assessed for the number of positions, the nature of the roles and associated training, and the commitment to local content optimisation.

Project Requirements

The approximated size of the construction labour force for the different project components is as follows, for the:

- MCPYs and access roads – 200–250 skilled and 20–40 unskilled workers
- pipeline spreads – 900–1700 skilled and 100–150 unskilled workers per spread depending on the stage of construction
- PSs – 130–200 skilled and 10–20 unskilled workers
- EHT – 20–40 skilled and 5–10 unskilled workers.

Local Content Management

A local content plan for the project will be established. This will identify:

- areas and disciplines where Ugandan companies can gain valuable capacity in partnership with international contractors
- ways to maximise Ugandan manpower
- opportunities for capacity building and technology transfer
- local communities’ development initiatives.

The project has already taken some initiatives to proactively work with Ugandan companies and encourage their participation in the project and field development activities. The objective is to focus on identifying and promoting the use of local resources and working collaboratively to develop the resources on a long-term basis by:

- maintaining communication between the project and potential Ugandan suppliers by initiating a regular and supervised dialogue
- providing assistance to Ugandan companies by offering support to specific sectors
- supporting the educational system by reinforcing the best academic institutions already in place to focus on certification programmes to develop qualified technicians.

The pipeline will be constructed near villages, towns and cities. Inhabitants from these communities will have the opportunity to provide labour and the supply of goods and services. Table 2.4.3 lists the population centres nearest to project facilities.

Table 2.4.3 Population Centres Near Project Facilities

Site	Population Centres	Distance in (km)
PS1 and MCPY1	Hoima	30
MCPY1	Kakumiro	43
MCPY1 and MCPY2	Kyankwanzi	57 and 83
MCPY2	Mubende	17
PS2 and MCPY3	Kyengera	24 and 30
PS2 and MCPY3	Sembabule	7 and 4
MCPY3	Lwengo	39
MCPY4	Rakai	20

Supply Chain Management

Supply Chain Management Philosophy

The project will follow competitive tendering process to select contractors to complete construction activities.

Local content will be a criterion among others for selection of the contractors.

Contractors and subcontractors will be required to implement and optimise local content by adhering to local content principles set out in the local content plan and be encouraged to propose ‘enhanced’ local content initiatives that go beyond such requirements.

2.4.2.2 Pipeline

When the land acquisition process is completed as described in Section 2.3.6.2, construction activities will be sequenced as follows:

Pipe Storage

For pipe storage in the RoW where soil (sand, loam or similar) berms are used, the following minimum measures will be applied:

- lay-down areas will be covered with polyethylene sheets or similar
- the soil or sand used for lay-down areas will be sifted and free from rocks and gravel.

Right of Way Clearing and Grading

Before clearing, a risk management process will be conducted for land mine potential, primarily for the pipeline near the national boundary and for MCPY4. It will include four steps:

- explosive remnants of war risk assessment
- nontechnical survey depending on risk assessment findings
- technical survey depending on nontechnical survey results and impact on the project
- clearance programme depending on technical survey results and impact on the project.

After clearance the 30-m-wide RoW will be grubbed to remove all organic material and cleared of debris to permit the movement of work crews, pipe and equipment. Topsoil and subsoil will be stockpiled, and silt fences will be installed to control erosion. Figure 2.4-3 is a photo of typical topsoil removal. Drainage and sediment mitigation measures will be implemented in areas prone to run-off and near surface water, see Section 2.4.3.3.

Where required existing services will be temporarily removed or permanently relocated.

Where the pipeline is routed along a side slope, benching of the RoW may be required to create a safe work area. On steep gradients or narrow ridges where successful reinstatement is difficult to establish, benching may become permanent.

Figure 2.4-3 Typical Topsoil Removal

Stringing

Pipe will be delivered to its pre-determined location, unloaded and positioned in a way that avoids damage to both the pipe and its coating. Pipe will be supported by skids to avoid contact with the ground. Figure 2.4-4 shows typical pipe stringing.

Figure 2.4-4 Typical Stringing

Bending

Bending accommodates elevation and directional changes and can be executed in two ways:

- Hot bending will be done during the pipe manufacturing process for tight-radius directional bends. This process allows for precise control of the specific bend angles.
- Cold bending, mostly done in the field and outside the insulated pipe, is used to bend steel pipe up to a maximum cold bending angle (approximately 10° per joint). The maximum allowable angle for the pipeline route will have to be taken into consideration and if this angle is exceeded hot bends are required. Figure 2.4-5 shows a typical cold-pipe bending machine.

Figure 2.4-5 Typical Cold Bending Machine

Welding

Pipe sections will be prepared and welded together. For main line welding the pipe sections are assembled in long strings that are placed in the RoW beside the trench. Tie-in welds, usually performed in the trench, connect pipeline sections. Figure 2.4-6 shows typical pipe welding.

Figure 2.4-6 Typical Pipeline Welding

Nondestructive Testing

Nondestructive testing is performed to identify joint weld flaws. The linear welds undergo testing at the place of manufacture.

Two nondestructive testing methods can be used:

- Industrial radiography tests for hidden flaws and defects in the weld with X-ray or gamma radiation. Film or specific sensor may be used.
- Manual or automatic ultrasonic testing are used for defect detection in steel components or welds. Figure 2.4-7 shows automatic ultrasonic testing. Ultrasonic testing makes use of high frequency (ultrasonic) sound waves. When the ultrasonic waves travel through a material, they will reflect or diffract (scatter in all directions) at inconsistencies and travel back to a transducer. The transducer records an electric signature that allows for the identification of inconsistencies.

The radiographic test and manual or automatic ultrasonic testing methods will be evaluated by the pipeline construction contractor, who will also be responsible for the selection of the most suitable method.

Figure 2.4-7 Automatic Ultrasonic Testing

Field Joint Coating

Joints will be protected with a coating that is compatible with the pipe anti-corrosion coating and thermal insulation system and that is applied in the field. Figure 2.4-8 shows an anti-corrosion field joint coating.

The weld surface will be cleaned and grit blasted in preparation for coating. A two-part liquid epoxy resin will be sprayed around the entire circumference of the pipe. A high-density polyethylene sleeve will be made for the joint and fuse welded to the pipe’s high-density polyethylene outer jacket ensuring water tightness and protection before injection of thermal Insulation into the sleeve.

On completion of the process, inspections will be conducted of the coated field joints.

Figure 2.4-8 Anti-Corrosion Field Joint Coating

Trenching

Trench Location

The trench centre line will be as identified and marked by the pre-construction survey team, taking into consideration the location indicated on approved pipeline alignment drawing and local topography (drains, rock and outcrops) restrictions. Local deviations may be required to facilitate construction.

Location of Services, Pipelines and Cables

Before any excavation, the owner and or operator of any facility or utility expected to be crossed or encountered closely by the pipeline will be informed.

Services, pipelines and cables that will be crossed will be located as accurately as possible by:

- assessment of available drawings
- electronic sounding
- hand digging.

Excavation

A trench will be excavated, approximately 1.8–2 m deep, in which the pipe will be installed. The trench bottom and walls are prepared to a condition that allows for the coated pipeline to be lowered in without damage.

Topsoil Segregation

In agricultural land, the topsoil and subsoil will be stripped and stored along the RoW on the side opposite to the working side. Topsoil will be stored separately from subsoil. Additional description of topsoil stripping is included in Section 2.4.3.2.

Excavation in Normal Soils

For excavation through normal soils, the trench will be advanced using a tracked excavator or a continuous trenching machine (Figure 2.4-9). The depth of the trench excavated will provide pipeline cover in accordance with the approved alignment drawing. The depth and width of the trench will be checked as excavation progresses by using gauge canes or templates, held by worker in front of the operator.

Figure 2.4-9 Typical Trenching Machine

In areas where personnel safety or the integrity of adjacent facilities is a concern, the trench will be sloped back to an appropriate angle, to prevent material from collapsing into the trench. Material excavated from the trench will be piled on the side of the trench opposite to the work side and sufficiently far back from the edge of the trench to prevent overloading of the trench walls.

The approximately 1 m wide trench bottom will be smooth with no rocks exceeding 25 mm in diameter and will match the pipeline profile.

Consistent with pipeline construction best practices, the trench will be excavated complete with escape ramps, or side cuts into the trench wall, to allow a safe exit from within the trench. The slope of the escape ramps should not exceed 45°. The ramps should be excavated every 500–1000 m (terrain dependent) to provide an escape route for any personnel working or animals that may become trapped in the trench.

Excavation in Rock

In areas of rock, when the grading is completed, a large machine that can rip rocks and a backhoe will be used to assess if the trench can be dug, ripped or requires blasting.

When the trench is to be excavated through areas of rock that can be ripped, the rock will be ripped using large construction equipment pulling a single shank ripper.

If blasting is required, it will be conducted by licensed contractors who will develop site specific plans that include:

- notification requirements for workers and surrounding population
- controls to prevent rock projectiles
- procedures that reduce environmental impacts (e.g., noise and vibrations).

On completion and implementation of the blasting plan, tests will be undertaken and geologists will:

- inspect the rock to determine blast effectiveness
- evaluate microblasting criteria for potential implementation.

Microblasting avoids rock projectiles and creates less noise and vibrations but can only be used under certain conditions. Sections suitable for microblasting will be identified during construction, based on geology, and proximity to infrastructure and environmentally sensitive features. If blasting is required, the excess blasted rock, which is unsuitable for use as backfill will be disposed of in approved rock disposal areas.

Excavation through Wetlands

Topsoil normally is not segregated in wetland areas. Dry wetland areas will be excavated using normal methods to the extent possible.

For saturated wetlands, the trench will be excavated using tracked excavators fitted with swamp mats, board roads, timber riprap or similar devices. Excavated spoil will be stockpiled on the nonworking side of the RoW for seasonal wetlands.

The extent of disturbance will be restricted to that which is required for the excavation of the trench. Traffic through the wetland is to be restricted to only those vehicles necessary to install the pipe, to the extent practical.

Flooded wetlands will be excavated using either tracked excavators or draglines from barges or similar equipment, or using marsh equipment excavators. Spoil will be piled adjacent to the pipe ditch.

Padding and Lowering and Laying

Before pipeline installation, the trench bottom will be cleared of hard and sharp elements and unstable soil encountered at the trench bottom removed. Figure 2.4-10 shows a pipe being lowered and laid.

Figure 2.4-10 Lower and Lay

The trench bottom, where necessary, will be covered with a continuous layer of soft padding material, using approved material. Padding material, free from rocks, stones and debris, will be placed to provide uniform bearing and support for each pipe section.

When the pipeline padding coating has been inspected and approved, side booms will lift the welded string, and lower and lay it into the trench.

Pipe sections will be lifted in a way that reduces the risk of damage to the coating. Booms will be fitted with padding and when lifting the pipe, the booms will be evenly spaced along the section for an even load.

When the pipe section has been placed in the trench, the ends will be welded to the adjacent sections, or sealed with caps to prevent the entry of dirt or animals until welded.

Backfilling

Initial backfill, free from large rocks and stones, will be placed from the padding material to approximately 0.3 m over the top of the pipe and will be placed as soon as possible to maintain pipe alignment and provide protection.

A high visibility polyethylene pipeline warning net, with a width equal to the pipeline diameter, will be placed 0.3 m above the pipeline over the entire route.

Final backfill will extend from the initial backfill to the top of the trench. Final backfill will be placed in layers of 0.3 m. No rocks or stones will be allowed within 1 m of the pipe. A front-end loader or a bulldozer will be used to push the spoil bank into the trench at an angle so that impact on the pipe is avoided. Surplus material will be spread over the trench.

High-Voltage Cables

The high-voltage power cables will be installed approximately 4.5 m from the pipeline centre or as far away from the pipe as possible, in a separate trench within the RoW, as shown in Figure 2.3-2. The required depth of burial will be approximately 1.25 m to top of the cable. In addition to the separation distance, the high-voltage line will be in an armoured cable, protecting the pipe from the induced electromagnetic field.

The high-voltage cables are installed using the same methods as the pipeline installation. The trenching and laying of the cable as shown in Figure 2.4-11, will be done concurrently using a trencher and cable laying equipment. Backfilling of the trench will use the same methods as for the pipeline.

Figure 2.4-11 High-Voltage Power Cable Installation

2.4.2.3 Construction Facilities

Civil Construction

Civil construction of construction facilities will include:

- cut and fill
- building of foundations
- laying drainage and underground services
- compacting soils for the stability of the site
- site surfacing.

Main Camp and Pipe Yard

MCPY construction will include:

- installation of fencing, a generator set, water wells and sewage treatment
- installation of camp materials and equipment that can be portacabins, containers or flat pack units. At some MCPY, buildings will be erected using concrete blocks.
- installation of offices and accommodation on wooden skids and connected to distribution networks
- building of concrete-block facilities, such as bunded fuel storage and workshops, by local subcontractors
- maintenance of access roads during construction activities.

2.4.2.4 Aboveground Installations

The remoteness of some of the AGIs may require the installation of construction infrastructure such as concrete batch plants. When possible, pre-fabricated construction will be employed to reduce field construction requirements.

AGI construction will begin with site preparation and establishment of drainage and erosion mitigation measures to assure that the site remains ready for further construction under all weather conditions. Once the site preparation crew executing civil construction is finished, they will begin preparation at another AGI site.

After the site is ready, foundations will be poured for major equipment, buildings, and pipe supports. Concurrently, equipment such as pumps, generators, other process equipment and tankage will be delivered to the construction site for setting. The lifting crews and equipment will move from site to site.

When the major equipment has been installed, piping and cables will be laid out and connected. When piping, electrical and instrumentation connections are completed, testing of each portion of the AGI facility will begin.

On completion of the primary AGI construction activities, fencing, station roads, guard houses and entry gates will be constructed.

2.4.2.5 Crossings

Overview

There will be a need to construct pipeline crossings of watercourses and wetlands, roads and infrastructure. Crossing alternatives are described in Section 3.8.3.3.

The construction for all crossings will require a temporary workspace area of approximately 1.5 ha that may extend beyond the 30-m wide construction RoW.

Where possible, the pipeline will intersect crossings at an angle as close to 90° as possible to reduce addition to pipeline length. External casing will be installed for the auger-bored crossings and where specifically requested by regulatory agencies and utility owners.

Pipe with a larger wall thickness will be used for waterbody and wetland crossings. For anti-buoyancy, pipe will be coated with concrete. Geotextile bag weights, concrete set-on weights, screw anchors or concrete coating could also be applied at the wetlands.

Regular pipe will be used for road and railroad crossings. Sealed tarmac roads and railroads will be bored with 36-in. casing, and murram roads and dirt tracks will be open cut without casing.

The project will consult with relevant government agencies responsible for infrastructure such as tarmac roads, power lines and the railway before constructing crossings to discuss crossing locations, timing, and infrastructure crossing guidance.

Types and numbers of crossings are provided in Table 2.4.4 and described below.

Table 2.4.4 Crossings

Type of Crossing	Number	Length (m)
Perennial Rivers	4	506
Perennial Streams	2	91
Ephemeral Streams	28	1387
Wetlands	56	24649
Murram Roads	166	1885
Sealed tarmac Roads	4	156
Railway	1	36
Powerline	17	TBD[6]
Fault lines	TBD	TBD
TOTAL	278	28710

Watercourse Crossings

Strategies for crossing watercourses depend on several site-specific factors, most importantly, the size and nature of the watercourse, and the nearby environmental

[6] To be determined during detailed engineering.

and social features. Open-cut is the default crossing method for all watercourse crossings in Uganda based on the FEED concept design. However, final site specific watercourse crossing methods will be chosen during detailed design and site evaluation by the selected construction contractors.

Wet Open Cut

A wet open cut crossing does not require a diversion of stream flow and includes the following steps:

- survey of the crossing location
- preparation of the pipeline string that will be installed
- digging a 1.8 m deep trench, starting and ending approximately 50 m either side of the watercourse
- pulling the prepared pipeline string, fitted with concrete weights where required, into the trench
- natural backfilling in turbid streams and engineered backfilling in the trench for clear-water streams.

Open-cut watercourse crossing methods will include the following mitigation measures:

- a reduced working width will be used
- a wider RoW will be used on either side of the crossing to accommodate the temporary storage of bed and bank material
- seasonal watercourses will be crossed during the dry season where practical
- sediment control will be installed
- fuel will not be stored within 30 m of the crossing.

Figure 2.4-12 depicts a typical open-cut crossing.

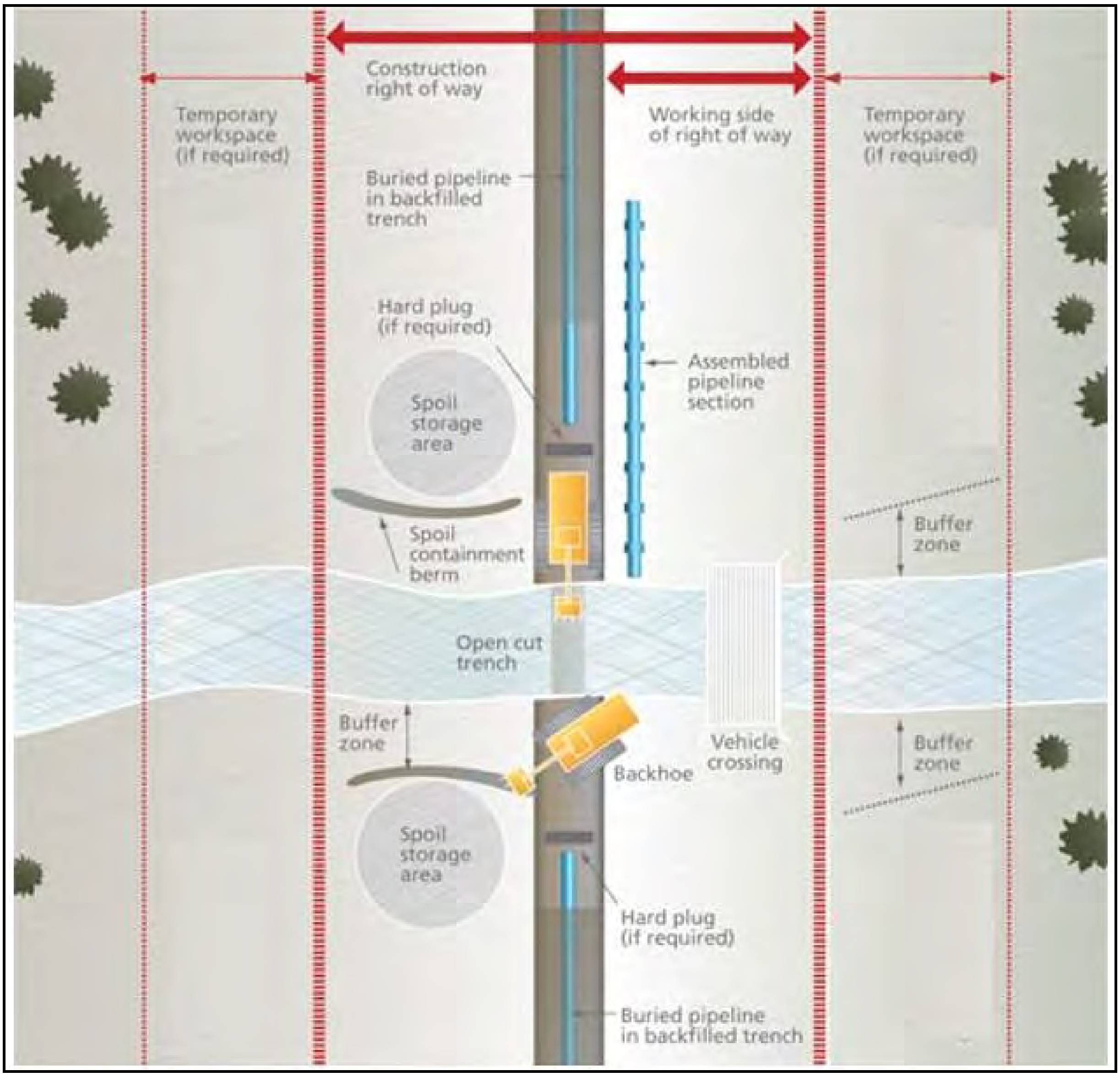

Figure 2.4-12 Open Cut Crossing

Wetland Crossings

Wetland crossings have been identified from LIDAR data and verified through field surveys.

Strategies for crossing wetlands will depend on several site-specific factors, most importantly, the size and nature of the wetland, and the nearby environmental and social features. Open-cut is the default crossing method for all wetland crossings based on the FEED concept design. However, the final site-specific wetland crossing method will be chosen during detailed design and site evaluation by the selected construction contractors

For open-cut crossings of annual wetlands (standing water or saturated soil for most of the year), construction equipment used (e.g., an amphibious excavator or floating pontoon) will have prefabricated equipment mats to reduce soil erosion. The amphibious excavators have a reach of up to 20 m in front and can operate in down to 10 m water depth. The specific type of equipment to be used will be selected during detailed engineering and site inspection. Sediment control measures will be installed to avoid impacts on adjacent wetland, and fuel will not be stored within 30 m of the wetland. Figure 2.4-13 shows a cross-section of an annual wetland crossing.

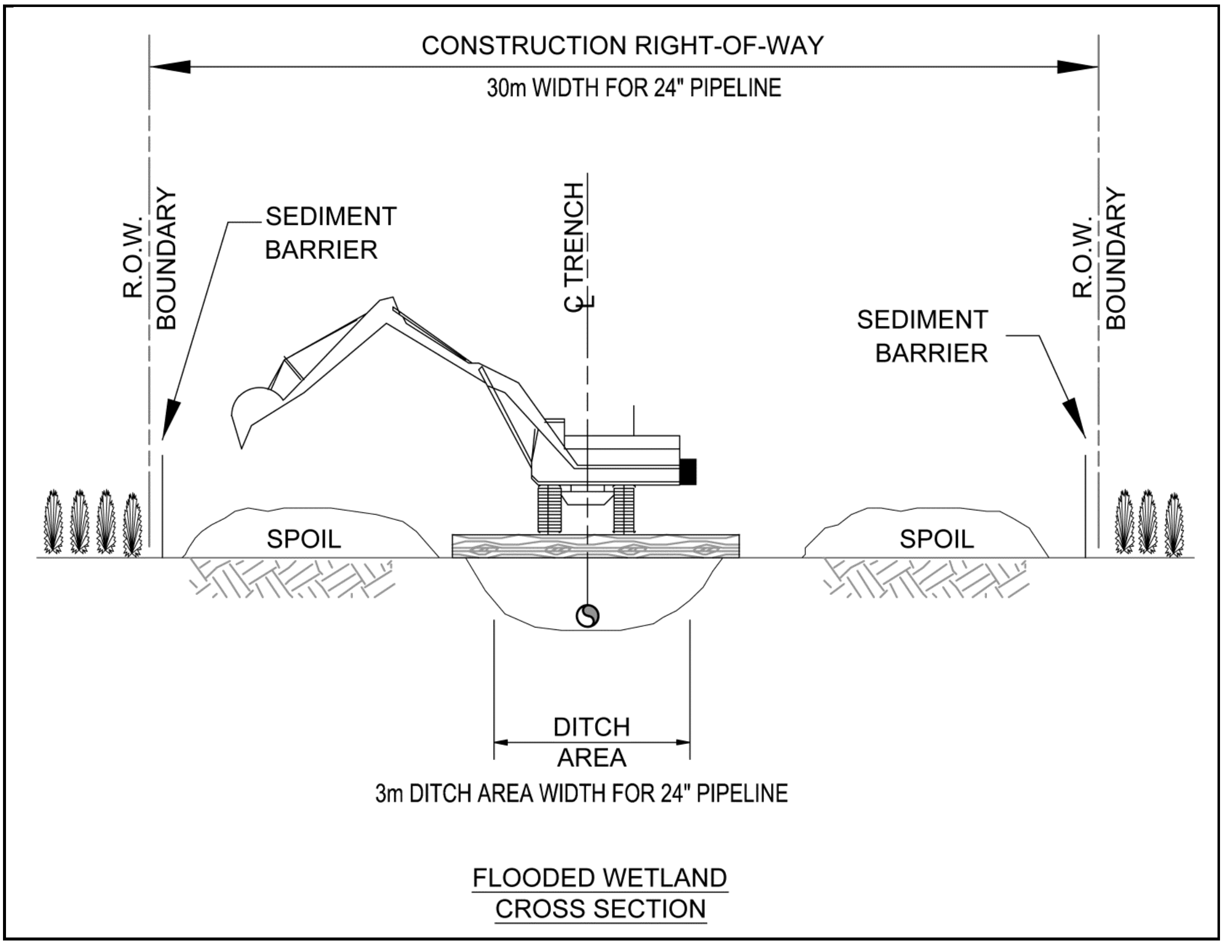

Figure 2.4-13 Crossing of Annual Wetlands

Seasonal wetlands (no standing water or saturated soil for most of the year) will be open cut with a narrower trench, as erosion is not as great a concern. Construction equipment will use prefabricated equipment mats to reduce soil erosion. Sediment control measures will be installed to avoid impacting on adjacent wetland, and fuel will not be stored within 30 m of the wetland. Figure 2.4-14 is a cross-section of a seasonal wetland crossing.

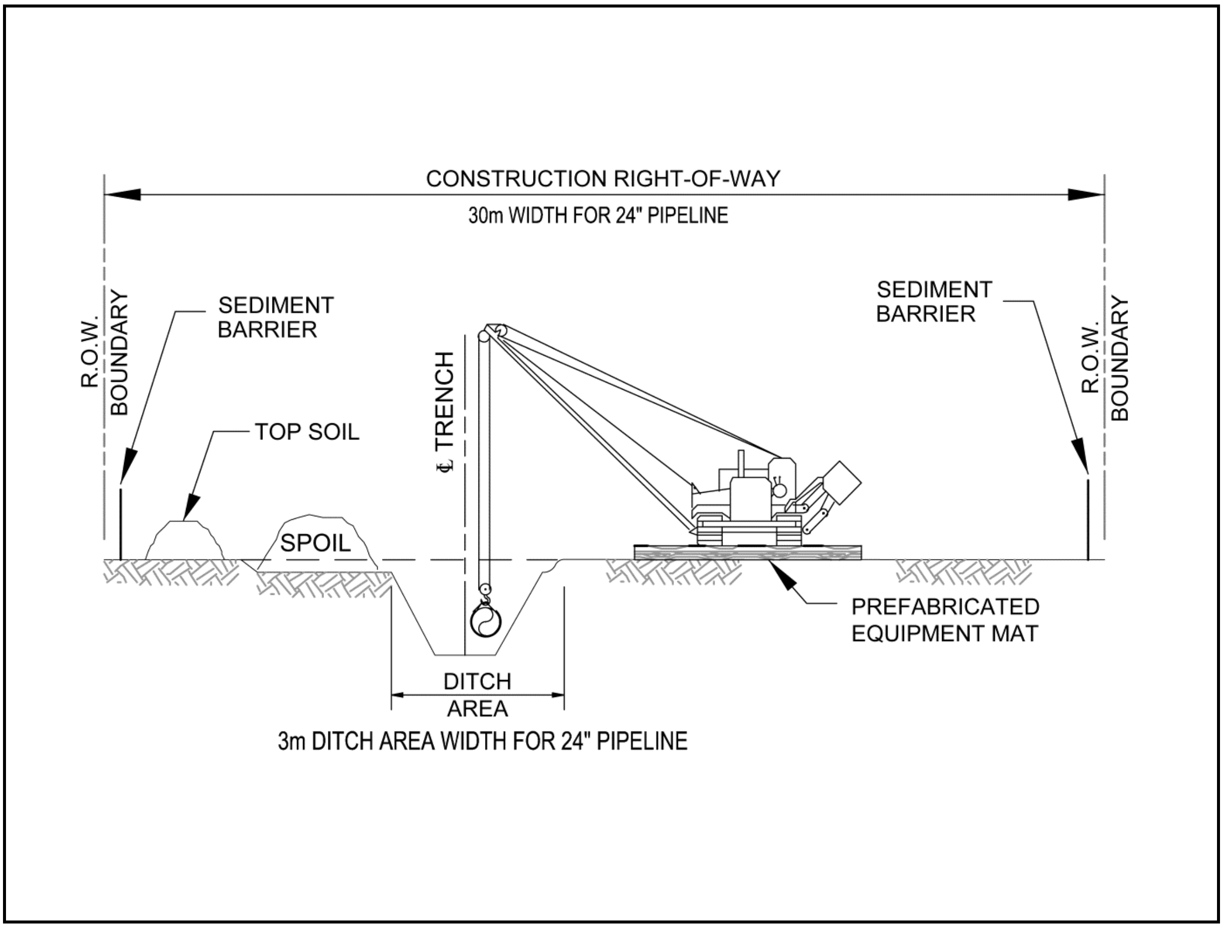

Figure 2.4-14 Crossing of Seasonal Wetland

Major Road and Railroad Crossings

Auger boring requires the excavation of access pits on either side of a crossing so that boring equipment can be lowered to the depth of the bore. Figure 2.4-15 is a photo of an auger bore. The auger will bore horizontally under the crossing emerging in the access pit on the other side.

Figure 2.4-15 Auger Bore

Fault Line Crossings

Locations of fault lines will be identified by the geological field survey. For fault lines, a crossing angle will be calculated depending on type of fault and activity. The pipeline will be constructed with a straight alignment for 100–200 m on each side. The trench will be backfilled with granular material and not machine compacted. Figure 2.4-16 depicts a typical fault crossing plan.

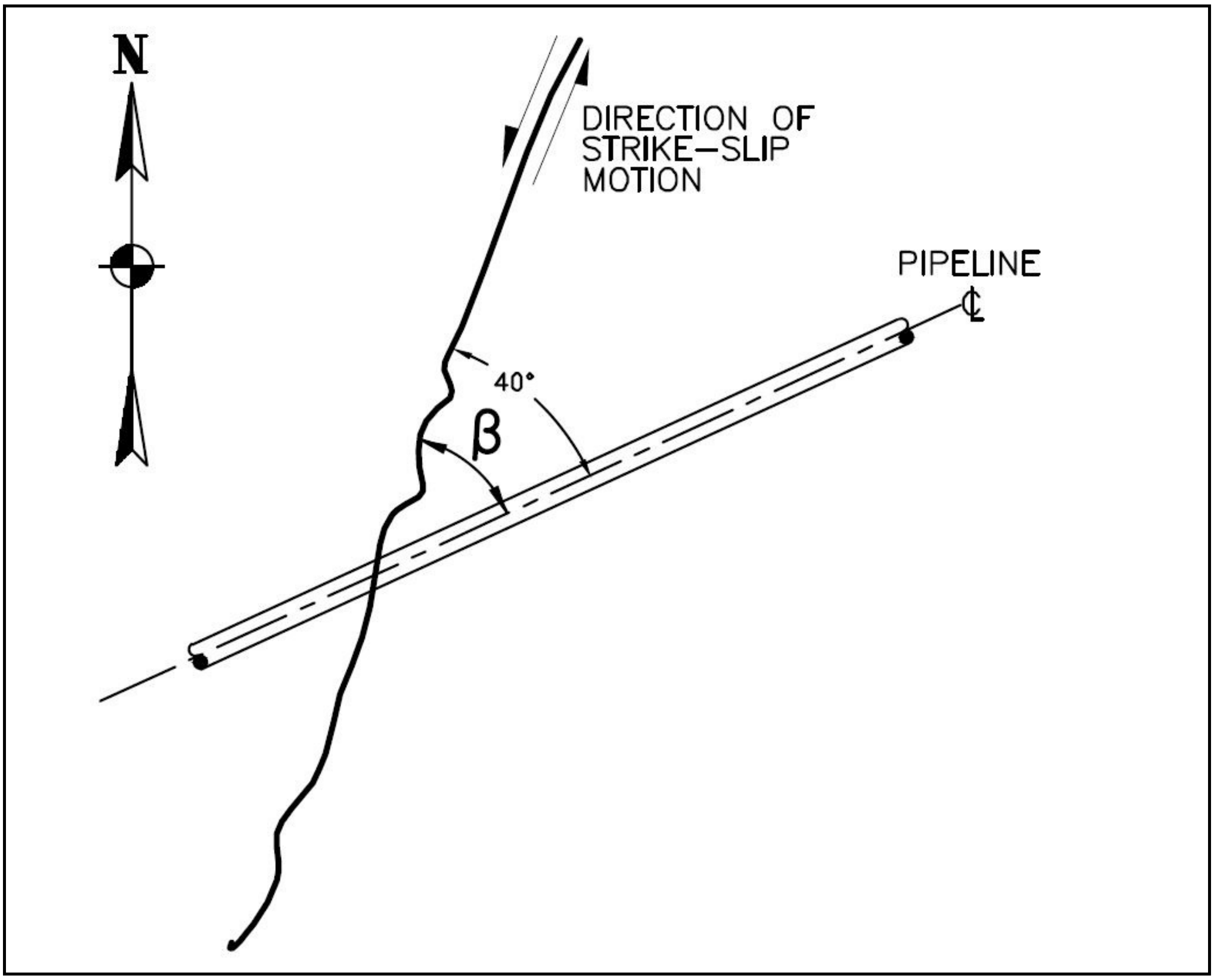

Figure 2.4-16 Typical Fault Crossing Plan

Underground Line Crossings

Underground lines to be crossed potentially include water, sewer and storm water lines, and fibre-optic, electrical and communications cables. The pipeline will cross a minimum of 0.3 m below underground lines.

2.4.2.6 Roads

Permanent and construction access roads can be:

- upgrades of existing murram roads
- newly constructed murram roads.

Access road construction will include, but not be limited to, the following equipment:

- bulldozers and graders for route preparation
- compactors for surface compression
- excavators for trenching
- pavers for surface preparation.

All new access roads will be graded to prepare the road base that will be compacted. Excavated materials approved for use as fill or backfill will be stored in the road RoW. Excavated materials which are not needed or are unsuitable for use as fill or backfill will be removed from the RoW and stored at district approved locations. Where additional material is required, locally available murram will be used.

The roads will be crowned with 2.5% slope for drainage and drainage diversion ditches will be constructed. Corrugated metal pipe culverts will be installed where the road crosses watercourses.

The extent of existing road upgrades will be identified in later phases of project development. Construction methods for upgrades will be the same as for new access roads.

The road RoW will be kept free from waste material. Waste and surplus materials will be removed from work areas and disposed of in accordance with the waste management plan (see Section 2.4.2.8).

Road Maintenance

Access roads will be maintained until project completion. Road safety measures will be implemented and where work will be carried out close to an existing road, the safety of vehicular and pedestrian traffic will be maintained at all times.

Acceptable dust reduction measures will be implemented for vehicles and sprinkling or other dust-control measures will be implemented as necessary.

2.4.2.7 Emissions, Discharges and Chemicals

During construction, the following sources of air emissions are expected:

- power generation using diesel-fired engines
- construction equipment and vehicle exhausts
- dust from vehicle movement and construction activities
- welding.

Section 8.22.2 and Appendix G3 discuss and quantify the greenhouse gas emissions from the construction phase.

During construction, the only expected water discharge from construction facilities is rainwater surface runoff and treated sewage water. Additional information on water discharges is included in various parts of Section 8, Potential Impact Identification and Evaluation – Normal Construction and Operation.

A HSE risk assessment will be completed for all chemicals to be used during construction before chemicals are brought to site.

Risk assessment results will be documented in chemical-specific procedures that will prescribe PPE to be used and environmental protection measures to be implemented.

A chemical register will be included in the chemical management plan. Chemical-specific procedures, chemical register and inventory, storage, use, disposal and waste management will be subject to weekly audit. Material safety data sheets (MSDS) will be displayed at point of use and place of storage for each chemical.

Appendix N lists chemicals that are likely to be used. Final chemical selection will occur during procurement and subject to risk assessment.

2.4.2.8 Construction Waste Management

The construction waste management will be based on the following elements:

- **avoidance** – establishing contracts to allow the return of excess product and packaging
- **reduction** – construction processes to reduce waste generation (e.g., accurate calculation of concrete mixes) and waste reduction techniques (e.g., volume reduction of waste materials).
- **reuse and recycling** – all categories of waste will be segregated to facilitate recycling and reuse. Waste materials which cannot be recycled either locally or shipped to recycling facilities (e.g., plastics) will be treated at site.
- **disposal** – where wastes cannot be treated onsite, residual waste will be transported offsite to a project- and regulatory-approved waste disposal facility.

A construction waste management plan will be developed which identifies waste types and volumes, and locations where these may be generated. Expected waste types will include

- solid waste
  - metal
  - concrete
  - combustible materials
- liquid waste
  - surface run-off collected at AGIs and the MST
  - other waste waters collected in the site drainage system
- hazardous waste
  - lubricants
  - organic solvents
  - chemical additives
  - waste containing heavy metals
  - hazardous chemicals used in the coating facility to create PUF
- Sanitary waste will be generated at all construction camps
  - sewage
  - grey water generation from sinks and wash-downs.

Sanitary waste will be treated to discharge quality standards. Dedicated bio-oxidation treatment facilities that treat sewage and grey water will be installed at all the MCPYs.

There will be periodic removal of sewage sludge from the units for treatment at an approved waste management facility. If there is no treatment facility or where effluent discharge is not permitted, raw sewage or effluent will be transferred by tanker to the closest available project facility for processing.

Food waste will be shredded, dewatered and composted into soil enhancer using an in-vessel composter.

Waste Reduction

Strategies will be employed to reduce the volume and hazardousness of waste, including a:

- **purchasing strategy** – procurement personnel will routinely employ strategies to identify and acquire environmentally ‘favourable’ products and to identify waste generation avoidance or minimisation opportunities
- **material reuse and recycling strategy** – materials will be identified and used that have a potential beneficial post-project use for local contractors working on the project.

Where it has been assessed safe to do so, waste that will not be reused by the project or contractors, will be made available to local communities (e.g., containers and wood).

Storage

All hazardous and nonhazardous waste generated, collected, segregated, stored in temporary stockpiles and removed from site will be managed in compliance with environmental regulations and legislation.

Collection Points

During construction, waste will be collected at worksite waste collection points. Segregation will be promoted via the provision of multiple waste containers. Waste will be transported from the waste collection points to a waste storage area for further segregation, treatment and compaction.

Storage Area

The MCPYs will include a waste storage area. The size of this area will be based on a factor of at least 1.5 above maximum capacity to account for unforeseen circumstances (e.g., inclement weather) and additional guests and workers. The waste storage area will be placed downwind of the construction camp.

The waste storage area will have dedicated storage areas for hazardous and nonhazardous wastes. Segregation and physical treatment of wastes will be undertaken to increase reuse and recycling opportunities.

Each MCPY will include dedicated waste management areas (WMAs). WMAs will be sized and laid out commensurate to the type and quantity of waste expected at each site such that:

- waste separation as per reuse, recycle/recover or disposal option is facilitated
- waste will be segregated and incompatible waste will not be stored together such that:
  - hazardous and non-hazardous waste will not be stored together
  - liquid and solid waste will not be stored together
  - chemically incompatible waste will not be stored together.

WMAs will be designed to facilitate safe drive through and loading by waste transfer services. WMAs will include all necessary pollution prevention measures such as bunding, roofing and wind-proofing as necessary. Subject to site-specific requirements and the type of waste to be managed at each site, WMA design may include the following:

- security such as chainlink fence and lockable gate to prevent unauthorised access
- equipment such as crushers, balers and shredders
- for non-hazardous waste, roofed storage areas where necessary (such as for paper and cardboard temporary storage)
- for hazardous waste, bunded (impermeable, blind-bund, i.e., no drainage) and roofed as per GIIP
- for domestic wastewater solids: sloped, concrete dehydration ponds.

Designated areas for each segregated waste type will be clearly signed. Only authorised personnel will have access to WMAs. WMA personnel will be fully trained and use appropriate personal protective equipment supplied by the project or the contractor as applicable. For hazardous waste, MSDS will be displayed at the storage place. WMA site layout plans will be on display at each WMA gate. Onsite temporary storage of waste (pending transfer) will meet applicable national regulatory requirements pertaining to maximum storage periods, maximum volumes and packaging requirements.

Disposal

Waste treatment will be implemented to render waste less hazardous and reduce its volume before final disposal. Waste incinerators will be used at the MCPYs for final disposal. Where waste cannot be incinerated onsite, residual waste will be transported offsite to a project and regulatory approved waste disposal facility.

General Waste Transport Requirements

All collected loads will be properly labelled in compliance with national waste management regulations, and all wastes will be accompanied by relevant MSDS and waste transfer notes.

Waste Collection and Transfer at Facilities

Wastes will be stored at the dedicated locations and collected by a licensed waste contractor.

Hazardous Waste

Hazardous waste will be collected, stored and transported by an authorised third party. MSDS will be available for all products and substances used.

Tracking System

A waste tracking system will ensure appropriate management of wastes produced.

Waste transfer notes will be used to ensure that wastes are transferred from the producer, through the transportation chain to the final disposal point and will provide a record of due diligence across the system. Each waste transfer note will track the consignment of waste from the point of origin to the final location.

2.4.3 Soil Management, Erosion Control and Reinstatement

2.4.3.1 Philosophy

Good soil management practices reduce the potential for erosion and will be the basis for reinstatement.

2.4.3.2 Soil Management

Topsoil Stripping

Topsoil and subsoil will be stripped and stored separately to avoid co-mingling.

In areas with thin topsoil, constant supervision during topsoil stripping will be implemented to preserve topsoil for reinstatement.

Topsoil and Subsoil Storage

Topsoil and subsoil will be stored away from project activities and protected from wind and water erosion.

If sufficient storage space exists, topsoil and subsoil may be stored on the same site. Signs will be erected on the topsoil and subsoil stockpiles to avoid mixing during removal and reinstatement.

Topsoil Maintenance

If topsoil is stored for more than six months, stockpiles will be monitored for anaerobic conditions that may affect soil fertility and subsequent success of reinstatement. Manual aeration will be undertaken if necessary.

2.4.3.3 Erosion and Sediment Control

Erosion and sediment control during construction is required to prevent sediment from entering watercourses and to reduce areas requiring erosion associated reinstatement.

Erosion Control

On pipeline construction sites erosion is mostly caused by heavy rain, which creates sediment laden run-off.

To prevent erosion and damage to soil structure, movement along the RoW by vehicles will be discouraged, especially in wet conditions. Erosion control measures will be installed on steep gradients and high-risk areas to reduce sediment laden run-off.

Erosion control measures may include, but not be limited to, French drains. Detailed erosion control measures will be defined during detailed engineering work. Figure 2.4-17 depicts a typical French drain. They may be installed across the RoW to restrict the movement of surface run-off. The collected run-off is discharged to the side of the RoW.

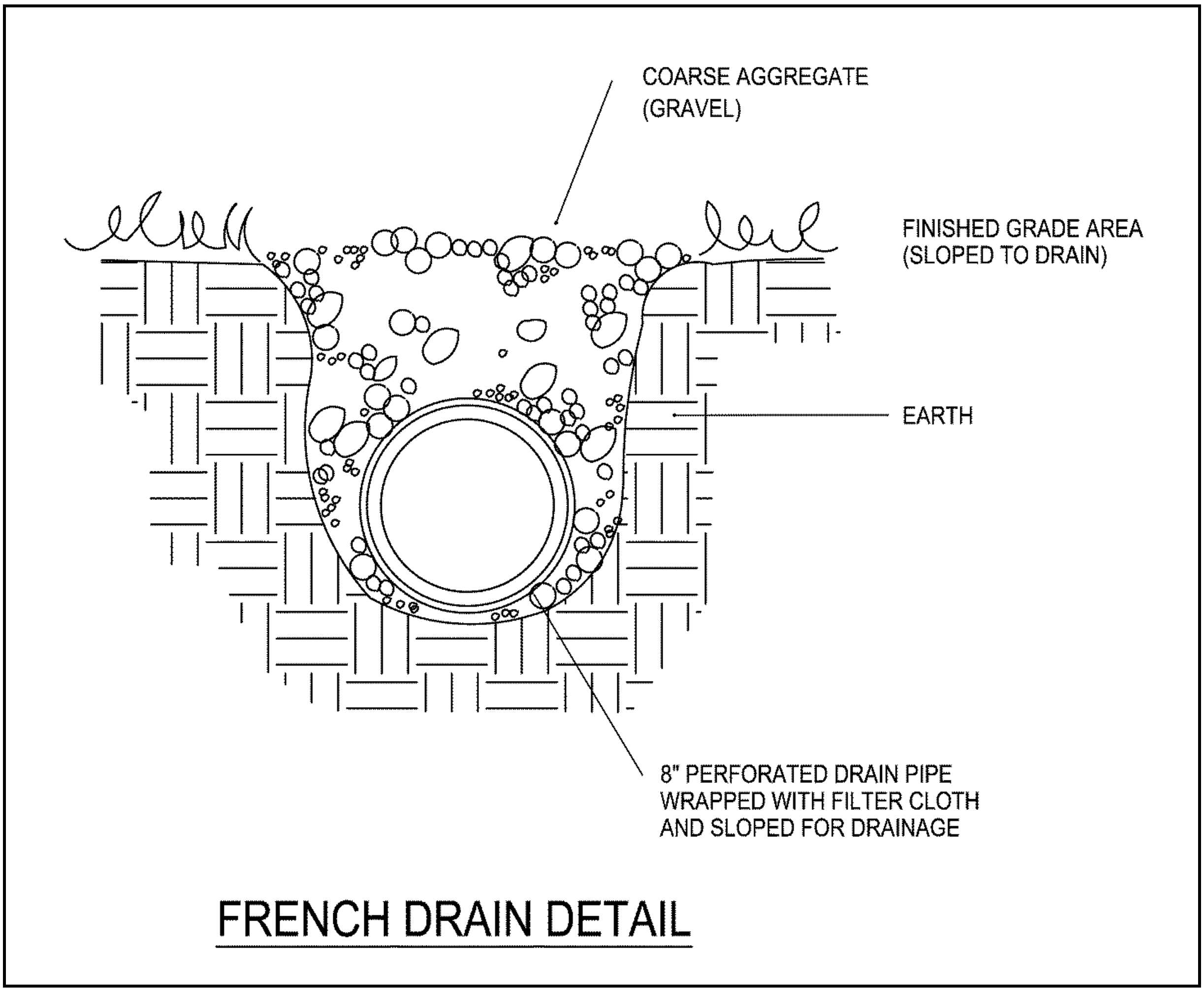

Figure 2.4-17 Typical French Drain

Sediment Control

Sediment control measures will be installed to remove sediment from run-off and may include, but not be limited to, straw-bale filters, silt fences, sediment traps and sediment basins.

Straw-bale filters could be installed at the bottom of slopes or across drainage ditches during road construction and at the time of ditch cleaning. Figure 2.4-18 depicts a typical straw-bale filter. The bales must be inspected often and replaced as required.

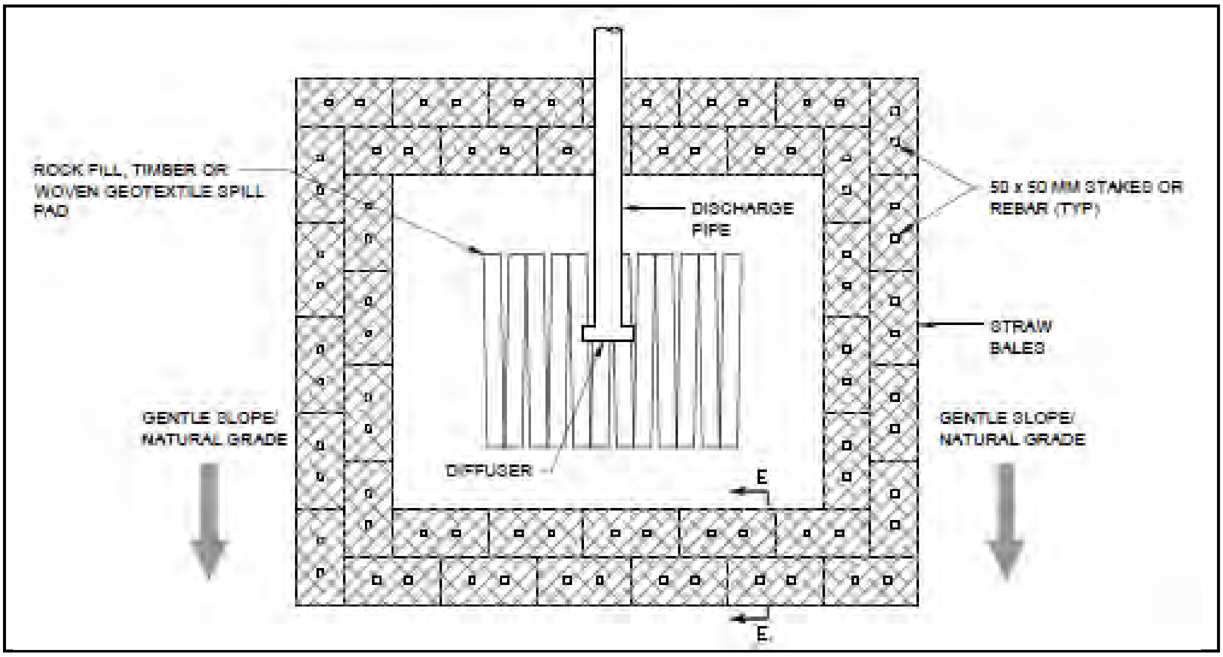

Figure 2.4-18 Straw Bale Filter

Silt fences could be installed at the side of the RoW and function as a run-off sediment filter. Figure 2.4-19 depicts a typical silt fence. Routine maintenance must be carried out on the silt fences to remove sediments.

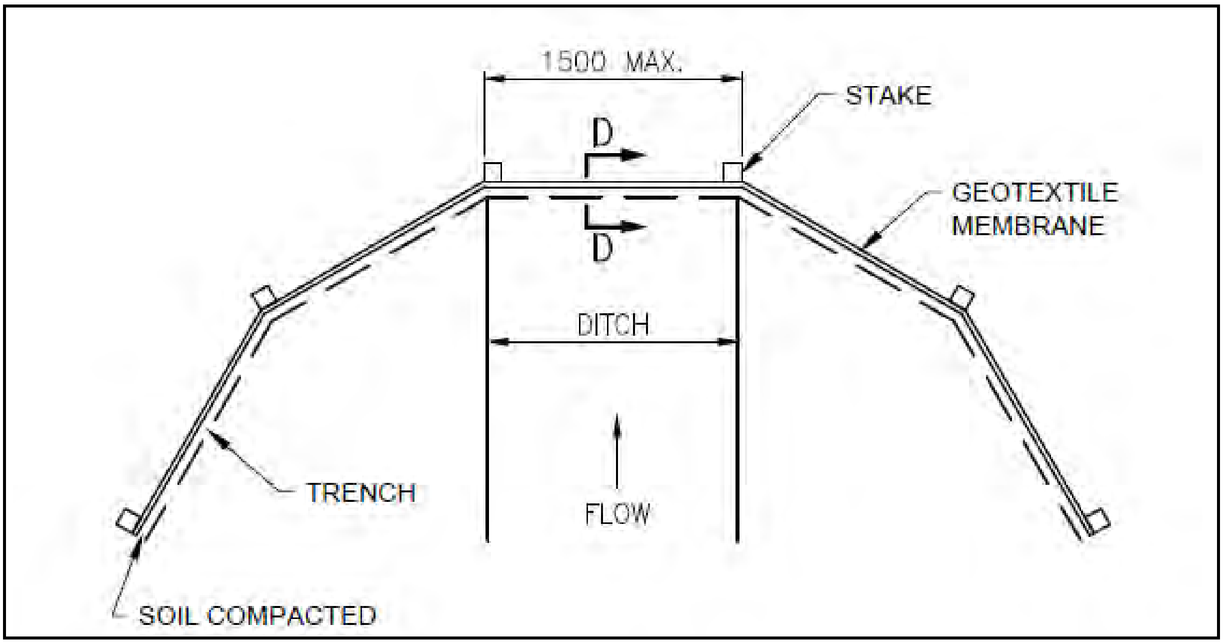

Figure 2.4-19 Typical Silt Fence

Sediment traps could be dug within the RoW to slow run-off and trap sediment. Figure 2.4-20 depicts a typical sediment trap. The number and spacing of sediment traps depends on the slope of the terrain.

When the sediment trap is half full, trapped sediment must be removed and filter material cleaned or replaced.

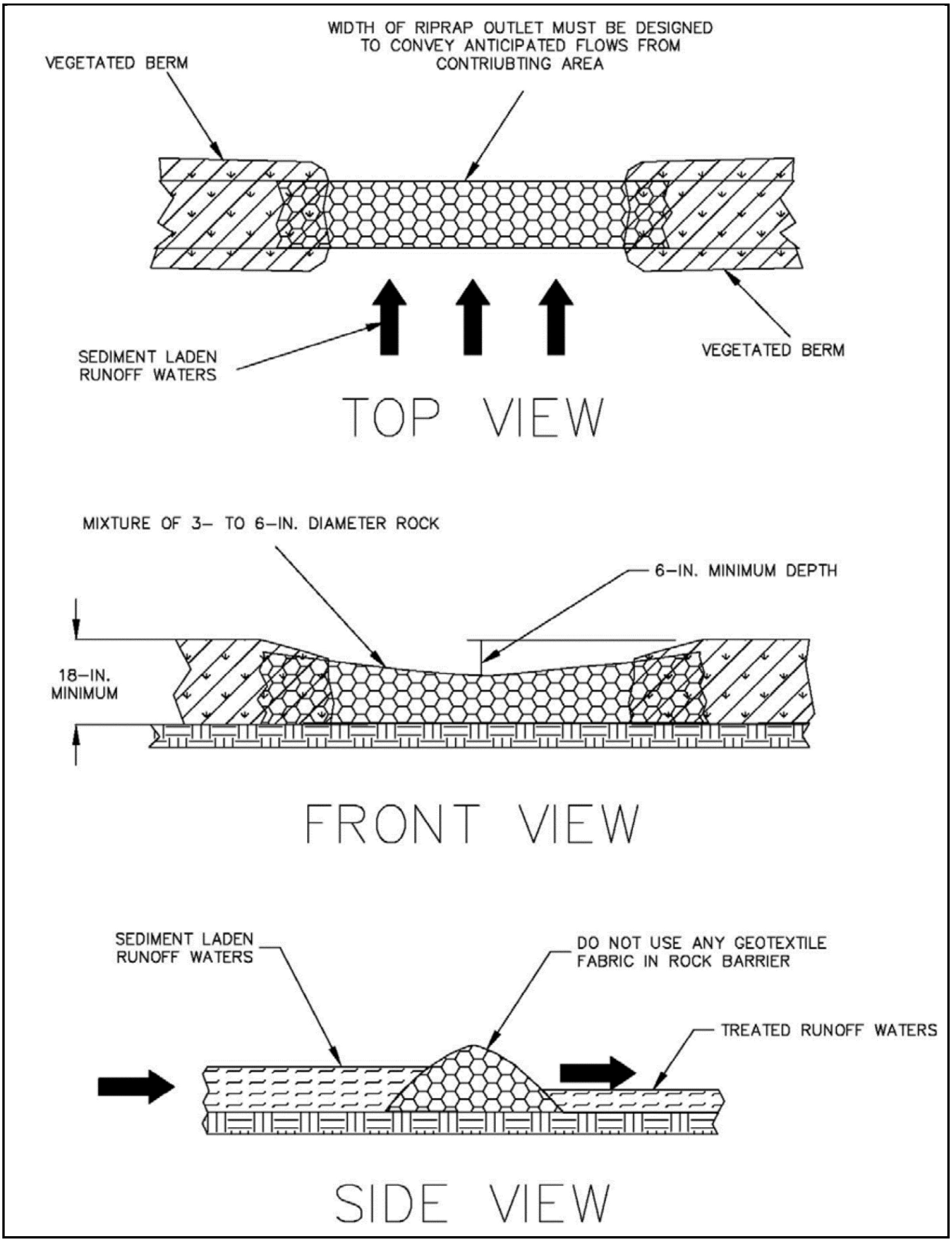

Figure 2.4-20 Typical Sediment Trap

Sediment basins are similar to sediment traps and can be used to collect sediment laden water and for settling of the sediment. Figure 2.4-21 depicts a typical sediment trap.

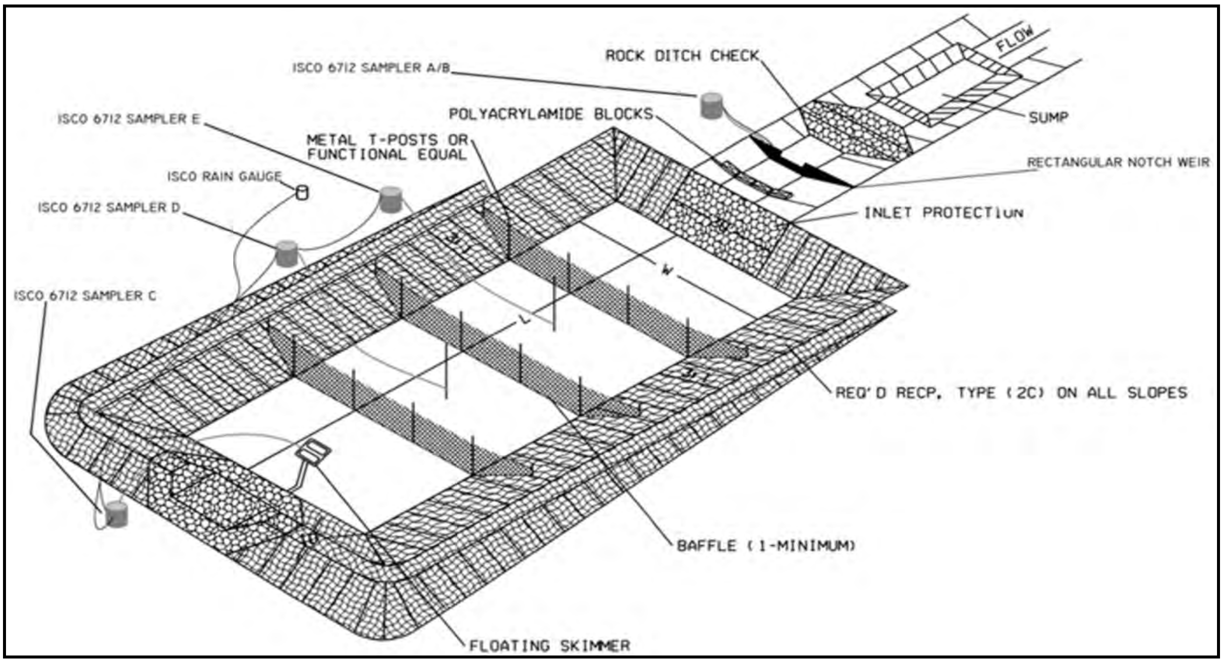

Figure 2.4-21 Sediment Basin

When the basin is half full, the sediments will be removed, and, if necessary, the filter material must be cleaned or replaced.

2.4.3.4 Reinstatement

On completion of construction activities, the following reinstatement activities will be undertaken:

- all debris, equipment and excess materials will be removed from construction areas
- disposal locations or the potential for local use of excess material (e.g., soil, rock) will be identified through engagement with local districts
- construction areas will be reinstated to their original profile
- the stored topsoil will be placed on construction areas
- stones lying on the surface from construction activities that may interfere with tilling of the land will be removed
- soil compacted by traffic in construction areas will be tilled
- temporary access paths that may be damaged by project traffic will be restored to their original condition
- fences (around the MCPYs), embankments, irrigation systems and ditches will be restored to a working condition
- in the steeply sloping areas of the RoW, drainage and erosion control measures will be provided
- construction in non-agricultural areas will be reinstated using natural revegetation to avoid the introduction of invasive species

- construction in agricultural areas will be reinstated as grassland
- in areas prone to erosion, native plant seeds will be used to expedite revegetation
- roads crossed during pipeline construction will be reinstated to pre-project condition at the minimum.

2.4.4 Pre-commissioning, Commissioning and Start-up

2.4.4.1 Overview

On completion of the construction phase, there will be a pre-commissioning phase and then a commissioning phase, followed by the introduction of oil into the pipeline through the inlet flange at the Kabaale Hub, Uganda.

EACOP System commissioning will be complete following detailed checks on all systems, successful transport of oil to the marine storage terminal in Tanzania and storage testing of the tanks.

Start-up sequences will drive the priorities for pre-commissioning activities. Start-up optimisation includes the timely and sequential completion of operational systems. For example, fuel distribution, power generation, EHT and pumping are required for start-up.

As part of the overall commissioning philosophy, the pipeline is divided into systems and subsystems.

The basic commissioning unit is the subsystem and there will be several hundred subsystems on EACOP. Each of these subsystems must reach a completion status during pre-commissioning, which includes three main types of activities:

- conformity checks
- static or de-energised tests
- piping tests.

When the tests are completed, a ‘Ready for Commissioning’ certificate will be issued for each subsystem. A subsystem is ‘Ready for Commissioning’ when all pre-commissioning operations on that subsystem are completed and there are no outstanding items.

Commissioning is the final quality check before transfer to the start-up team and includes:

- dynamic verification
- testing with substitute fluids
- preparing the pipeline system for start-up.

Commissioning Execution

A commissioning execution plan will be developed during detailed engineering. It will govern and describe all aspects of pre-commissioning and commissioning for all components. The plan will also define the entire internal commissioning organisation with a mobilisation plan and the corresponding witnessing required for all the phases of commissioning.

2.4.4.2 Pipeline

Before commissioning can begin, the following core pre-commissioning activities will be completed:

- controls and instrumentation system check and verification
- flushing with water and initial cleaning of the pipeline with gauging of pipeline wall thickness
- hydrostatic testing consisting of a strength and leak test
- final cleaning and dewatering or nitrogen fill after completion of hydrostatic testing
- communications systems check and verification.

Flushing, Initial Cleaning and Gauging

The water used to flush and subsequently clean the pipeline will be filtered and normally no additives are required.

Cleaning will use a pig fitted with water jetting, brushes and magnets to collect debris. Reuse of pre-commissioning water will be optimised. Used water will also be analysed to assess substance presence and concentration, and solid content, and will be released consistent with regulations and industry best practice.

Gauging will include the deployment of gauging plates on pigs that monitor pipeline diameter. Deviations will be analysed and repairs made to maintain structural integrity.

Hydrotesting

The pipeline will be hydrostatically tested to confirm pipeline integrity and strength.. Pipeline sections of approximately 35–50 km will be cleaned and gauged using several large batches of approximately 16.000 m^3 of water separated by pigs. The water used for cleaning will be reused in the next pipeline section or released to environment after suitable filtration. The water will be released to the environment when analysis indicates that the water parameters comply with water discharge regulations. When satisfactorily cleaned and gauged, the pipeline section will be filled with water to remove all air from the test section and will be pressurised, over a minimum of 8 hours at 1.25 times the design pressure, as a combined strength test and leak test. The strength tests will confirm the integrity of the pipe and welds, and establish the operating pressure limit of the pipeline section.

All MLBV assemblies will be tested separately from the mainline hydrostatic testing.

A hydrotest management plan will be prepared that will include information on the quantity and quality of water needed, the potential use of chemical additives, an evaluation of available water resources in the relevant regions and proposed abstraction points, as well as discharge proposals in accordance with the requirements of the project environmental standards and relevant specifications. Among others, the plan will include the following procedures:

- abstraction points will have filters to reduce the entrapment of fish, sediment and residues in the hydrostatic test water

- opportunities will be assessed for hydrostatic test water to be reused between test sections to reduce the overall volume of water required
- locations for discharging hydrostatic test water will be assessed; discharge locations will be selected carefully based on environmental sensitivity and assimilative capacity of the receiving waters
- preferred discharge is to surface waters in which case hydrostatic test water will be discharged through diffusers to re-oxygenate the water
- filtration mediums will be used to reduce suspended solid content before final discharge
- flow rate will be controlled to reduce the risk of soil erosion and disturbance to riverbed sediment and erosion protection measures implemented as required.

The project will also be responsible for obtaining all necessary approvals and permits for hydrostatic test water discharge and will implement a monitoring regime to ensure compliance with requirements of discharge permits. All monitoring will be undertaken in compliance with the requirements of the monitoring and reporting plan.

Hydrostatic test water discharge locations will be assessed on the basis that all discharges will comply with discharge permit conditions in addition to the relevant water discharge standard documented in Appendix F.

A table of contents of the hydrotest management plan is included in Appendix E5.

Final Cleaning and Gauging

The final cleaning process will follow the same steps as those described for initial cleaning.

The pipeline will be dewatered and filled with nitrogen for corrosion prevention. No drying is anticipated, as the oil fill will contain up to 0.5% water.

Commissioning Completion

When these commissioning activities are completed, and the marine storage terminal has been commissioned and is ready, oil will be introduced in a controlled way until it arrives at the terminal. Commissioning will be considered complete once all the above testing activities have been performed successfully.

Markers and Signs

Markers in English and the respective local languages will identify the pipeline and high-voltage cable locations and direction every 500 m. Warning signs will identify the pipeline and high-voltage cables at road, railroad, stream and river crossings. Warning signs will be on both banks of every waterbody crossed by the pipeline. Additional warning signs will be installed in areas at greater risk of excavation and construction activities. These signs will identify the presence of the pipeline and high-voltage cables, and provide company telephone numbers.

2.4.4.3 Aboveground Installations

Pumping Stations

Each system will be checked for operational preparedness. Table 2.4.5 lists the major checks that will be conducted.

Table 2.4.5 Pumping Station Function Checks

System	Function Tests
Pumps	Turn in correct direction
Process piping	Flushing, initial cleaning, hydrotesting, and cleaning and drying performed similar to that described is Section 2.4.4.2 except that the water source will be AGI's water wells and disposal will be through the AGI's water management system.
Fuel tankage and piping	As for process piping, but with tank leak testing and level monitoring testing
Alarms	Tested
Fire and gas detection	Tested

Performance testing will be completed for major systems (e.g., pumps) when crude oil enters the PSs. Stops and starts are to be expected as the systems are brought to operational capacity. Operators, engineers and construction personnel will be at the PSs to monitor commissioning.

Electric Substations

The EHT electric substations will be checked for proper operation. The following fundamental checks of major items will be conducted:

- transformer operates properly
- switch isolates and connects properly
- heating cables checked for shorts or opens
- remote operation of switch checked.

The electric substations will all be set at maximum power for commissioning so that the EHT system can be powered to prevent flow stoppage. Operators will control the substations manually during early operating stages.

2.4.5 Operations

2.4.5.1 Operating Philosophy

The operating philosophy establishes the facility design requirements to ensure safe, efficient and cost-effective operations. This philosophy will guide the principles for field operation organisation and implementation.

2.4.5.2 Operations and Maintenance

The EACOP System in Uganda, including PSs, electric substations and MLBVs, will be managed from either the MST CR in Tanzania or the CR at the Tilenga Project

CPF in Uganda. Automation capabilities with special focus on a remote start–stop control will ensure emergency response in the event of unplanned incidents.

Operations will follow work permit procedures. Maintenance and inspection activities will be executed to complete scheduled interventions required to retain the integrity and reliability of the installations.

An EPRS (Emergency Pipeline Repair System) will be established for the pipeline, and equipment and procedures to manage abnormal operation and incidents.

Security measures are described in Section 2.4.5.6.

Wax deposition during start up and when the pipeline starts to operate below design capacity is expected to be low with EHT active. However, some wax deposits may still form requiring pigging.

Residue collection from pig trap receivers will normally be heated and reinjected into the pipeline. At each PS, the waste storage system will accommodate residuals not suitable for reinjection.

A maintenance team will be dedicated and trained to execute repairs that may be required due to:

- corrosion (internal or external)
- seismic events
- landslides
- erosion or scouring
- external causes (vandalism and accidental digging).

Complex repairs will be conducted by specialists for:

- pipeline section replacement
- thermal insulation (PUF) repair
- fibre optic cable repair
- high-voltage power cable repair
- electric heat tracing repair.

In areas where the pipeline traverses natural habitat, manual vegetation management of the operational RoW will be undertaken to ensure that a width of 10 m is kept free of deep-rooted plants to maintain pipeline integrity and facilitate access. In other areas, vegetation management to support grassland will be undertaken across the full width of the operational RoW.

The design of the not permanently manned stations will take into consideration that up to four operators may be required to be present during the day time for daily operational activities (not campaigns). However, local security will be present 24 hours a day.

2.4.5.3 Resources and Local Resourcing

Services and Supplies

During the operation phase, services and supplies for the project will be sourced in accordance with applicable national legislation and project commitments. Services and supplies include:

- maintenance and inspection activities
- catering and camp operation services
- supporting services (e.g., logistics, medical services and civil works).

Labour

Production, maintenance and inspection personnel will be locally recruited and trained during the construction phase to ensure that there is a trained resource pool that can be used for pre-commissioning, commissioning and operations.

Approximately 16 personnel are planned.

Local Content Management

An operations local content strategy and plan will be established for the project. This will:

- aim to maximise Ugandan manpower
- identify areas and disciplines where Ugandan companies can gain valuable capacity in partnership with the project.

The objective will be to focus on identifying and promoting the use of local resources, and working collaboratively to develop these resources on a long-term basis by:

- maintaining communication between the project and Ugandan suppliers by initiating a regular and supervised dialogue
- supporting the educational system by reinforcing the best academic institutions already in place to focus on certification programmes to develop qualified technicians.

Supply Chain Management

The project will follow competitive tendering process to select contractors for operations activities.

Local content, see above, is a core criterion for selection of these contractors.

For operations the project will:

- use Ugandan companies, when possible, for the provision of goods and services
- prioritise when possible the purchase and use of goods produced or manufactured in Uganda
- invest in training and technology transfer with the objective of enhancing the performance or capacity of local suppliers.

2.4.5.4 Emissions, Discharges and Chemicals

During operations, the following sources of air emissions are expected:

- occasional operation (including regular testing) of standby generators
- vehicle movement, and operation and maintenance activities
- oil-fired bulk heaters using heating medium heaters (later in the project life).

Section 8.22.2 and Appendix G3 discuss and quantify the greenhouse gas emissions from the bulk heaters.

During operations, the only expected discharge from project facilities is rainwater surface runoff and treated sewage water. Additional information on water discharges is included in various parts of Section 8, Impact Identification and Evaluation – Normal Construction and Operation.

A HSE risk assessment will be completed for all chemicals to be used during operation before chemicals are brought to site.

Risk assessment results will be documented in chemical-specific procedures that will prescribe the PPE to be used and environmental protection measures to be implemented.

A chemical register will be included in the chemical management plan. Chemical-specific procedures, chemical register and inventory, storage, use, disposal and waste management will be subject to weekly audit. MSDS sheets will be displayed at point of use and place of storage for each chemical.

Appendix N lists chemicals that are likely to be used. Final chemical selection will occur during procurement and subject to risk assessment.

2.4.5.5 Operations Waste Management

An operational waste management plan will be developed which identifies waste types and volumes, and locations where these may be generated. The plan will be based on the same elements as the construction waste management described in 2.4.2.8, waste avoidance, reduction, reuse and recycling, and disposal. Expected waste types will include:

- solid – wax deposited in the pipeline will be cleared from the pipeline by pigging operations. Most of the wax will be reinjected into the pipeline. Disposal space will be provided for residual wax not deemed suitable for reinjection.
- liquid – primary liquid waste will be from spills that are contained in open drains flowing to the water treatment system of each PS. The fully treated effluent water will be recycled as fire water and or discharged to the environment according to regulatory discharge standards for water quality.
- hazardous – operational hazardous waste plans will be generated. Other than trace amounts of biocide; anti-corrosive, oxygen scavenger; and maintenance wastes, no hazardous wastes are expected from typical pipeline operations. The preferred and alternative waste management methods used will be waste specific. When these methods are not available, the waste will be stored safely while a method is developed.
- Sanitary – there will be minimal sanitary waste requirements at unmanned AGIs (PS1 and 2). All sanitary waste from unmanned facilities will be treated and or disposed of in accordance with regulatory requirements. Food waste will be

shredded, dewatered and composted in an in-vessel composter for soil enrichment at a suitably licensed facility.

Segregation

The objective of waste segregation will be to achieve a high recovery of recyclables, in particular, all wood, paper, plastic, packaging materials, glass and scrap metal.

The waste bins or skips for segregation of waste will be colour coded with appropriate signage and labels to facilitate segregation.

Waste Storage

Wastes will be stored to prevent:

- accidental spillage or leakage
- contamination of soils and groundwater
- corrosion or wear of containers
- loss of integrity from accidental collisions or weathering
- scavenging and infestation of vermin and disease bearing insects.

Each AGI will have dedicated WMAs that meet the requirements of the waste types expected to be managed at each site. WMAs will be sized and laid out commensurate to the type and quantity of waste expected at each site such that:

- waste separation as per reuse, recycle/recover or disposal option is facilitated
- waste will be segregated and incompatible waste will not be stored together such that:
  - hazardous and non-hazardous waste will not be stored together
  - liquid and solid waste will not be stored together
  - chemically incompatible waste will not be stored together.

WMAs will be designed to facilitate safe drive through and loading by waste transfer services. WMAs will include all necessary pollution prevention measures such as bunding, roofing and wind-proofing as necessary. Subject to site-specific requirements and the type of waste to be managed at each site, WMA design may include the following:

- security such as chainlink fence and lockable gate to prevent unauthorised access
- equipment such as crushers, balers and shredders
- for non-hazardous waste, roofed storage areas where necessary (such as for paper and cardboard temporary storage)
- for hazardous waste, bunded (impermeable, blind-bund, i.e., no drainage) and roofed as per GIIP
- for domestic wastewater solids: sloped, concrete dehydration ponds.

Designated areas for each segregated waste type will be clearly signed. Only authorised personnel will have access to WMAs. WMA personnel will be fully trained and use appropriate PPE supplied by the project or contractor as applicable. For hazardous waste, MSDS will be displayed at place of storage. WMA site layout plans will be on display at each WMA gate. Onsite temporary storage of waste (pending transfer) will meet applicable national regulatory requirements pertaining to maximum storage periods, maximum volumes and packaging requirements.

Disposal

Waste treatment will be implemented to render waste less hazardous and reduce its volume before final disposal.

General Waste Transport Requirements

All collected loads will be properly labelled in compliance with applicable Uganda waste management legislative requirements. Any hazardous wastes will be accompanied by relevant MSDS with the Waste Manifest Transfer Note (WMTN).

Waste Collection and Transfer at Facilities

All waste not suitable for incineration and the product of incineration (incinerator ash) will be stored at dedicated locations and collected by a licensed waste management contractor.

Hazardous Waste

Hazardous waste will be transported to a licensed waste facility for appropriate treatment and or disposal in accordance with the applicable waste acceptance criteria for the facility. MSDSs will be available, where applicable, for all waste products and substances produced.

Tracking System

A waste tracking system will be adopted to ensure appropriate management of wastes produced from operations activities.

WMTNs will be used to ensure that wastes are transferred from the producer, through the transportation chain, to the final disposal point and will provide a record of due diligence across the system. Each WMTN will track the consignment of waste from the point of origin to the final location.

Signed WMTNs will be returned to the site of generation, and scanned for filing. Hard copies will be stored on site for a period of one year, and thereafter transferred to the marine storage terminal for longer term retention.

2.4.5.6 Monitoring

Pipeline Operational Monitoring

Pipeline monitoring along the RoW may be assisted by a ‘community watch’ system and or unmanned aerial vehicles. These people and equipment will monitor for intrusions or other activities on the RoW.

Pipeline Integrity

The supervisory control and data acquisition (SCADA) system will be operated from the CR for centralised monitoring and control of process and safety systems for the pipeline and AGIs. A pipeline acoustic intrusion system may be installed along the pipeline and connected to the fibre optic cable. The pipeline acoustic intrusion system will identify disturbances (e.g., unauthorised digging or blasting) in the pipeline RoW and communicate these disturbances via the fibre-optic cable to the security control room.

An EPRS will form part of the pipeline system's contingency plan. The contingency plan will be designed to facilitate rapid and safe repair of pipeline damage. The EPRS will integrate leak detection with operations and emergency response and repair. Additional information on contingency planning is included in Section 9.2.

Corrosion Management

For precautionary purposes, the pipeline is specified with a fusion-bonded epoxy anticorrosion coating applied to protect the pipe against external corrosion over the course of its operational life. This coating will act as a second barrier in case of water ingress below the bounded thermal insulation system. To provide additional corrosion control, cathodic protection measures may be implemented.

Cathodic protection measures will only be provided on AGIs. For the pipeline, internal corrosion will be monitored by intelligent pigging, see footnote in Section 2.3.3.3, and for microbiologically induced corrosion. (To further manage oil spill risk at sensitive locations, such as water crossings, block valves will be installed, see Section 9.5.2.12.)

The intelligent pigs that will be used travel through the pipeline to monitor its integrity and diagnose matters such as metal defects. Intelligent pigging will be conducted as follows:

- during commissioning to establish a baseline
- initial in-service inspection in year five or earlier
- subsequent in-service inspections every five years (or more often depending on monitoring results).

Biocide injection will be required if microbiologically induced corrosion is confirmed.

Security

The project will abide by the national laws of the country and will develop its security based on international standards and best practices. A security risk assessment has identified a set of security measures for each phase of the project.

Physical Security

Physical security includes passive and active measures to protect personnel and facilities against potential threats. Passive measures include the use of architecture, landscaping and lighting to achieve improved security by deterring, disrupting or mitigating potential threats. Active measures include the use of systems and technologies designed to deter, detect, report and react against potential threats.

During the operations phase, closed-circuit television and intrusion detection systems will be in place and will be monitored from a security control room.

Operational Security

Operational security is the process of creating policies and procedures, and establishing controls to protect the facilities and assets of the project. It includes:

- policies and procedures to establish controls to prevent unauthorised access to a facility or assets, whether through carelessness, criminal intent or an outside threat
- controls that are performed on a regular basis to ensure that the requirements are met by all security stakeholders.

The project's facilities will be secured by local security providers who have been trained by professionals with expertise in voluntary principles on security and human rights.

Other Monitoring

Environmental and social monitoring is described in Section 10.7.18 and Appendix J.

2.4.6 Decommissioning

2.4.6.1 Construction Facilities

A decommissioning plan for the construction facilities will be developed, which includes a social management component that addresses associated impacts (e.g., loss of jobs and economic activity). In addition, the plan will ensure that all the project components that were required for constructing the pipeline, but that will no longer be required during the operational phase, are removed and the land returned to the Government. This will be based on the following principles:

- engagement with stakeholders at local, regional and district levels to determine potential use of all redundant equipment and structures
- project structures to be removed from land that is no longer required for operations
- before decommissioning, site environmental due diligence will be undertaken based on historical site data and monitoring data done throughout the life of the field
- land to be reinstated to a capability similar to that which existed before construction activities.

As described in Section 2.3.6, the land required for facilities will be leased from the Government. When the operational phase has been completed, and after decommissioning, the leases will be surrendered. Some of the facilities, such as the camps, after the construction phase, may be transferred to the Government with some structures left in place. The Government may convert the camps into community facilities and manage them on behalf of the host communities.

2.4.6.2 Pipeline

When pipeline oil shipping volumes diminish to the point that it becomes inefficient to transport oil via the pipeline, the pipeline will be decommissioned based on Ugandan regulations and standards, and international standards and protocols. The decommissioning process will be based on the following principles:

- engagement with stakeholders at local, regional and district levels to determine potential use of all redundant equipment and structures

- project structures to be removed from land that is no longer required for operations
- environmental due diligence to ensure that substance-affected soil is managed
- land to be reinstated to a capability similar to that which existed before pipeline construction.

A decommissioning plan, which includes a social management component that addresses the impact of decommission (loss of jobs and economic activity), will be prepared and the scope will be developed in consultation with stakeholders at that time.

2.5 Associated Facilities and Third-Party Developments

2.5.1 Associated Facilities

Associated facilities are those projects that would not normally be developed independently without the development of the EACOP project. See the definition in the footnote in Section 2.1.1. Additional summary information on the associated facilities is included in Appendix H.

Associated facilities include the:

- Tilenga Project which comprises the upstream field development (including production wells, in-field pipelines and roads) and CPF (including electrical power generation, oil heating facility and a PS for the Tilenga feeder pipeline) and the Tilenga feeder pipeline.
- Kingfisher Oil Project on the southeast shoreline of Lake Albert, which includes a MCPY near PS1 of the Uganda EACOP project. The Kingfisher Oil Project will comprise field development, a CPF, a water abstraction station, flow lines and a feeder pipeline to PS1.

There will be a need to source aggregate from borrow pits. The current plan is that either existing borrow pits will be sourced or borrow pits will be developed by the project construction contractor after acquiring requisite land rights as described in Section 2.3.6.2, and regulatory approvals. If the supply from either of those options is not adequate and existing borrow pits need to be expanded, or new ones need to be developed by external developers, those pits will be considered associated facilities. The external developers are expected to conduct requisite environmental evaluations, develop mitigation and reinstatement measures, and acquire approvals.

As mentioned in Section 2.4.2.4, owing to the remoteness of some AGIs, construction infrastructure (concrete batch plants) may be required and would be developed in the early stages of construction. If it is decided that some of the concrete batch plants are best developed by external contractors, the plants will be considered associated facilities. The contractors would be expected to conduct requisite environmental evaluations, develop mitigation and reinstatement measures, and acquire approvals.

The construction waste management plan described in Section 2.4.2.8 refers to the potential use of existing waste management facilities and the operations waste management plan described in Section 2.4.5.5 refers to the potential use of a waste management service provider. If the existing waste management facilities and service providers are not adequate to receive construction and operation wastes, and the facilities and services needed to be expanded, they will be considered associated facilities. Similar to the borrow pits and concrete batch plants mentioned previously, contractors would be expected to conduct requisite environmental evaluations, develop mitigation and reinstatement measures, and acquire approvals.

Since the need for development of new facilities or expansion of existing facilities is uncertain, and potential locations and design of such facilities are not known, they have been screened out of the cumulative impact analysis of associated facilities (see Appendix H).

2.5.2 Third-Party Developments

Third-party developments that are reasonably defined, reasonably predictable or foreseeable have been identified to assess cumulative impacts within the spatial and temporal boundaries of the EACOP project. These are described below.

- Kabaale International Airport will be expanded to facilitate the delivery of equipment and transportation of personnel during oil-field exploration and development phases.
- A 132-kV electricity transmission line from the Tilenga Project CPF to Kabaale Industrial Park. The line will evacuate excess power generated at the Tilenga CPF and import power to the Tilenga CPF when excess gas is reduced or depleted. The line will also be used to provide power to the Kabaale Industrial Park and surrounding areas. A preliminary route is available.
- Two 33-kV transmission lines to Kabaale Airport will be installed, associated with the Kabaale Airport development.
- A 60,000-barrel-per-stream-day hydrocracker and coker refinery will be constructed at Kabaale within the 29 km^2 area of land already acquired for the Kabaale Industrial Park.
- A 210-km long Hoima–Buloba Pipeline will be built for transporting refined petroleum products from the refinery in Hoima (see UG07) to a distribution terminal in Buloba, Kampala.
- Road improvements will be developed under the jurisdiction of UNRA to supporting the oil industry. These include the following roads:
  - Kabaale–Kiziranfumbi
  - Kaseeta Lwera via Bugoma Forest
  - Hohwa-Kyarushesha-Karokarungi
  - Buhimba–Kakumiro
  - Bulima–Kabwoya and construction camp
  - Kyotera–Rakai.
- Transmission line upgrade – construction of 33 kV overhead lines in Hoima district.
- A 2-ha opencast gold mine in the hills of Kamusenene village, Kitumba subcounty, Mubende district.

- A gold processing plant on 0.873 ha of land for the existing gold mine in the Namwasa Forest Reserve.
- Information and communication technology infrastructure – a 1536.39-km long buried optical fibre cable to be laid across the country to build the National Data Transmission Backbone.

2.6 Schedule

A schedule for the project is shown on Table 2.6.1. Project activities are progressing with construction being planned after the conclusion of the Uganda Environmental Impact Statement regulatory process and the resettlement action planning study and implementation.

Table 2.6.1 Project Schedule

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Regulatory approval			■	■								
Detailed engineering	■	■	■	■	■	■	■					
Logistics		■	■	■	■	■	■	■	■			
Construction facilities				■	■	■	■					
Pipeline					■	■	■	■	■	■	■	■
AGIs					■	■	■	■	■	■	■	■
Stakeholder engagement	■	■	■	■	■	■	■	■	■	■	■	■