2 PROJECT DESCRIPTION

This section is equivalent to Section (vi) project background and description, of the legislative structure. If in doubt, please refer to Table 1.5-1 Environmental Impact Statement Structure on page 1-5.

2.1 Introduction

2.1.1 Project Description Contents

This section describes the crude oil export system and the marine storage terminal (MST) that collectively comprise the components of the EACOP System in Tanzania (Figure 2.1-1) and includes information on:

- 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), pressure reduction stations (PRS), electric substations and mainline block valves (MLBV)
  - MST
  - 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

[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 (International Finance Corporation (IFC) Performance Standard 1, Social and Environmental Assessment and Management Systems).

impact assessment (ESIA) of the EACOP System in Tanzania. 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 the National Environment Management Council (NEMC) then an ESIA addendum will be submitted to NEMC. The EACOP System overview information is included in Figure 2.1-1.

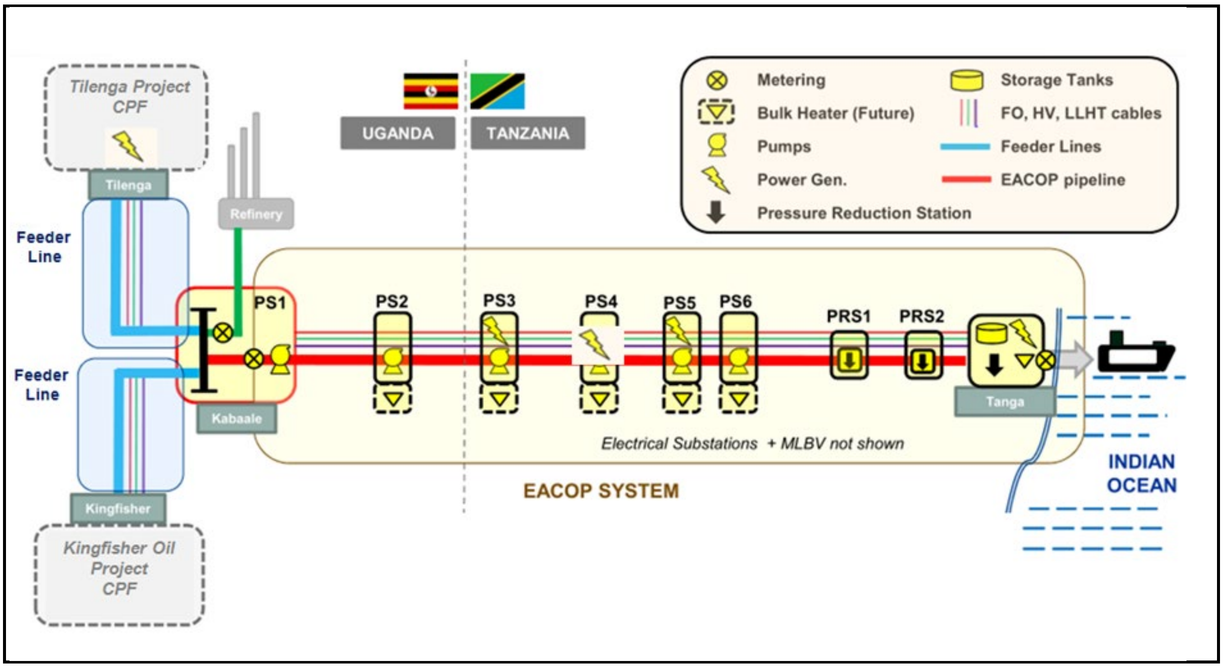

Figure 2.1-1 EACOP System Components[2]

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
Marine storage terminal (MST) minimum storage tank oil temperature	63°C

[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)

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 1147 km in Tanzania[3] (see Figure 2.3-1).

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)
- MST bulk heaters.

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.

[3] The Scoping Report stated 1157 km but through optimisation the planned length is now 1147 km. Further optimisation may result in minor length changes.

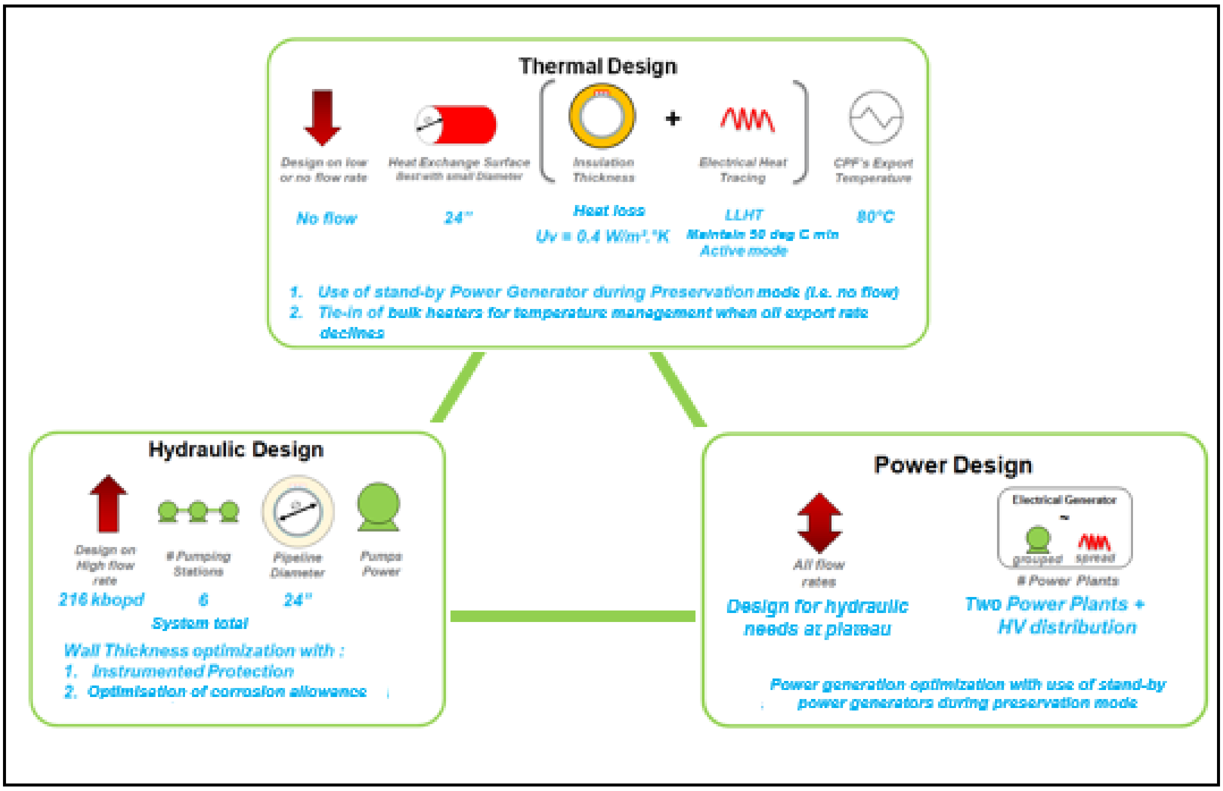

Figure 2.2-1 Design Principle Overview

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

PS3 and 5[4] will be permanently manned. PS4, PS6, PRS1 and PRS2 will not be permanently manned. Owing to the distance between AGIs, a design principle is that operations can be managed remotely 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

[4] PS1 and PS2 are part of the EACOP System in Uganda.

- 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
- a study of location options for a marine terminal and load-out facility (LOF). The LOF includes a trestle and loading platform and is described in Volume 2, Section 2.

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
- layout and sizing for the MST, including the LOF trestle and loading platform
- civil works design
- development of a project logistics philosophy plan.

FEED optimisation was undertaken for:

- centralised power generation at PSs and distribution, resulting in fewer PSs with generators
- the MST and LOF, resulting in one less tank for the MST.

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)
- hydrography.

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.

In general, the route initially traverses predominantly undulating to flat terrain, wetlands and seasonal wetlands in Uganda before it crosses the border into Tanzania. As the route passes the western side of Lake Victoria, it traverses an area characterised by high rainfall and humidity. This area is sparsely populated, although there is extensive cultivation across the corridor in this area. As the route turns to the southeast at the southwest corner of Lake Victoria, it passes through undulating terrain in areas of cultivated land with greater population density. This area is much drier and as the route approaches the Rift Valley at the Tanzanian Divergence, the area becomes sparsely populated. East of this point, the route traverses through the low undulating, dry, bushland of the southern Manyara region. Beyond this zone, the route crosses varied terrain with occasional agricultural land and adjacent to settlements as it approaches the coastal region to the MST site.

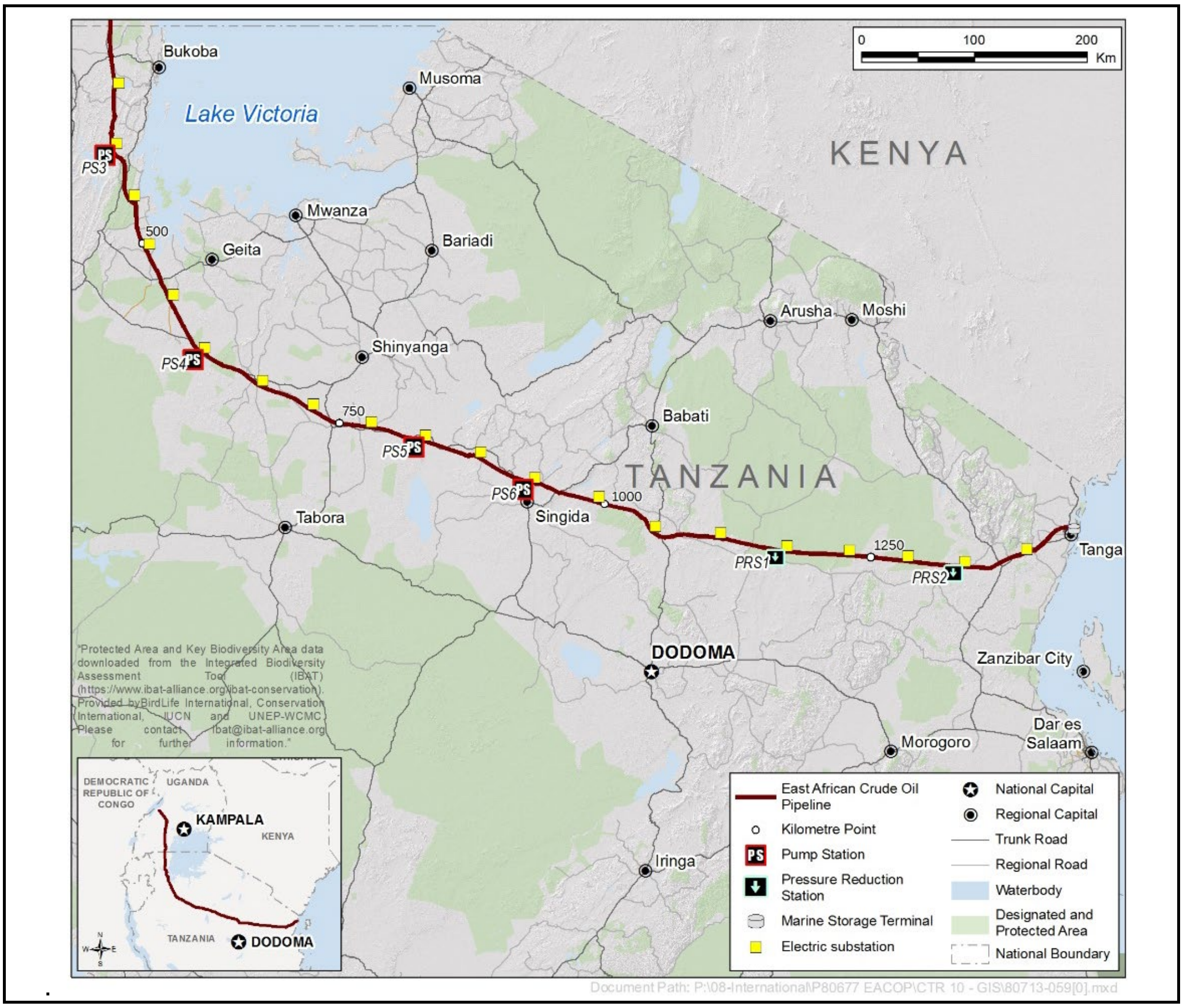

Figure 2.3-1 EACOP Corridor and Aboveground Installations

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, which is parallel to the pipeline trench. Power will be supplied from PS3 and 5, and the MST. 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 heat tracing system. The electrical generation and distribution system is described in Section 2.3.3.4.

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 will be installed for strain detection.

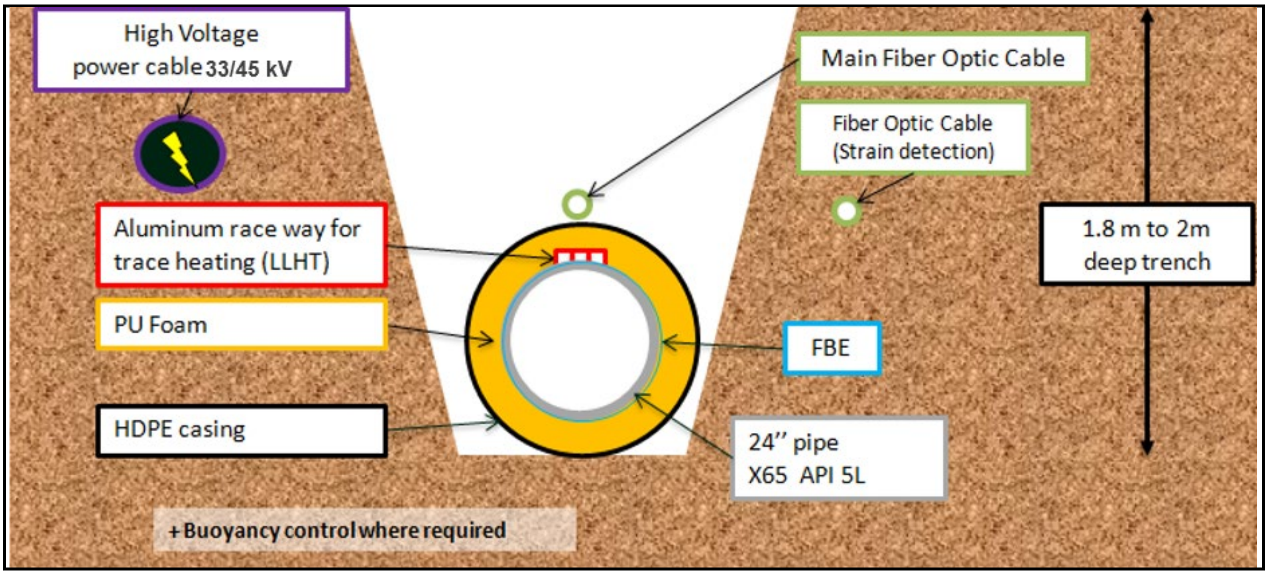

Figure 2.3-2 Typical EACOP Pipeline Cross-Section

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 Tanzania.

Table 2.3-1 Components of the EACOP System in Tanzania

Component	Aspect
PS[5]	PS3 – kilometre point (KP) 405 PS4 – KP610 PS5 – KP825 PS6 – KP931
Standalone MLBV stations	49 in the operational RoW
Stand-alone electric substations	3 in the operational RoW
MLBV stations co-located with electric substations	11 in the operational RoW
Electric substation combined with AGIs and the MST	7
PRS and system	PRS1 – KP1172 PRS2 – KP1330 PR system – KP1443 (within the MST)
MST (2.0 MMbbls capacity)	KP1443
New or upgraded permanent access roads to PSs, PRSs and the MST	47 km
New or upgraded construction facility access roads	60 km
Pipe coating facility	KP701
Main camps and pipe yards (MCPY)[6]	MCPY5 – KP326 MCPY6 – KP420 MCPY7 – KP513 MCPY8 – KP595 MCPY9 – KP702 MCPY10 – KP800 MCPY11 – KP915 MCPY12 – KP1038 MCPY13 – KP1144 MCPY14 – KP1238 MCPY15 – KP1318 MCPY16 – KP1404

2.3.3.2 Pumping Stations

Function

The function of a pumping station is:

- pressurisation for the transport of crude oil through the pipeline
- power generation and distribution (PS3 and 5)
- provision of operator-based camps (PS3 and 5)

[5] PS1 and PS2 are part of the EACOP System in Uganda.

[6] MCPY1 through to MCPY4 are part of the EACOP System in Uganda.

- crude oil temperature management (power supply for EHT and for bulk heaters).

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. Selection of PS locations also considered proximity to roads and power lines, and land use and environmental characteristics.

Based on these criteria the final PS locations were selected (see Table 2.3-1 and Figure 2.3-1). Figure 2.3-3 depicts a PS layout with power generation.

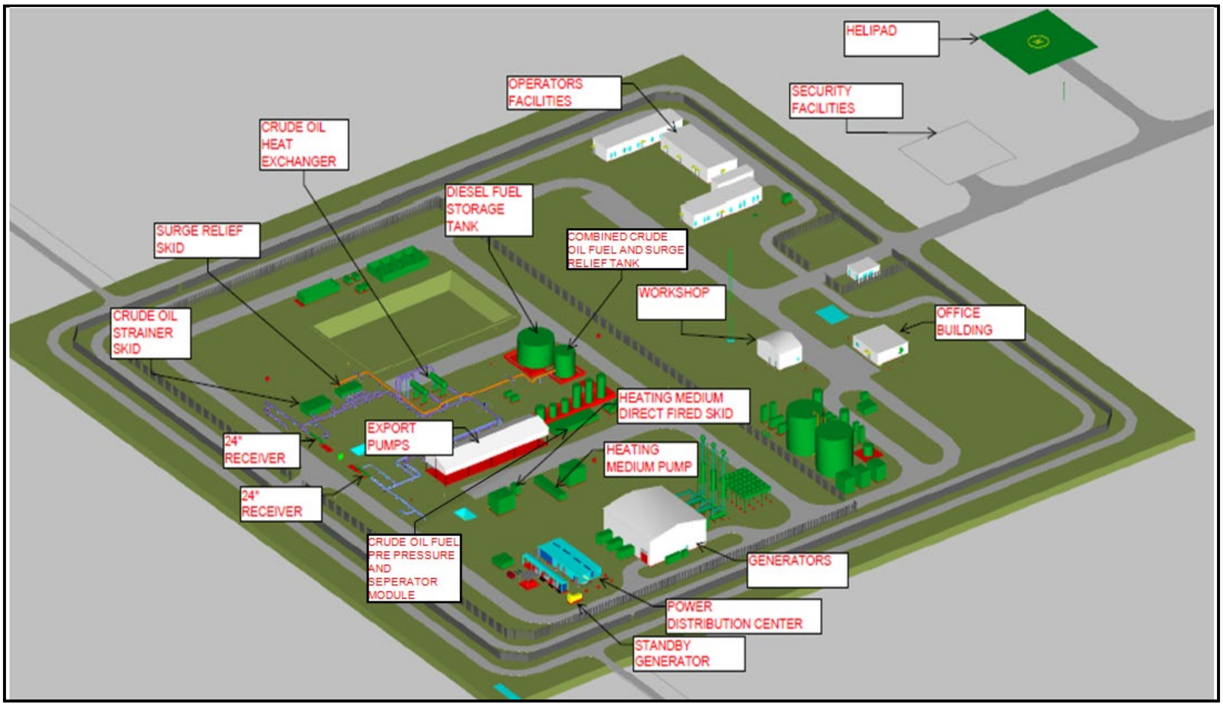

Figure 2.3-3 Typical Pumping Station with Power Generation

Each PS will require a total area of 310 × 400 m, plus a 50 × 50 m helipad. During construction 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 PS3 and 5, and the MST, 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 pumping stations is as follows:

- pumping:
  - the PS will be self-contained and independent of any locally supplied electricity, water, and waste or sanitary treatment (with PS3 and 5 acting as the power generation centres and distributing the required power to PS4 and 6 respectively).
  - each PS will have three electrically powered pumps, based on the 216,000 barrels a day flow rate (see Table 2.3-2 for the approximate sizing for the power generation to be used in each PS)
  - PS3 and 5 will support operations and include accommodation facilities for up to 20 personnel within their footprint. PS3 will support PS4 operations and PS5 will support PS6 operations
- power generation:
  - power generation units will be installed at PS3 and 5 and will be sized, see Table 2.3-2, for the demands of utilities and EHT for flowrates up to the design rate (PS5 will also power PRS1)
  - a power generation unit will be installed at the MST sized for the demands of utilities and EHT at the MST, the LOF and PRS2
  - the primary source of fuel for each of the PS generator sets will be the export crude oil being transported via the pipeline, which will be conditioned, stored in a holding tank and then supplied to the generator set inlet manifold
  - crude oil conditioning for the power generation unit is incorporated into the plot plan design and post conditioning residual waste constituents will be heated and injected into the pipeline
  - an emergency diesel generator will support basic nonpumping operations (e.g., lighting, firewater system and generator start compressors) and will be used for commissioning and start-up
- temperature management:
  - the EHT will provide heating during reduced flow rates, shutdowns or when maintenance is required
  - when upstream production declines the PSs may be fitted with a crude oil bulk heating system to maintain crude oil at operational temperature 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 all PSs.
- other facilities:
  - fire protection pumps and fire-water storage tanks in PS3 and 5 will be sized according to applicable national and international codes and standards. Manual fire protection will be provided at the other PSs.
  - all PSs include operator facilities and an office building. PS3 and 5 will be manned permanently and will include facilities that can accommodate up to 20 personnel.
  - diesel storage is included in PS3 and 5 for start-up power generation and when crude oil is not available for fuel
  - diesel storage is also included for the emergency generator

- at PS4 and 6, a surge relief skid and relief tank will be included for over pressure from closed valves. At PS3 and 5, the surge relief will be directed to the crude oil fuel storage tank.
- pigging[7] facilities will be installed (see Section 2.4.5.2).
- one communication tower (approximately 100 m high will be subject to optimisation during detailed design).

The pumping stations will be fenced.

Table 2.3-2 Pumping Stations

Pumping Station	KP	MW Installed Power	Manning
PS3	406	22.04	Manned
PS5	825	27.55	Manned
MST	1443	17.9	Manned

2.3.3.3 Pressure Reduction Stations

Function

The flowing pressure in the pipeline is automatically adjusted by the PRS to stay below the maximum operating pressure.

PRS1 and 2 remain fully open during high flow rates, but pressure reduction control valves remain partially closed in the MST pressure reduction system to maintain a positive back pressure in the pipeline. When crude oil flow rates decrease, first PRS1 and then PRS2 control valves will maintain a positive backpressure upstream.

PRS1 and 2 will not normally be manned and will be controlled remotely from the CR (see Section 2.4.5.2).

Locations and Size

Two dedicated PRSs (PRS1 and 2) are in the descending section of the pipeline between kilometre point (KP) 1100 and KP1443 and a third pressure reduction system will be in the MST (see Table 2.3-3).

Table 2.3-3 Pressure Reduction Station Locations

Pressure Reduction Station	KP
PRS1	1171
PRS2	1330
Pressure reduction system	1443 (MST)

[7] 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.

PRS1 and 2 straddle the RoW. A voltage-regulating transformer to power the EHT is within the fence. The PRS equipment requires a 100 × 100 m area and is contained within a fenced area of 175 × 190 m.

Layout and Components

A layout of PRS1 and 2 is depicted in Figure 2.3-4.

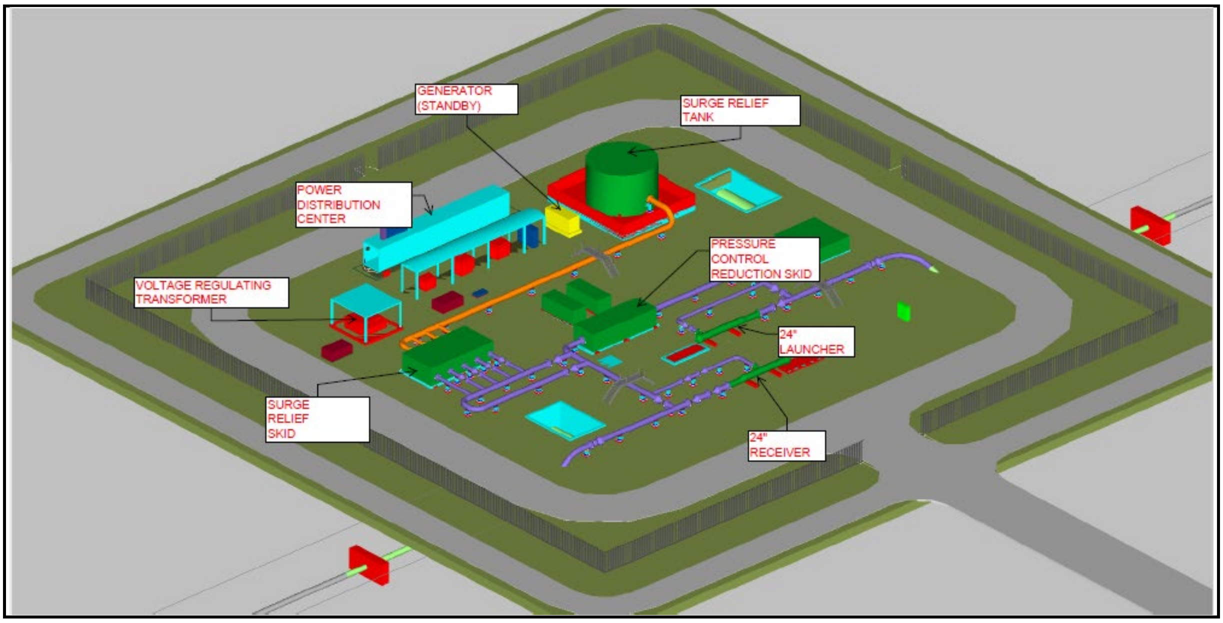

Figure 2.3-4 Typical Pressure Reduction

PRS1 and 2 consist of the following components:

- a pressure control reduction skid automatically keeps the flow rate pressure below the maximum operating pressure. This system is monitored remotely from the CR (see Section 2.4.5.2).
- a pressure surge relief system has surge relief tanks sized to hold the maximum quantity of oil that may be released during surge events. Tank contents will be reinjected after the pipeline is operating again.
- pig launchers and receivers will be installed at both the PRS inlet and outlet. Collected wax will be reinjected into the pipeline.

The high-voltage system that parallels the pipeline powers a distribution centre and voltage-regulating transformer that powers the EHT (see Section 2.3.2). Power for PRS1 is supplied by PS5 and power for PRS2 is supplied by the MST via a high-voltage cable.

The pressure reduction and surge control system at the MST reduces inlet pressure from the descending section of the EACOP System to a level below 5 bar for the storage tanks.

The purpose and configuration are the same as for PRS1 and 2, but the surge relief system directs the released oil to the slop tanks instead of a dedicated surge relief tank.

2.3.3.4 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 2.3-5 depicts the power generation and EHT supply architecture.

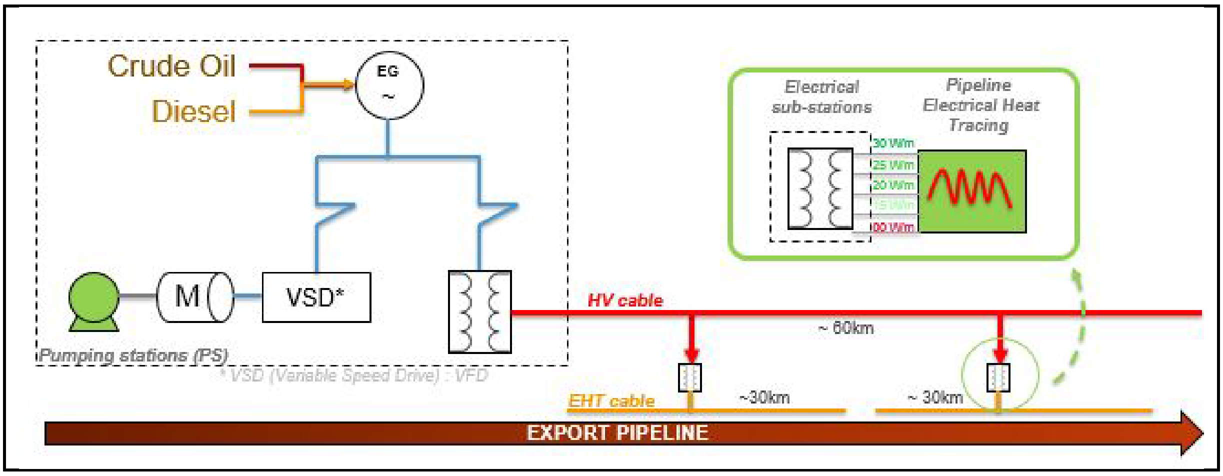

Figure 2.3-5 Power Generation Architecture

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

Locations and Size

Figure 2.3-6 depicts the electrical distribution system for the entire EACOP System, with power provided by the PS, at a distance 50–60 km between electric substations.

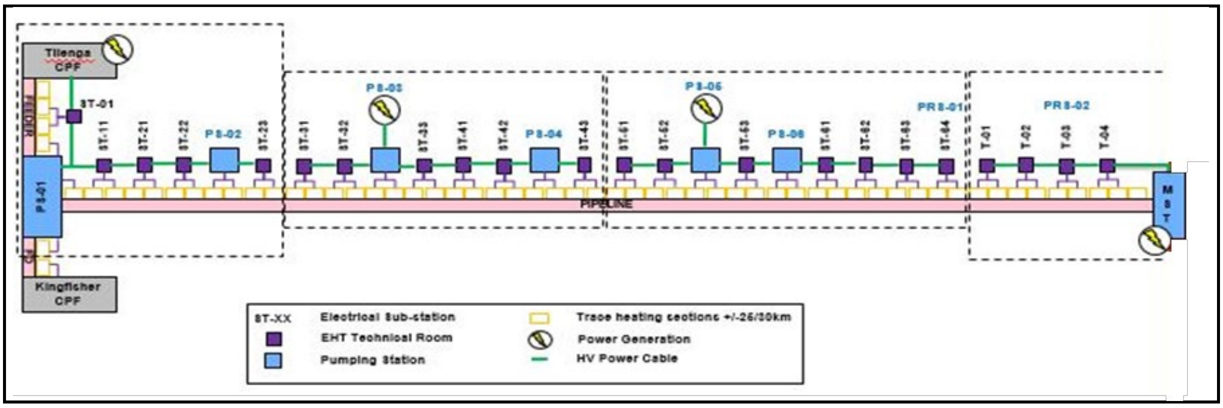

Figure 2.3-6 Electrical Distribution System

There will be 21 electric substations associated with the Tanzania portion of the project (Figure 2.3-1) within the RoW. Three independent substations will occupy an area of 24 × 18 m. The 11 electric substations combined with MLBV stations have a footprint of 24 × 28 m. Another seven electric substations are included in the AGI and MST footprints.

Layout and Components

The layout of the electric substations, depicted in Figure 2.3-7, 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 is available for personnel during maintenance visits.

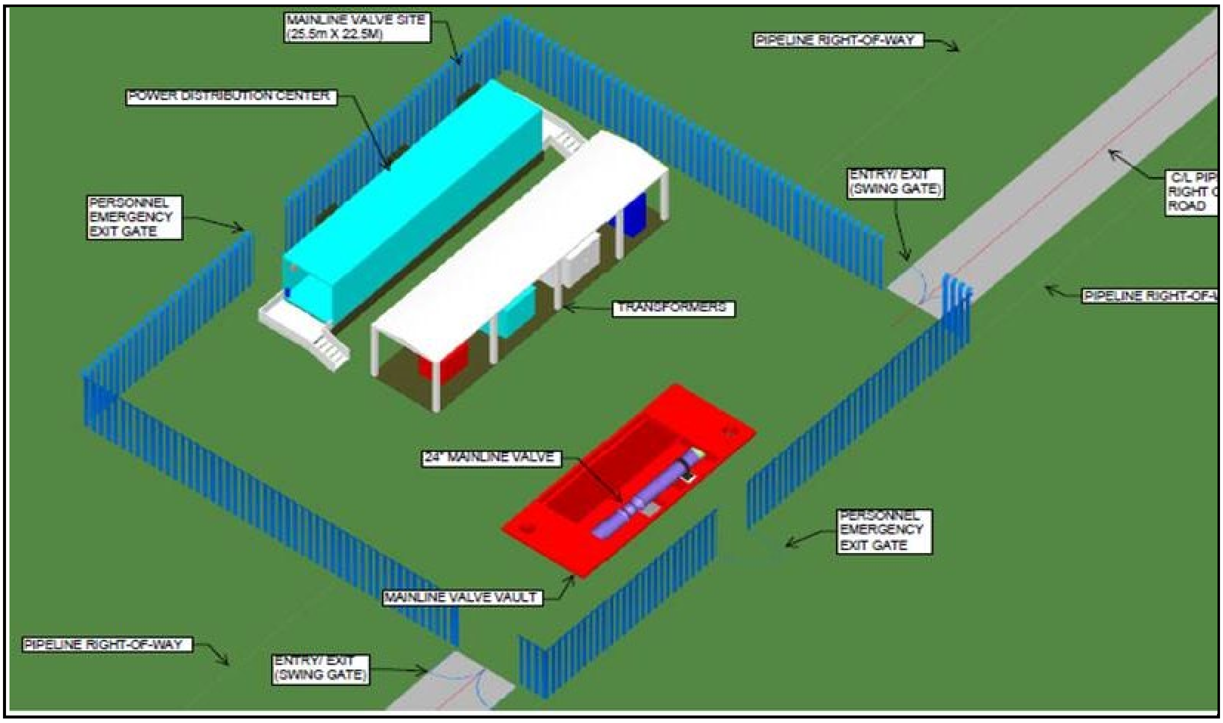

Figure 2.3-7 Typical Electric Substation with Main Line Block Valve Station

2.3.3.5 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 MLBV 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 every PS, PSR, and the MST
- along continuously ascending or descending elevation profile
- 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.

Sixty MLBVs will be within the permanent RoW of which eleven will be combined with electric substations.

Layout and Components

The pipeline enters the MLBVs, as depicted in Figure 2.3-8, 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 reduce 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).

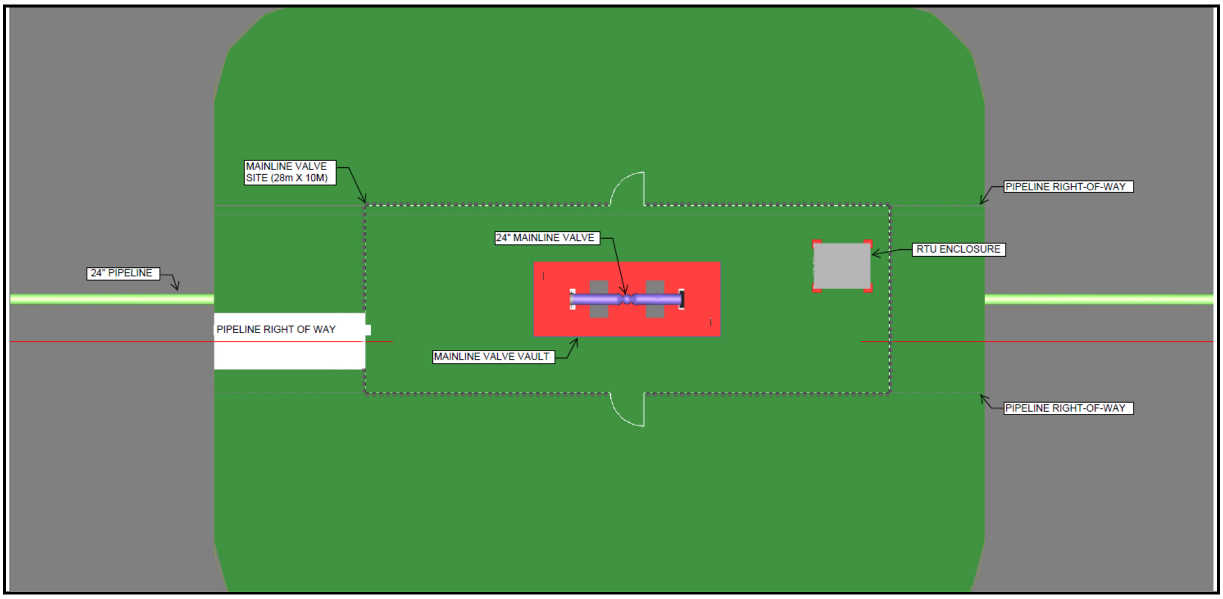

Figure 2.3-8 Typical Main Line Block Valve

A series of photovoltaic solar panel arrays, depicted in Figure 2.3-9, and batteries with six days autonomy could be provided for the low power supplied at the MLBV with a total power consumption estimated to 1.1 kV (ICSS, telecom and electro-hydraulic actuated valves).

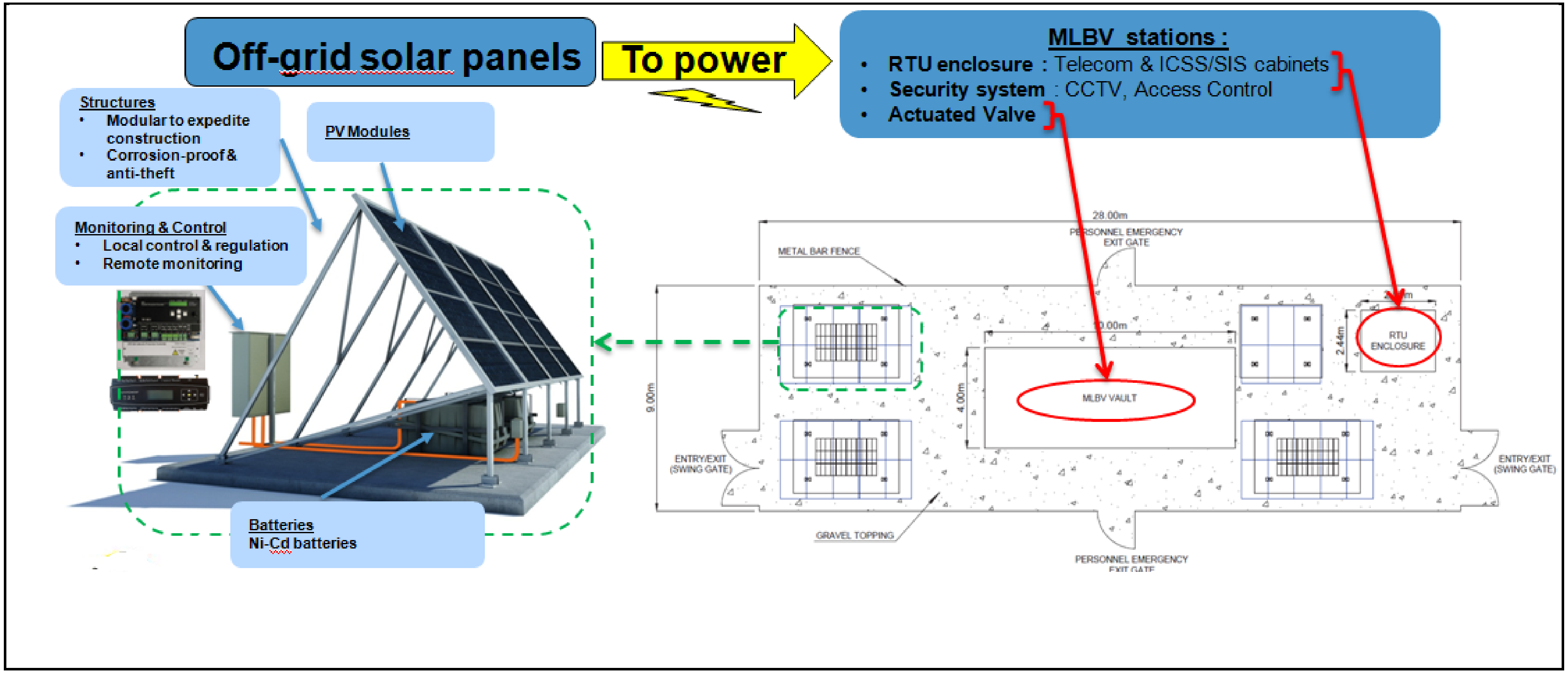

Figure 2.3-9 Typical Solar Panels Array at Main Line Block Valve Stations

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 the telecommunication system. Synchronisation of these terminal units is required for accurate leak detection and leak location. The remote terminal unit is within the MLBV footprint (see Figure 2.3-8) and is in direct communication with the CR. In the event of abnormal pipeline operation, block valves can be closed from the CR.

2.3.4 Marine Storage Terminal

2.3.4.1 Function

The pipeline terminates at the MST, which will store crude oil before transfer to tankers at the LOF (see Volume 2 Section 2 for LOF description). The MST design is based on a minimum overall storage capacity of 2 million barrels and the requirement to load a Suezmax type tanker (0.9–1.0 million barrels parcel) within 24 hours from the start to end of loading operation.

The MST will be a permanently manned facility. During operations, the MST will be controlled and monitored from the CR (see Section 2.3.4.3 and Section 2.4.5.2).

Fiscal metering will also be performed at the MST.

2.3.4.2 Location and Size

The MST is on the Chongoleani peninsula in Tanga district (henceforth referred to as Tanga) 5–6 km northeast of the seaport of Tanga on the coast of the Indian Ocean (Figure 2.3-10).

The MST footprint is approximately 1000 × 460 m (46 ha). The facilities will occupy approximately 40 ha. During construction, a temporary worksite of approximately 10 ha will be established next to the western side of the MST. The worksite will accommodate a storage area, workshops and construction workforce camp, which has similar layout and components of the MCPYs described in Section 2.3.5, where a typical layout is presented. The construction workforce camp at the worksite will provide accommodation for approximately 500–800 people at its maximum use.

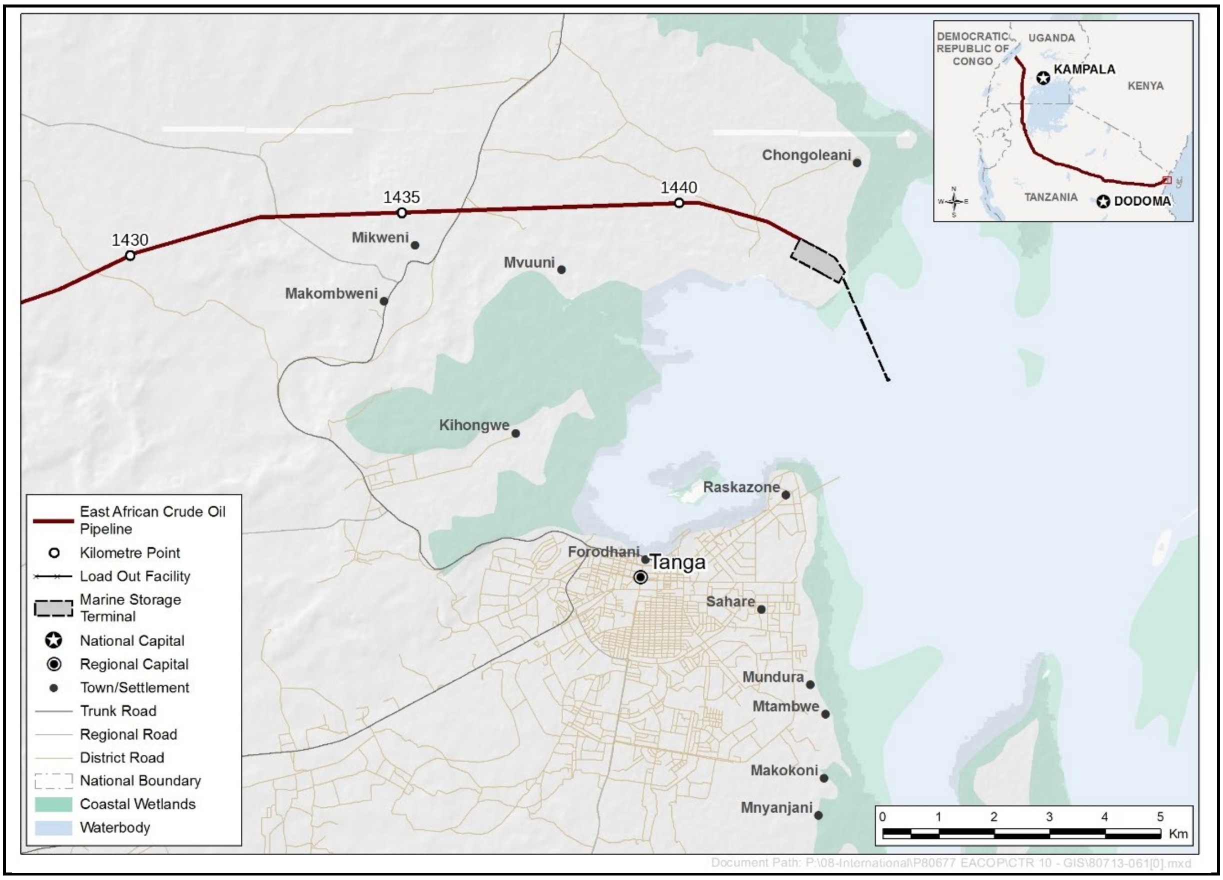

Figure 2.3-10 Marine Storage Terminal Location

2.3.4.3 Layout and Components

The MST layout, as depicted on Figure 2.3-11, has taken into consideration safety and environmental considerations within and around the MST to reduce risks to as low as reasonably practicable (ALARP). The MST will consist of the following:

- four heated storage tanks, each with a capacity of approximately 500,000 bbl. The tank farm will use bund walls for containing potential spills from the floating roof tanks.
- storage tanks will maintain the oil temperature above 63°C using external recirculation loops and internal heating coils, which will use oil as a heating medium. The tanks will be also thermally insulated for thermal efficiency.
- a power generation system using dual fuel engines, sufficient to provide electricity to meet the maximum demands during the load-out operations and to provide the required power supply demands to PRS2 and associated substations
- a pressure reduction system, as described in Section 2.3.3.3, before the bulk-heating unit
- crude oil export pumps to deliver the crude oil through the LOF (comprised of a trestle and loading platform) that has a capacity to load 1,000,000 bbl of oil in 24 hours to a Suezmax vessel
- fire protection and suppression systems, including diesel-powered fire pumps, fire-water storage tanks and a fire-water loop around the MST perimeter

- a CR within the administration building with a dedicated emergency diesel-fired generator
- an operations and maintenance building that includes a sampling laboratory, spare parts and an emergency standby generator
- accommodation facilities designed to accommodate up to 40 personnel
- a stormwater runoff containment and treatment system, piped along the trestle and discharged under water below the trestle[8]
- utility systems (compressed air, potable water, vapour recovery unit (if required), sanitary and process waste treatment and disposal, and diesel storage) sized to meet the demands of the MST and LOF during maximum peak demand periods
- a 100-m high communications tower, the height of which will be further optimised during detailed design.

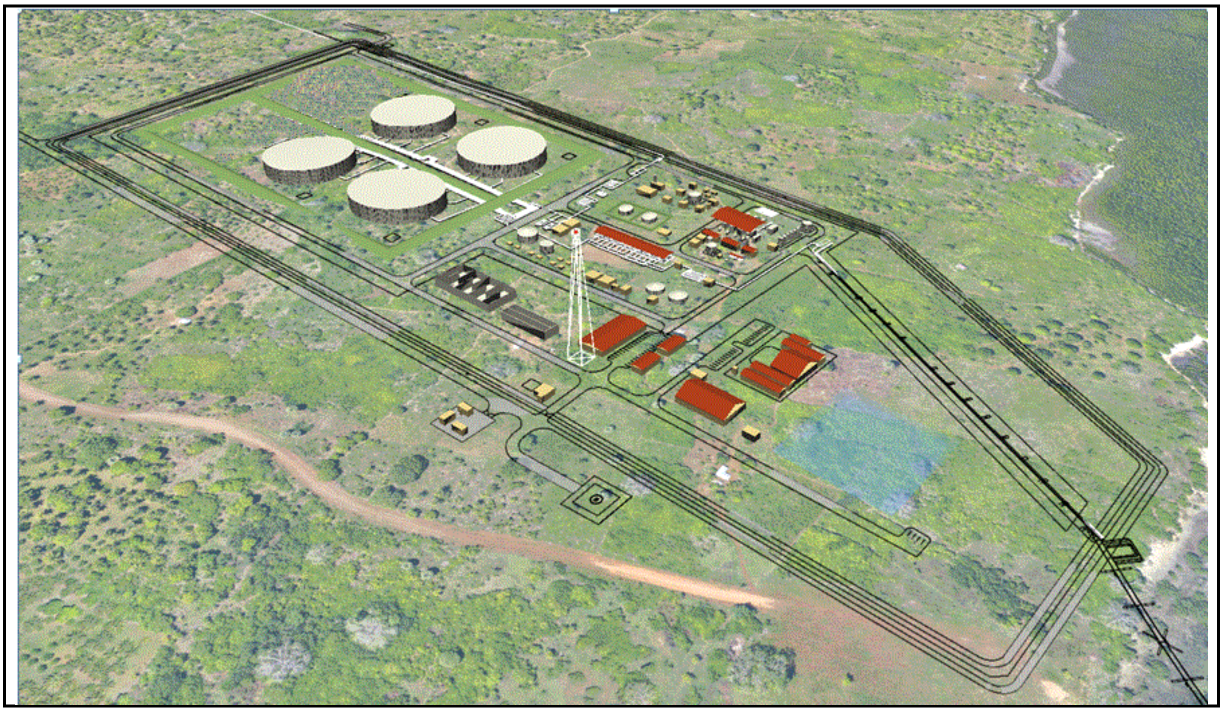

Figure 2.3-11 Marine Storage Terminal Layout

There are two CRs, one at the MST and one at the Tilenga Project CPF. The function of the CR is to remotely monitor and control all process and safety systems for the pipeline and the MST through a supervisory control and data acquisition system (SCADA). SCADA is a control system that uses computers, networked data communications and graphical software for high-level process supervisory management.

[8] The plan is to release surface runoff to an area other than the intertidal area. The release design and location continue to be under consideration.

2.3.5 Construction Facilities

Construction facilities will be required to support pipeline construction and include:

- MCPYs
- coating facility and camp.

Figure 2.3-12 shows locations of construction facilities.

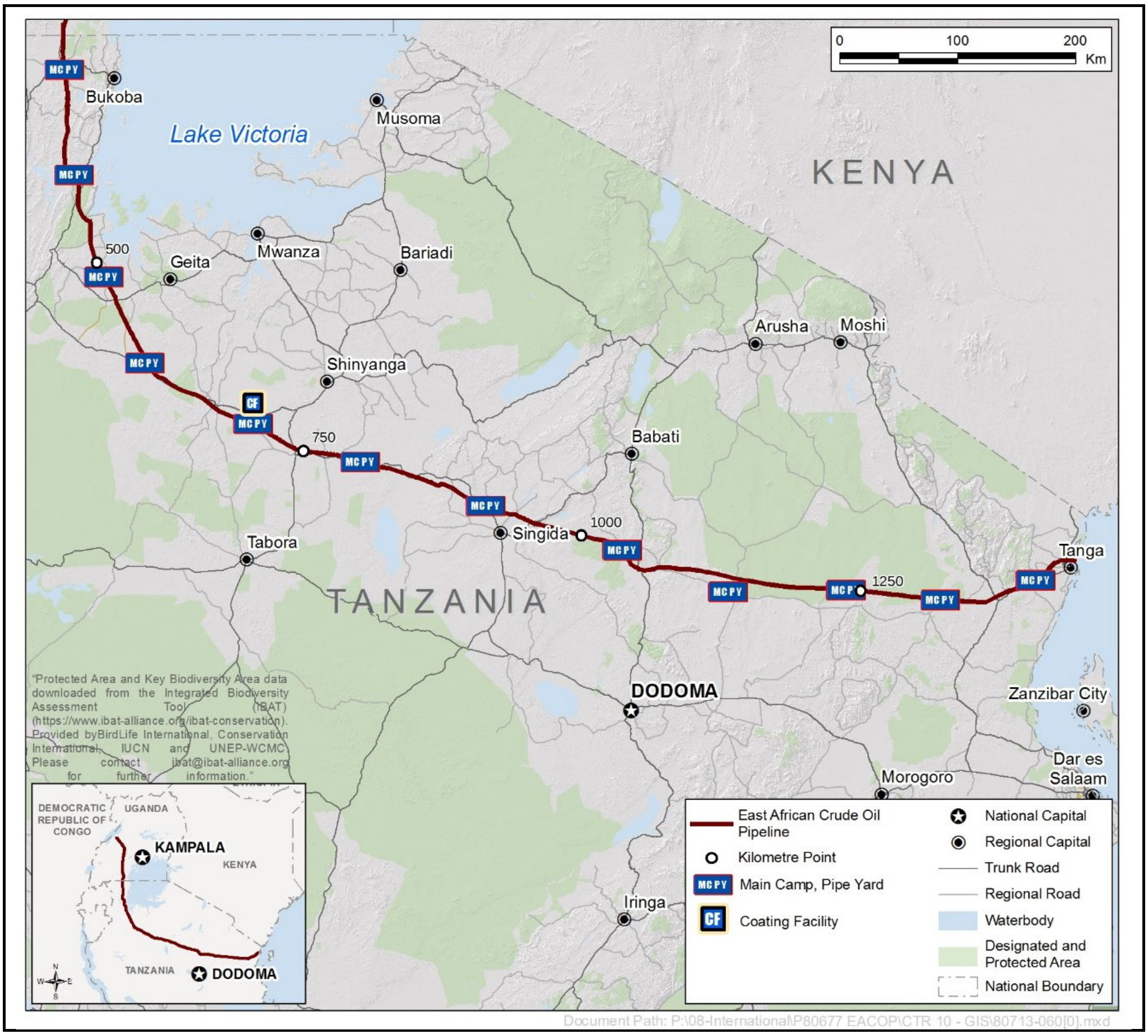

Figure 2.3-12 Construction Facility Locations

2.3.5.1 Camps

Function

Twelve 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. Locations of MCPY are provided in Table 2.3-4.

Table 2.3-4 Main Camp and Pipe Yard Locations

MCPY	KP
MCPY5	326
MCPY6	419
MCPY7	513
MCPY8	595
MCPY9	702
MCPY10	800
MCPY11	915
MCPY12	1038
MCPY13	1147
MCPY14	1238
MCPY15	1318
MCPY16	1404

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. Most MCPYs are on agriculture lands with customary rights of occupancy.

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 2.3-13.

Raw Water Treatment

Drinking water will be treated to meet World Health Organization (WHO) drinking water quality standards. Raw water quality will be analysed for each water source at MCPYs and results will inform drinking water treatment plant design for each MCPY. Typically, water treatment for drinking water involves filtration of particles from the water followed by water treatment to eliminate bacteria and viruses such as ultraviolet light or chlorine dosing (WHO guideline 5 mg/L).

Domestic Wastewater Treatment

Each MCPY will have an onsite sewage treatment plant (STP) designed for the expected load of domestic waste water (grey and black water) at each camp; domestic wastewater will undergo tertiary treatment, namely:

- primary stage: solids separated from liquid, dehydrated and treated (for example incinerated or composted)
- secondary stage: biodigestion (using indigenous, water borne bacteria) of dissolved organic matter in the liquid train; residual solids from biodigestion are settled from the wastewater and treated as per primary stage (EACOP project may use engineered reedbeds in lieu of biodigesters)
- tertiary stage: wastewater is then tested (BOD, COD, pH, TSS, coliforms, nitrogen and phosphorous) and dosed if necessary to meet disposal standards (see Section 3.2 of Appendix F).

Domestic wastewater will pass from point of generation (e.g., showers, toilets, kitchens) to the STP directly. Treated wastewater that meets relevant discharge standards may be stored in lagoons for evaporation or for use in dust suppression activity. Treated wastewater that does not meet relevant discharge standards will be stored temporarily in fully lined lagoons (impermeable liner) before being passed through the STP for retreatment. Only treated wastewater that meets the relevant discharge standards will be disposed to environment or used for dust suppression. Wastewater discharge will comply with relevant wastewater discharge permits.

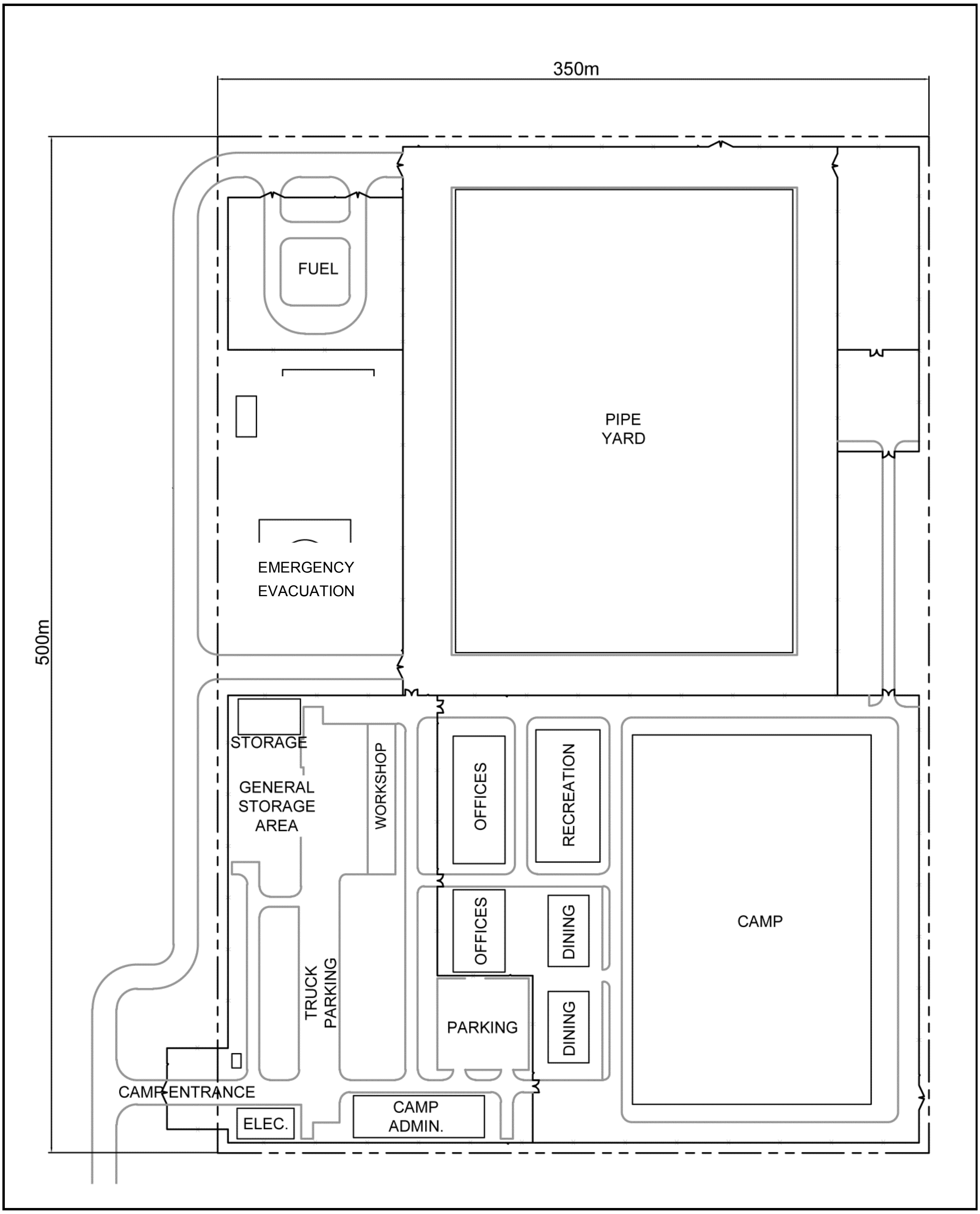

Figure 2.3-13 Typical Main Camp and Pipe Yard

2.3.5.2 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. MCPY5, 8, 11 and 16 are marshalling yards that serve for 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.

2.3.5.3 Coating Facility

Function

The pipe will be imported with fusion-bonded epoxy (FBE) coating applied. As mentioned in Section 2.2.1, the crude oil requires an operational temperature above 50°C (maximum admissible temperature is 80°C as per design) which will be maintained by pipeline thermal insulation and an EHT system. Figure 2.3-2 is a cross section of an insulation coated pipe. A coating facility has been included in the project to insulate the pipe.

The insulation coating operation is shown in Figure 2.3-14 and consists of:

- receipt, inspection and storage of pipe
- transport of pipe to the process area, for reinspection and cleaning
- installation of the EHT cable raceways or channels on the pipes
- application of the PUF insulation layer by either foam injection into a mould that contains the pipe or a continuous moulding process
- wrapping with a barrier to prolong the effective life of the insulation followed by the application of a protective high-density polyethylene (HDPE) outer jacket layer
- inspection of pipe before being moved to the coated-pipe storage area.

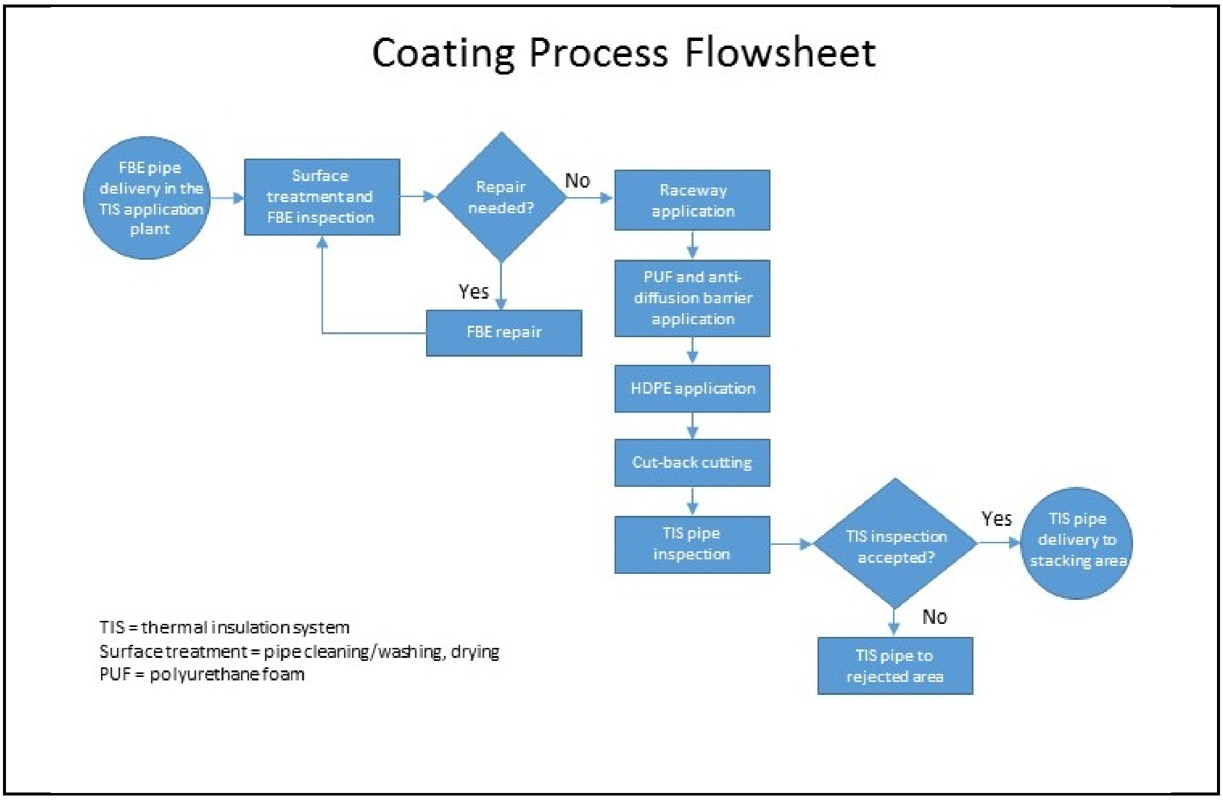

Figure 2.3-14 Coating Facility Process Flow

Locations and Size

The coating facility is within an agricultural hamlet in Sojo village, Igusule ward, Nzega district, Tabora region approximately at KP701, as shown on Figure 2.3-12.

The total land required for coating facility, with its associated pipe yard, is 40 ha (500 × 800 m). Most of the space will be for the pipe storage yard.

Layout and Components

The coating facility will contain the following components:

- coating process area
- raw materials storage area
- uncoated pipe storage area
- coated-pipe storage area
- workshops
- camp administration
- parking
- power generation (estimated 6.25 MW)
- waste area
- fuel yard
- sewage treatment area
- communication tower
- access road.

The coating facility camp is designed to accommodate up to 450 people and includes offices, and dining and recreation facilities. Figure 2.3-15 depicts the coating facility layout.

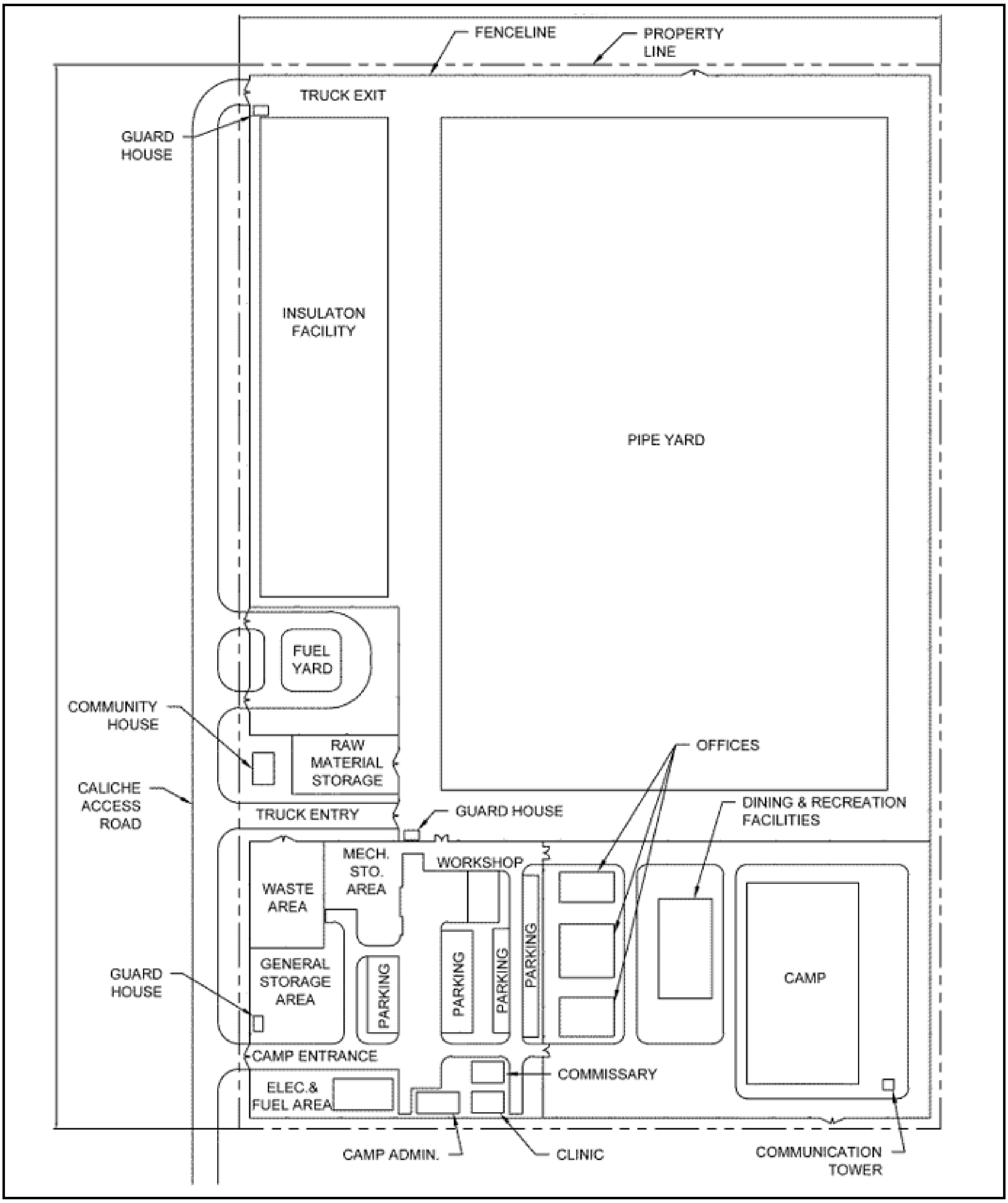

Figure 2.3-15 Coating Facility Layout

Operation

The general operation of the thermal-insulation-system application in the coating facility consists of:

- receipt, inspection and storage of pipe
- transport of pipe to the process area, for reinspection, cleaning and potential FBE repair

- installation of three aluminium raceways along the line pipes
- application of the PUF insulation layer
- wrapping, first with an anti-diffusion barrier to prolong the effective life of the insulation and then with a protective high-density polyethylene outer jacket
- inspection of pipe before being moved to the coated-pipe storage area.

The duration of the coating operation phase will be 18 months, with teams working in shifts. Besides the coating operations, there will be routine daily camp operations, such as preparing meals, laundry and maintenance. Limited emissions of several volatile organic compounds from the coating materials and solvents used in connection with the production are expected. The volatile organic compounds include isocyanate monomers, blowing agent, ethylene monomer and solvents. Depending on the application process and the requirement to control the emissions, a fume extraction system may be installed. Additionally, personal protection equipment will be provided to the operators during the production.

Power Generation

Operational phase power generation[9] will be by diesel engine-powered generator at the coating facility; this will require 3.3–6.25 MW total power dependent on subcontractor processes (note, subcontractors are still to be chosen). Typically, power generators will operate at 100% with one generator spare at 0%. The associated outputs of power generation for the coating facility include the coating of pipe and the operation of offices and workshops at the coating facility. The following is the expected power requirements:

- coating process: between 3 × 1500 kVa (including one spare) and 4 × 1800 kVa (including one spare)
- camp and offices: between 2 × 350 kVa (including one spare) and 2 × 520 kVa (including one spare)
- lighting: between 10 × 8 kVa to 3 × 100 kVa (including one spare).

Associated overall inputs for power generation:

- 200,000–2,000,000 L diesel for camps and offices
- 3,000,000–11,979,000 L for the coating process.

Associated emissions[10] for power generation:

- camp power generators: 558–5360 t equivalent CO_2
- thermal insulation system power generators: 8370–32,104 t equivalent CO_2.

[9] The EACOP project is in discussion with TANESCO regarding the possibility to connect to the local grid; discussion is ongoing at time of issue.

[10] Emissions for production phase power generation only (excluding vehicles and emissions from coating process); potential impact from project related atmospheric emissions are evaluated in Section 8.9. NOx, PM and CO emissions for the coating plant diesel engine powered generators will be dependent on the engines that will be selected by the subcontractor. The engines will be expected to be compliant with national standards. Compliance with the project environmental standards (PES) will be a project target.

Chemicals and Wastes

The types of chemicals and approximate amounts that will be used for insulating and coating the pipe, and wastes generated are included in Table 2.3-5.

The chemicals included in Table 2.3-5 used for manufacturing the pipe coating and insulation are standard coating industry ingredients used to formulate the FBE coating applied directly on to the pipe, the insulating PUF and the HDPE casing. The pipe length, diameter and thickness of coating of pipe were used by project engineers to calculate the amounts of coating and insulation required and those amounts were used to estimate the volume of each of the ingredients and the amount of waste that is likely to be generated. The volume of diesel to be used and waste volumes generated are based on expert engineering experience from previous projects of similar type and scale.

Table 2.3-5 Coating Facility Chemicals and Wastes

	Minimum	Maximum
Potential Chemicals and Products		
Isocyanate (tons)	10,911	13,200
Polyol (tons)	6,562	8,700
HFC 245fa (tons)	620	1,000
Cyclopentane (tons)	756	1,017
Polyethylene (tons)	19,507	26,395
PU face protect (L)	4,962	13,000
Diesel (L)	2,632,448 6,359 L/day	20,000,000 49,000 L/day
Waste or Emissions		
PUF (tons)	156	900
Isocyanate barrels (pcs)	35,000	66,000
Polyol (tons)	40	270
Polyol barrels (pcs)	29,827	71,600
HFC 245fa (tons)	38	101
Cyclopentane barrels (pcs)	1482	1994
Blowing agent barrels (pcs)	1,216	196
Polyethylene (tons)	341	2,660
Pallets (PE storage) (pcs)	7780	30,861
Plastic woven bag (PE storage) (pcs)	780	33,700
PU face protect (L)	Not determined	Not determined

Major chemicals used for insulation processes will be stored under controlled conditions in tank farms in a separate building. Chemical management plan and work instructions will be prepared and implemented by a dedicated crew during the tank farm operation. Safety data sheets for coating-process chemicals will be displayed onsite. The wastes will be managed based on the construction waste management plan described in Section 2.4.2.9.

2.3.6 Access Roads

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

- permanent new and upgraded existing access roads to permanent AGIs
- new and upgraded existing access roads to temporary 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 2.3-6 below.

Table 2.3-6 Access Roads and Approximate Lengths

Facility Type	New Access Road (m)	Existing Road Upgrade (m)
Permanent Facilities (AGIs)		
PS3	7,225	6,863
PS4	761	1038
PS5	843	1,027
PS6	2,091	4,751
PRS1	11,165	-[11]
PRS2	217	2,532
MST	1,597	6,490
Construction Facilities		
Coating Facility	30	-
MCPY5	583	328
MCPY6	9	9,855
MCPY8	51	1,971
MCPY9	457	-
MCPY10	1,479	-
MCPY11	113	-
MCPY12	624	8,644
MCPY13	13	14,849
MCPY14	81	17,760
MCPY15	2,401	-

[11] Facility or MCPY near to existing road

Table 2.3-6 Access Roads and Approximate Lengths

Facility Type	New Access Road (m)	Existing Road Upgrade (m)
MCPY16	64	792
Total	29,804	76,900

All roads will be surveyed, designed, constructed, repaired and maintained using The United Republic of Tanzania Ministry of Works Standard Specification for Road Works 2000, with the cooperation of TANROADS and Tanzania Rural & Urban Roads Agency (TARURA). 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.

2.3.7 Land Requirements

2.3.7.1 Area Requirements

There are two categories of project land requirements:

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

All land required for the project in Tanzania, summarised in Table 2.3-7, will be acquired on a permanent basis, even for construction facilities. The title to the land will be transferred to the government and the land provided for use by the project by a lease arrangement with the Tanzania Petroleum Development Corporation.

Land will be required for construction facilities such as MCPYs, the pipe coating facility 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 government unless otherwise negotiated and agreed between the project and third parties or the government.

Table 2.3-7 Land Requirements

Project Component	Estimated Affected Area
Construction Facilities	
Coating facility (one in Tanzania)	40 ha
Two main construction camps with marshalling yards	17.5 ha + 18.0 ha = 35.5 ha
Ten main construction camps/pipe yards	Between 17.5 ha and 18.4 ha, approximately 175 ha in total
Hydrotest water storage	To be confirmed
Construction and Operation	
New access roads to construction facilities, pipeline corridor and AGIs	Estimate: 74 ha
Operational Facilities	
Export Pipeline	
30-m-wide construction corridor	30 m corridor: 3,441 ha
Additional temporary construction workspace along corridor (estimate)	163 ha
Permanent AGI	
MST and tanks	72 ha
Four PSs, including buffer and construction staging area (15.0 ha each with 1.0 ha in pipeline corridor)	4 x 14 ha outside 30 m corridor = 56 ha
Two PRSs (estimated 3.3 ha each additional to pipeline corridor)	2 x 3.3 ha outside 30 m corridor = 6.6 ha
MLBV stations and electrical substations	Constructed within pipeline corridor, no additional land required
Total project land requirement[12] (construction and operation)	4,063 ha

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 unimpeded, with provision for vehicle crossings at existing roads. During operations the pipeline RoW will continue to be 30 m.

[12] 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 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.

2.3.7.2 Land Acquisition

The principles used for the land acquisition process have been presented in the resettlement policy framework (RPF) (Appendix L). These principles align the project land acquisition process to the Tanzanian legal requirements and the international financing standards required to secure project financing.

The land use required by the project can be classified into two categories;

- short-term use
- long term use.

Short-term land use is primarily for construction purposes whereas long-term use is for the operational phase of the project. All project land in Tanzania will be permanently acquired on behalf of the government of Tanzania (GoT) who will grant the right of occupancy to Tanzanian Petroleum Development Corporation (TPDC). TPDC will then lease the land to the project in accordance with the intergovernmental agreement (IGA) principles. The land acquisition process is presented in Figure 2.3-16 and the sequential steps described below.

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.

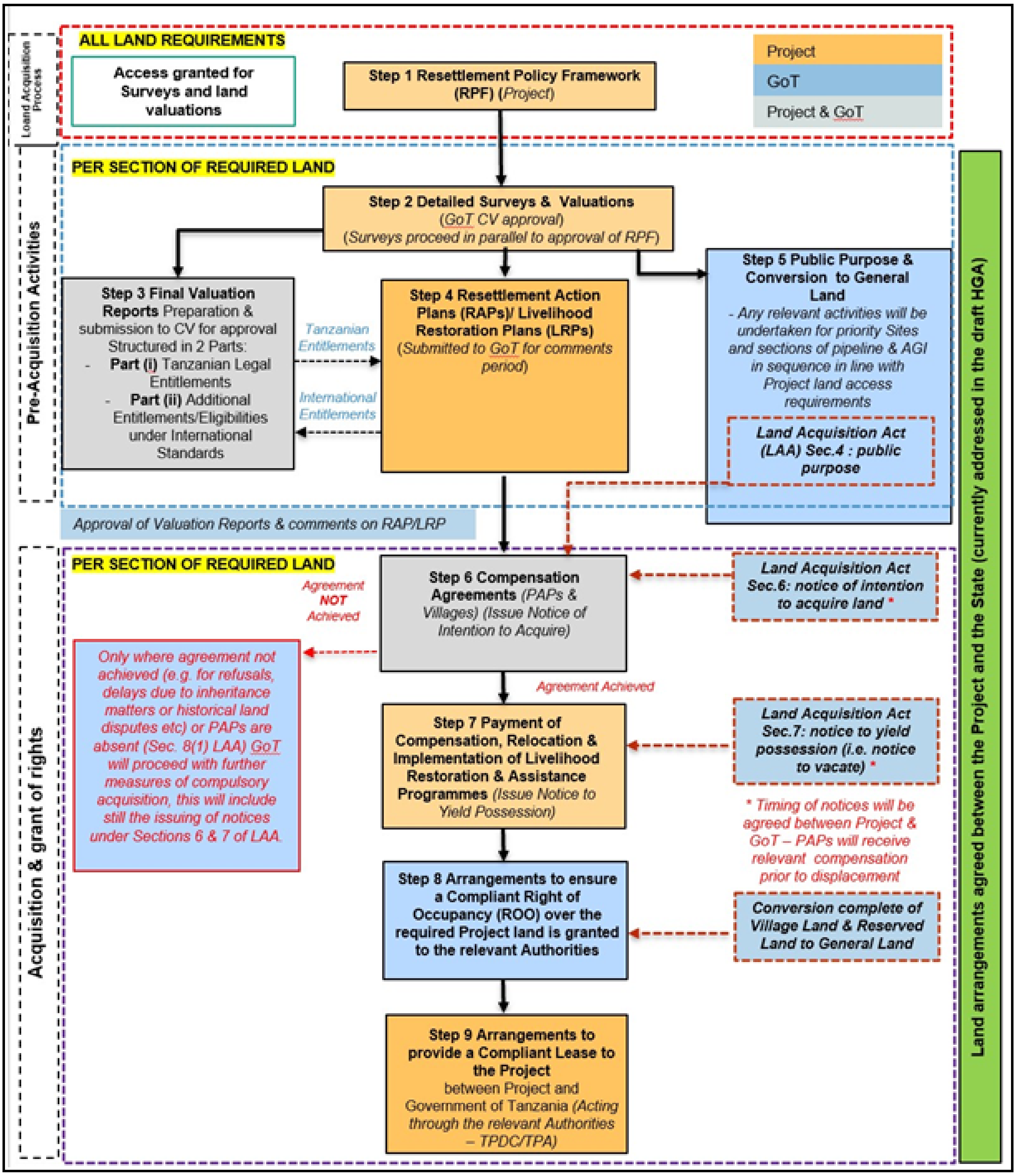

Figure 2.3-16 Land Acquisition Process

Step 1 – Resettlement Policy Framework

The RPF is applicable to all the project's land acquisition in Tanzania and guides all subsequent steps in the land acquisition process to ensure consistency between the individual resettlement action plans (RAPs)/livelihood restoration plans (LRPs) to be produced. The RPF was drafted by EACOP, reviewed by the GoT and finalised following receipt of the GoT comments. The RPF was then publicly disclosed in 2018.

Step 2 – Detailed Surveys and Valuations

This step includes several activities that ultimately inform the valuation reports. An example of the valuation process is used to inform the land acquisition process for the construction facilities. The survey and valuation process is outlined in Table 2.3-8.

Table 2.3-8 Survey and Valuation Activities

Activity	Timing Activity Undertaken
Determination of base compensation rates	February 2018
Determination of land areas for surveys	
Preparation for surveys	
Announcement of surveys and cut-off date	March 2018
Community sensitisation	
Land delineation and adjudication survey	
Asset valuation survey	
Socio-economic survey	
Validation of valuation schedules	April and June 2018
Preparation of valuation reports and compensation schedules	May - September 2018
Disclosure of individual PAP compensation schedules	September–October 2018

Step 3 – Final Valuation Reports and Compensation Schedules

Both the valuation report and the compensation schedule are comprised of two parts:

- Part (I): Tanzanian Entitlement items
- Part (II): Additional Entitlements under International Financing Standards Requirements items.

Valuation reports were signed-off by the village, ward and district authorities as required under the legal framework prior to submission for approval to the chief valuer.

Step 4 – RAP Preparation

The outcomes of the steps described above are documented in the RAP (which does not contain information on individual project-affected persons (PAPs).

Step 5 – Gazettement of Public Purpose & Conversion of Land

Land for the project will be acquired on the basis that the project is in the public interest, and land required for the project will be deemed as in the public purpose.

The majority of land acquired for the project will be converted into general land by the GoT.

Step 6 – Compensation Agreements

Based on the values and entitlements confirmed in the approved final valuation report (Step 3) and in the entitlements framework, a compensation agreement for each PAP will be prepared. The compensation agreements are proposed to be tripartite with the signing of these agreements by the following three parties: the GoT (as the 'Acquirer') (first party), the project (second party) and PAP (third party).

Entitlement briefings will be conducted at village level with the support of district, ward and village authorities and will involve presenting entitlements to PAPs (including the PAP's spouse, where appropriate) and discussing entitlement options with them. These options will include selection between cash and in-kind compensation options where eligible, as well as selection between various livelihood restoration options (e.g., land-based activities, nonland-based activities). PAPs will then be given the opportunity to make informed decisions regarding the compensation and livelihood restoration options they select.

The project will undertake engagement with the PAPs and affected communities seeking to achieve consensual compensation agreement with them. Once qualifying PAPs have selected their preferred compensation and livelihood restoration options, the agreements will be signed by the PAP and witnessed. The compensation agreements will include a spousal consent (where appropriate).

Step 7 – Payment of Compensation, Relocation and Implementation of Livelihood Restoration and Assistance Programmes

The project proposes to pay the compensation and provide the additional entitlements (including in-kind and livelihood restoration) and therefore would be a signature party to the compensation agreements.

Cash compensation due to PAPs will be paid on a rolling basis after the agreements have been signed and will be deposited directly into the bank account of PAPs.

Following selection of compensation options by PAPs and signing of the agreements (Step 6), it will be possible to make a more precise determination of land required for replacement housing and replacement farms. The project will then finalise securing replacement land for PAPs identified during the RAP planning phase. The project will be responsible for the preparation of replacement plots and for construction of replacement houses according to PAP eligibility and selected house designs, which will be from the range of house designs prepared by the RAP architect.

Implementation of livelihood restoration and assistance programmes will involve giving effect to the additional entitlements related to livelihood restoration.

Monitoring and evaluation is required for the duration of the RAP implementation process to ensure that resettlement and compensation commitments are honoured, entitlements are delivered and livelihoods are restored to at least pre-resettlement levels.

Step 8 – Granting of Rights of Occupancy to TPDC

The GoT will ensure that, once the relevant project land has been transferred to the GoT, further steps will be undertaken to ensure that the TPDC will be granted the right of occupancy in such a manner as will enable the TPDC to grant to the project a lease that is compliant with the IGA principles.

Step 9 – Lease for Land Provided to the Project

Once a granted right of occupancy on the required land has been granted to TPDC, the GoT will be required to undertake steps to ensure that such authorities grant a "compliant lease" to the project.

At the time of this ESIA is completed, land acquisition process and preparation of the RAP is still ongoing. From the preliminary surveys in the field, the estimated number of PAPs for construction facilities (MCPYs and the coating facility) and the estimated number of PAPs for the pipeline corridor and AGIs are presented in Table 2.3-9 and Table 2.3-10 respectively.

Table 2.3-9 Estimated Number of PAPs for Construction Facilities

Construction Facilities	Region	District	PAPs	PAPs Losing Land	Tenant (Only) PAPs	Physically Displaced PAPs	Economically Displaced (Only) PAPs
MCPY05	Kagera	Missenyi	33	24	9	5	28
MCPY06	Kagera	Muleba	52	29	23	7	45
MCPY07	Geita	Chato	14	8	6	0	14
MCPY08	Geita	Bukombe	47	29	18	9	38
MCPY09	Tabora	Nzega	6	5	1	4	2
CY-KP701	Tabora	Nzega	38	35	3	5	33
MCPY10	Tabora	Igunga	17	8	9	0	17
MCPY11	Singida	Singida Rural	27	24	3	4	23
MCPY12	Dodoma	Kondoa	15	14	1	0	15
MC13	Manyara	Kiteto	3	3	0	0	3
PY13	Manyara	Kiteto	16	10	6	0	16
MCPY14	Tanga	Kilindi	9	6	3	0	9
MCPY15	Tanga	Handeni	71	63	8	0	71
MCPY16	Tanga	Muheza	6	1	5	0	6
Total	**Tanga**		**354**	**259**	**95**	**34**	**320**

Table 2.3-10 Estimated Number of PAPs for Pipeline Corridor and AGIs

Region	Land Delineated (km^2)	Total Kilometres of Land Delineated (%)	No. of PAPs Delineated	PAPs Delineated (%)	No. of Valuations Completed	No. of Replacement Houses Required
Kagera	166.99	14.42	2,087	23.36	2,690	123
Geita	176.73	15.26	1,378	15.42	1,679	49
Shinyanga	54.03	4.67	607	6.79	853	15
Tabora	149.96	12.95	876	9.80	1,073	42
Singida	144.71	12.50	1,225	13.71	1,600	50
Dodoma	106.37	9.19	788	8.82	922	30
Manyara	152.15	13.14	469	5.25	629	34
Tanga	207.03	17.88	1,505	16.84	1,734	59
Total	1,157.96	100	8,935	100	11,180	402

Land additional to that required for operations and construction facilities, such as borrow pits, will be temporarily secured by contractors. Contractors will be required to assess and mitigate potential environmental and social impacts consistent with regulatory and IFC requirements and manage associated land access in compliance with the national and international standards, as addressed in the project's resettlement policy framework.

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 Study

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

A study to identify and evaluate potential water sources to support construction, commissioning and operations is being undertaken in collaboration with the Tanzania Ministry of Water. 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, Tanzanian and international potable water standards, effluent discharge standards, and Tanzanian 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 Facility Water Sources

MCPY	KP	Potential Water Source	Borehole, New/Existing
MCPY5	326	Surface water (Kagera River) or groundwater	Direct river abstraction or new
MCPY6	419	Groundwater	New
MCPY7	513	Groundwater	New
MCPY8	595	Groundwater	New
MCPY9	702	Groundwater	New
MCPY10	800	Groundwater	New
MCPY11	915	Groundwater	New
MCPY12	1038	Groundwater	New
MCPY13	1147	Groundwater	New
MCPY14	1238	Groundwater	New
MCPY15	1318	Groundwater	New
MCPY16	1404	Groundwater	New

For hydrotesting, described in Section 2.4.4.2, a hydrotest management plan will be prepared.

As part of the hydrotest management plan, the project will identify sources of water for hydrostatic testing and be responsible for obtaining necessary abstraction approvals and permits.

The plan will include information on the quantity and quality of water needed, the proposed 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.

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

Surface water, not groundwater, is expected to be the primary source of water for hydrostatic testing. If surface water is not available to make up losses incurred during testing, groundwater, if available, may be used to make up losses, if permitted, and without causing impacts to local groundwater resources. Permits for groundwater abstraction will be acquired and permit conditions adhered to by the EACOP project.

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.

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.

The hydrotest management plan will assess locations for discharging hydrostatic test water; for any discharge of hydrotest water in nearshore marine waters, 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, and flow rate will be controlled to reduce the risk of soil erosion and disturbance to riverbed sediment and erosion protection measures implemented as required.

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

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.

For the project, early works includes the construction of a coating facility (see Section 2.3.5.3) and a 30-m long access road.

Spread Strategy

The pipeline is expected to be constructed in four spreads in Tanzania, 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.

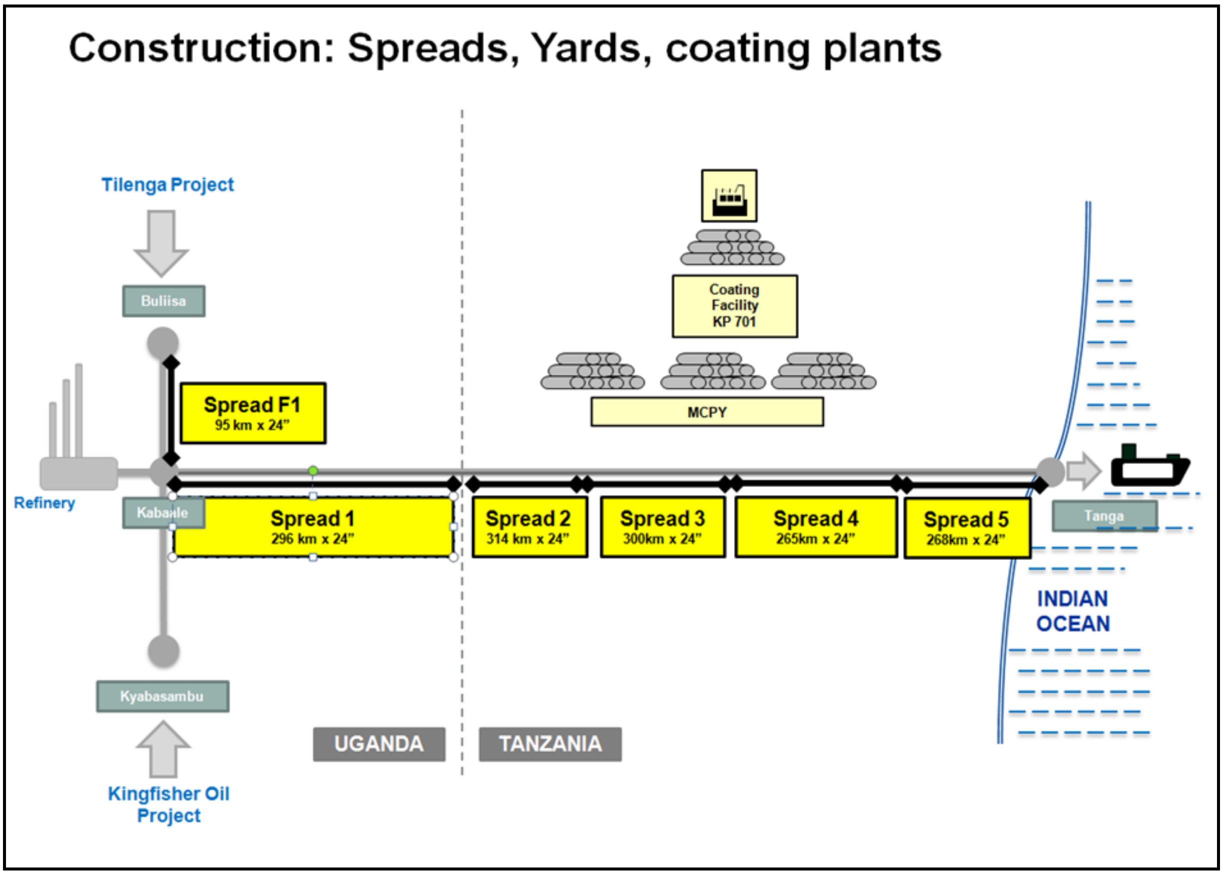

Figure 2.4-1 Construction Spreads

Construction from KP296 (Uganda–Tanzania border) to KP910, in the Lake Victoria and South Victoria regions is divided into spreads 2 and 3.

Spread 2, KP296–610, includes the following components:

- 314 km of 24-in. pipeline
- Kagera River horizontal directional drill (HDD), 826 m length in a 36-in. steel casing pipe
- 19 MLBV sites
- four independent electric heat trace substations.

Spread 3, KP610–910, includes the following components:

- 300 km of 24-in. pipeline
- 14 MLBV sites
- four independent electric heat trace substations.

Construction from KP910–1442.8 (MST) crossing the Rift and coastal region is divided into spreads 4 and 5.

Spread 4, KP910–1175, includes the following components:

- 265 km of 24-in. pipeline
- 14 MLBV sites
- three independent electric heat trace substations.

Spread 5, KP1175–1442.8, includes the following components:

- 268 km of 24-in. pipeline
- Sigi River HDD, 1216 m length in a 36-in. steel casing pipe
- 13 MLBV sites
- three independent electric heat trace substations.

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 86,500 × 18-m-long pipe sections, and associated infrastructure constraints and opportunities, were considered to identify the optimum logistics strategy. Section 3.8.2 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 the coating plant and AGI components and construction materials will be transported to storage facilities and construction sites.

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

Ports

The project will receive the following cargo through Dar es Salaam and Tanga ports, based on their infrastructure:

- containers
- break bulk (goods not in shipping containers)
- construction components.

The following cargo will be received through Dar es Salaam:

- pipe
- heavy load or overload.

Railroad

Tanzanian Rail Corporation operates between the port of Dar es Salaam and Isaka (KP702). Use of the railroad to transport the pipe to the Isaka would reduce road transportation requirements.

Tanzania Railways Limited has been engaged for discussions on the availability of slots and rolling stock to meet project logistics requirements. When maintenance is completed, transit time from the port of Dar es Salaam to Isaka is planned to be two days. Based on a two-day, one-way transit time plus one day for loading and one day for offloading, a total round trip time will be six days.

Road

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 8.17.2.1, Tables 8.17-1 and 8.17-2.

Maintenance and Upgrades of National Roads

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

Permanent and construction access roads required by the project are addressed below in this section and in Section 2.4.2.7.

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, coating facility 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, 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 518 crossings of various types described in Section 2.4.2.6.

When the pipeline corridor crosses large infrastructure or watercourses, special construction methods (see Section 2.4.2.6) 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 Tanzania. 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 Tanzania through TANROADS is currently upgrading roads in Tanzania. The project will work with TANROADS on its planned road upgrades, shown in Table 2.4-2 and Figure 2.4-2, that will support the project logistics.

Table 2.4-2 Road Upgrades

Road Section	Length (km)	Type
Road from Chato to B4-970	94	TANROADS upgrade ongoing
Biharamulo to Masumbwe (sections of B8 and B3)	188	Areas for repair
B3 between Nzega and Sanilwa	67	Murram road to be converted to sealed tarmac
B3 between Singida and Nzega	215	Areas for repair
Kondoa to Korogwe	341	Murram road portion to be upgraded

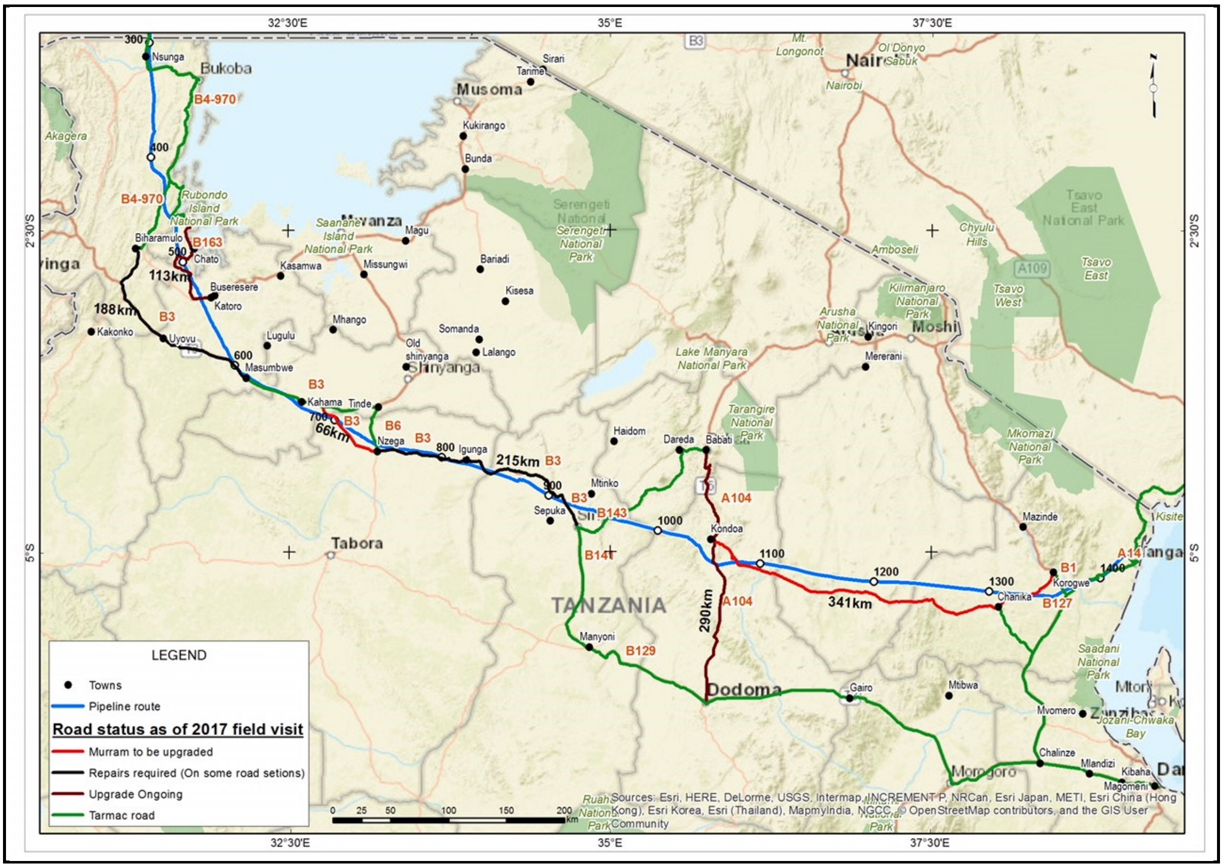

Figure 2.4-2 Road Upgrade Plans

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 that are required from Tanzania 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 – 170,000 m^3
- sand – 200,000 m^3
- cement – 17,000 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 Tanzania and that will be assembled or installed at site include, but are not limited to:

- pipe
- pipe coating materials
- pipe insulation materials
- power generation equipment and high-voltage cable for power distribution
- heating equipment including 3441 km of heat tracing cables
- fibre-optic cables
- valves and metering equipment
- storage tank materials.

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
- coating facility requirements — 160 m^3/day.

The coating facility will have an associated camp and will require approximately 90 m^3 of water/day for the camp and 70 m^3/day for operations.

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 Tanzanian 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
- PRSs – 50–80 skilled and 5–10 unskilled workers
- EHT – 20–40 skilled and 5–10 unskilled workers
- MST – 300–400 skilled and 20–40 unskilled workers.

Local Content Management

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

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

The project has already taken some initiatives to proactively work with Tanzanian 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 Tanzanian suppliers by initiating a regular and supervised dialogue
- providing assistance to Tanzanian 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 (km)
MCPY5	Misenyi	10
MCPY6 and PS3	Muleba	10
MCPY7	Chato	10
MCPY8 and PS4	Bukombe	20
MCPY9	Kahama	35
MCPY10 and PS5	Igunga	25
PS5	Igunga	10
MCPY11 and PS6	Singida	25
PS6	Singida	25
MCPY12	Kondoa	20
MCPY13 and PRS1	Kibaya	25
MCPY14	Kiberashi	20
MCPY15 and PRS2	Sindeni	20
MST	Tanga	15

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 2.3.7.2, 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.

RoW Clearing and Grading

Before clearing, a risk management process will be conducted for land mine potential, primarily for the pipeline near the national boundary, MCPY4 and PS3. 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.

On 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 shows typical topsoil removal. Drainage and sediment mitigation measures will be implemented in areas prone to runoff and near surface water (see Section 2.4.3.3).

Figure 2.4-3 Typical Topsoil Removal

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.

Stringing

Pipe will be delivered to its predetermined 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 is a photo of 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 is used to detect defects 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).

Figure 2.4-9 Typical Trenching Machine

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.

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 that 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.

Coating Facility

Coating facility construction activities will include, but not be limited to:

- earth works (e.g., clearance of vegetation, fencing, foundations and internal drainage)
- construction of a new access road to the facility and maintenance of existing access roads during construction activities
- installation of water supply infrastructure
- construction and installation of coating process areas
- construction and installation of a pipe storage yard
- building a maintenance workshop for coating-process equipment
- installation of generators and fuel storage
- construction and installation of camp facilities.

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, prefabricated 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 Marine Storage Terminal

Construction of the MST will include:

- construction of a construction camp and laydown area
- site preparation
- installation of support foundations for tanks
- construction of containment berms and drainage systems
- construction of the control buildings and assembly of the control systems
- construction of roads and parking areas
- installation of generators and fuel storage
- installation of pumps, heating and vapour recovery units, valves, manifolds, piping and utilities
- installation of the pressure reduction system
- installation of firefighting and fire suppression systems
- installation of health and safety engineering systems
- lighting, fencing, and security systems.

The biggest single MST component will be the storage tanks. Pre-fabricated tank components will be transported and assembled on site. The tanks will be constructed within bunds, which provide secondary containment to retain accidental oil spills and to prevent fire from spreading to surrounding areas. An impermeable layer will be placed under the constructed stable gravel pad for the entire bunded area.

Before MST construction, a temporary construction workers camp will be established to accommodate construction personnel, equipment and materials. The size of the camp will be approximately 10 ha (400 × 250 m). Similar to the MCPYs, the construction of the MST temporary construction camp will include site clearance, fencing, earth works, foundation works, installation of a power generation set, water supply and drainage, and installation of facilities such as offices, accommodations, dinner rooms and wash rooms.

2.4.2.6 Crossings

Overview

For smaller crossings, the pipeline will be installed using an open-cut method, where a trench is excavated to a minimum depth of 1.8 m. This may require the crossing to be temporarily blocked or diverted during construction.

For larger crossings, the pipeline will be installed underneath without an open trench. This will be achieved through techniques such as auger boring and HDD.

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.

Types and numbers of crossings are provided in Table 2.4-4 and described in more detail below.

Table 2.4-4 Crossings

Type of Crossing	Number	Length (m)
Perennial rivers	16	4,125
Perennial river (by HDD)	2	2,052
Perennial streams	14	284
Ephemeral streams	218	6,082
Murram roads	193	2,316
Sealed tarmac roads	15	676
Railway	3	108
Power line	57	855
Fibre-optic cable	≈ 10	TBD[13]
Fault lines	TBD	TBD
Total	518	16,498

[13] To be determined during detailed engineering

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 and social features. Open-cut construction methods will be used for all watercourse crossings except two HDD crossings at the Kagera and Sigi Rivers, as identified during FEED and site verifications undertaken during the design stage.

At the Kagera River, HDD was selected to avoid the national road parallel to the river. HDD was selected for the Sigi River which passes through a small gorge, which would make an open cut crossing difficult to construct.

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.

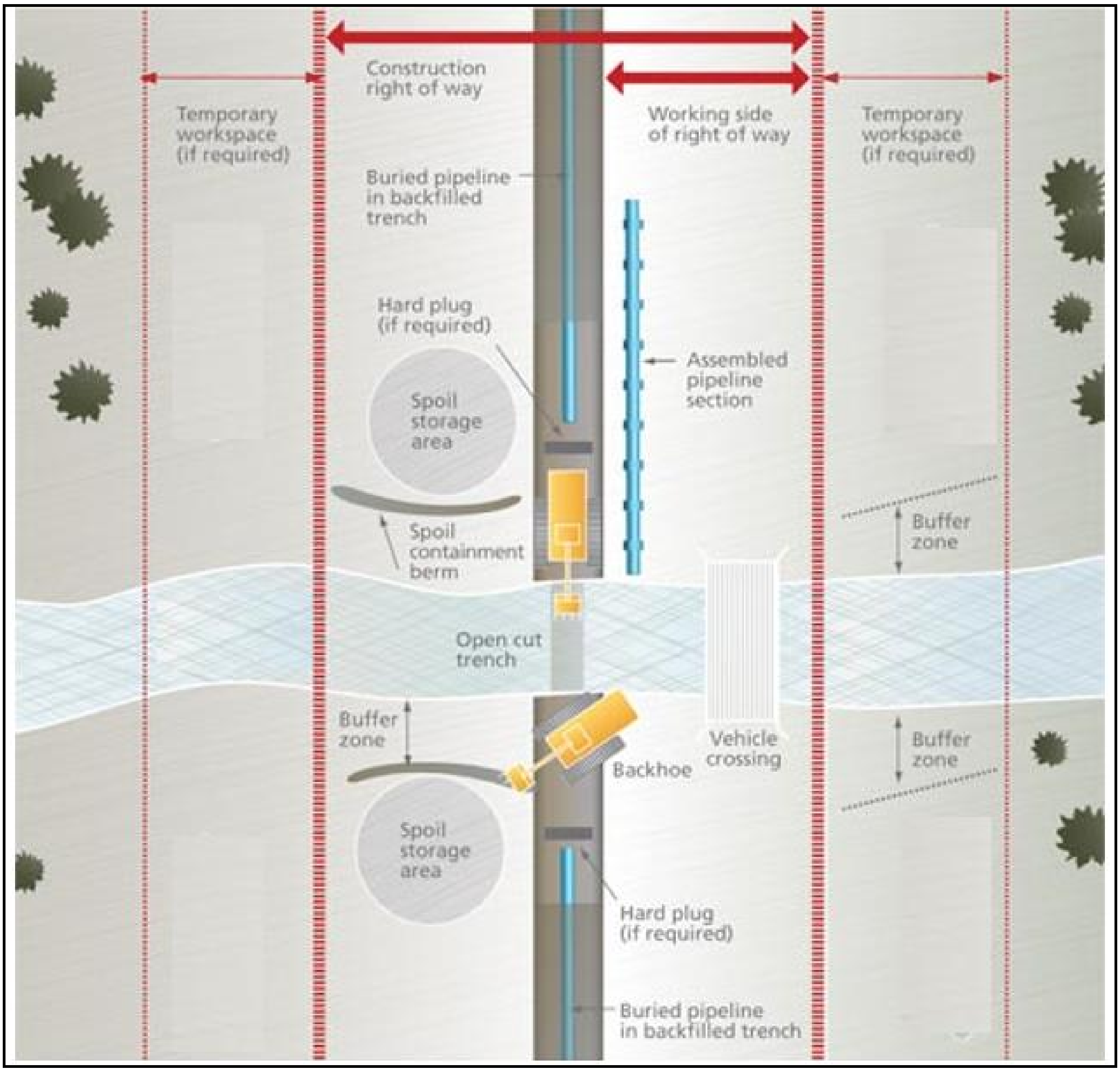

Figure 2.4-12 Open Cut Crossing

Horizontal Directional Drilling

HDD will be used for the crossing of the Kagera and Sigi Rivers, with crossing lengths of 836 m and 1216 m respectively. During HDD, a hole will be drilled to the opposite bank beneath the riverbed, at sufficient depth to protect the pipeline from future changes such as riverbed scour. The welded section of thermally insulated pipe, all in a protective casing to shield the thermal insulation coating and fibre-optic cable from damage, will be pulled through the drilled hole. This is done with the assistance of steel cradles with rollers enabling the pipe to be pulled through the hole with a minimum of friction. Figure 2.4-13 is a photo of an HDD setup.

For HDD undertaking, it is necessary to consider several factors during the planning phase that ultimately lead to appropriate and regulatory compliant management of HDD returns.

The management of HDD returns, in particular residual drilling mud and cuttings, depends on three main criteria:

- site: geological, and geotechnical conditions
- type of drilling fluid used: It is the intention of the EACOP project to use water-based bentonite mud and biodegradable polymers (if required)
- type of mud treatment equipment: to limit the consumption of mud additives and hence waste volumes, the drilling mud will be recycled. The recycled drilling mud will be pumped through vibrating screens and de-sanded/de-silted using hydrocyclones before the return to the mixing/suction tank of the HDD apparatus.

During the drilling process, optimum recycling of the mud returns by use of moisture control equipment and other treatment options to separate returns from fluids is paramount to reduction of return volumes.

However, in all cases, at the end of the HDD operations, a remaining volume of drilling mud and cuttings has to be removed from the site. As drilling muds are essentially constituted of water (70 to 90% as an average) the remaining parts being bentonite and drilled cuttings, the most important step is to separate the liquid and the solid returns.

After dehydration/separation process, the liquid stream can be discharged into surface water, over land or reused for the purpose of dust suppression on project access roads and RoW. Discharge is proceeded, if the analytical results confirm that the liquid stream satisfies the required discharge standard to the receiving environment. In all cases, all necessary regulatory discharge permits will be acquired and associated conditions complied with.

Options for management of the solid phase of HDD returns are varied and influenced by many factors, in particular the results of chemical sampling and analysis of the returns. The least preferred option for EACOP is the transportation of the material for disposal in landfill.

The solid phase of the HDD returns can be reused or recycled, e.g., use as bedding material in the trench through rocky areas to minimise importation of virgin quarried backfill material, land spreading and cultivation either on the pipeline RoW or adjacent agricultural land. These options would be subject to agreement with all relevant stakeholders and acquisition of regulatory approvals and permits.

Figure 2.4-13 Horizontal Directional Drilling Setup

Wetland Crossings

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

Crossings of annual wetlands (standing water or saturated soil for most of the year) will be open-cut with a wider trench to reduce erosion. Construction equipment will use prefabricated equipment mats to reduce soil erosion. 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 2.4-14 is a cross-section of an annual wetland crossing.

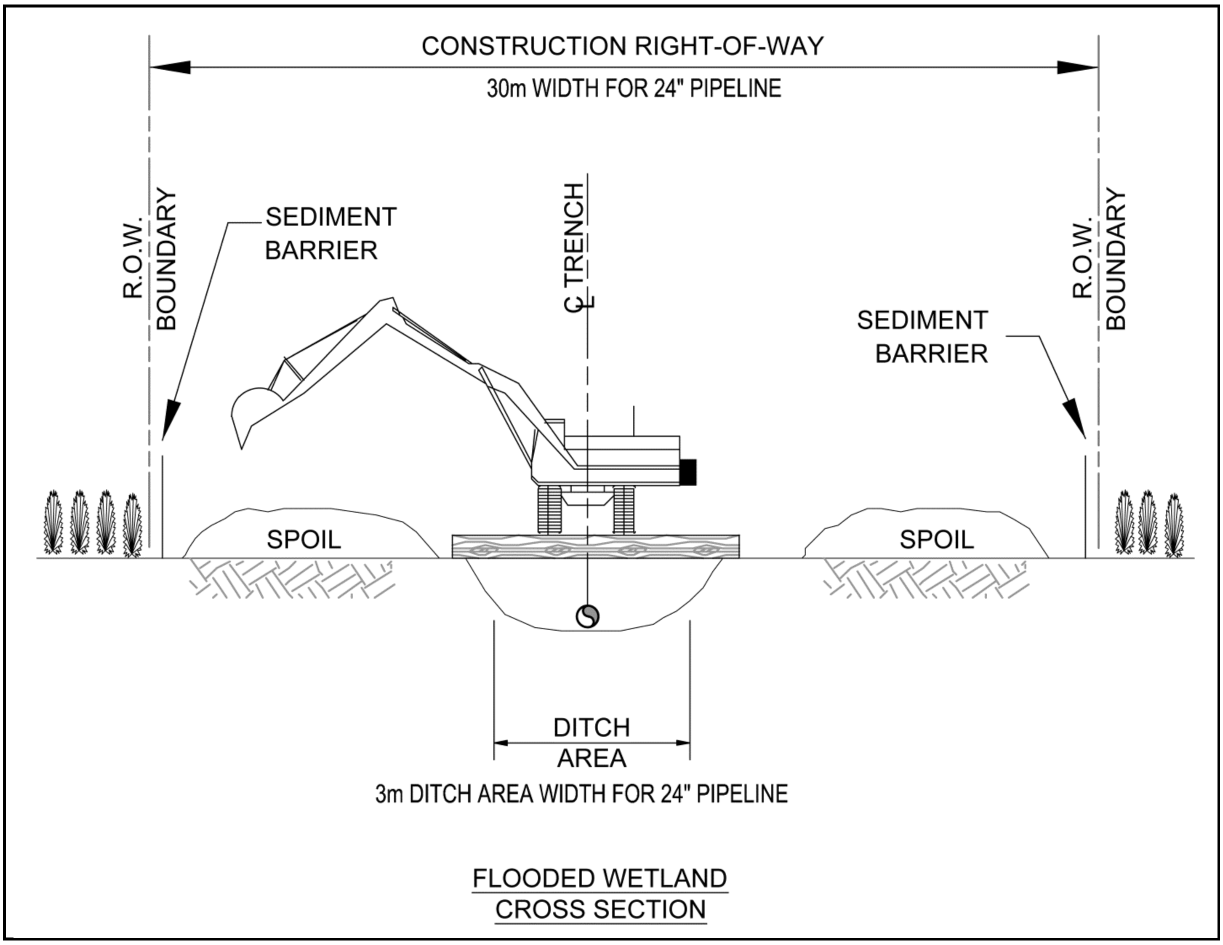

Figure 2.4-14 Crossing of Annual Wetlands

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 2.4-15 depicts a cross-section of a seasonal wetland crossing.

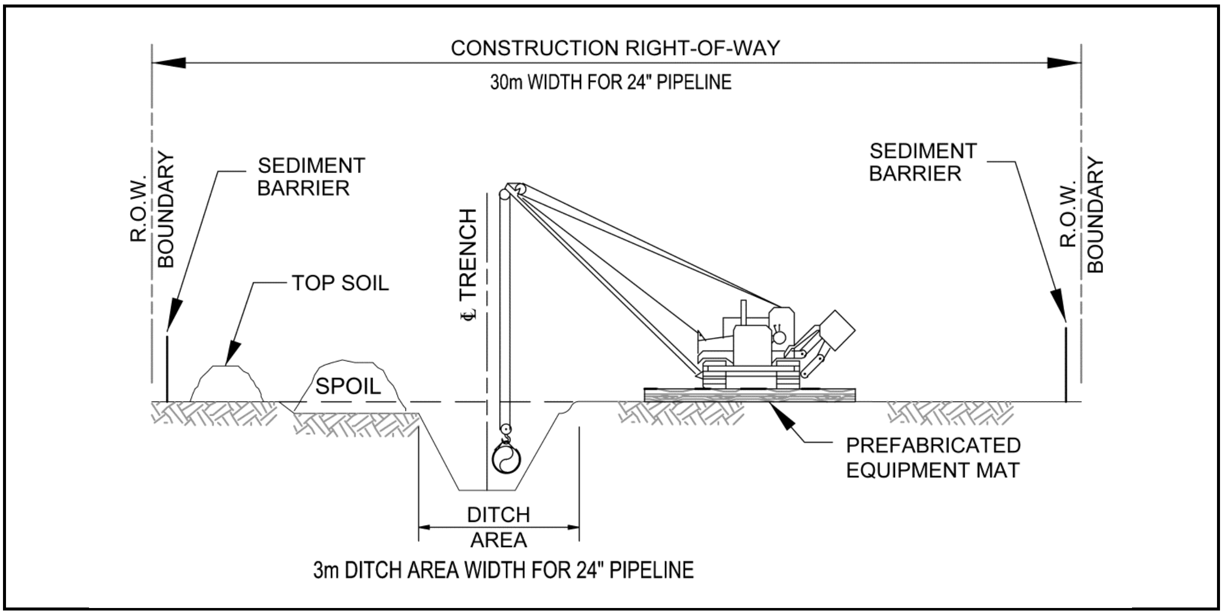

Figure 2.4-15 Crossing of Seasonal Wetland

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 2.4-16 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 2.4-16 Auger Bore

Runways

One abandoned runway will be crossed using an open-cut method without casing.

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 2.4-17 depicts a typical fault crossing plan.

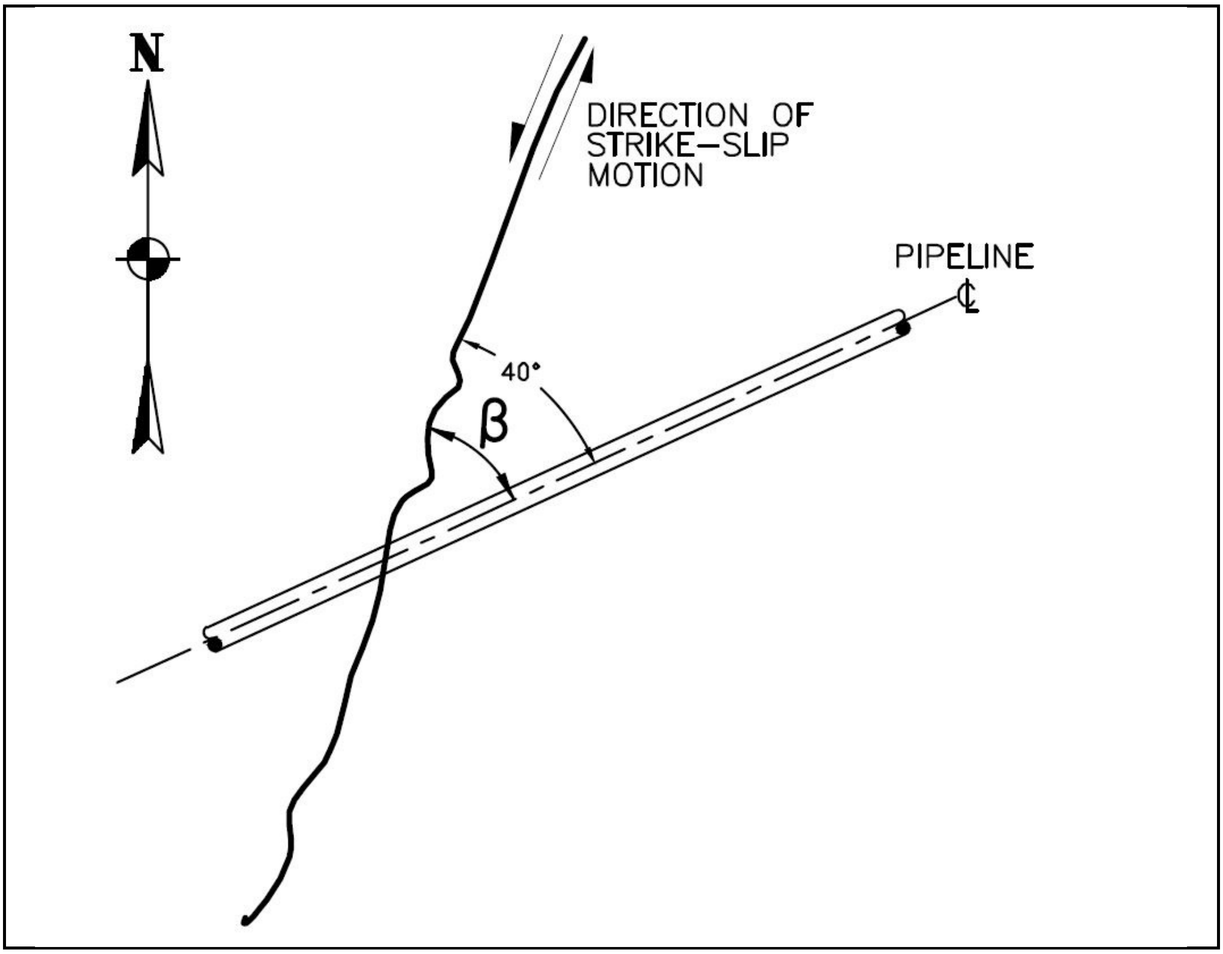

Figure 2.4-17 Typical Fault Crossing Plan

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.

2.4.2.7 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 2.4.2.9).

Road Maintenance

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

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

2.4.2.8 Emissions and Discharges

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.

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.

2.4.2.9 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 runoff 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, which 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 waste storage areas. The size of these areas 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 areas will be placed downwind of the construction camps.

The waste storage areas 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 and the coating facility 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 sign-posted. 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, material safety data sheets (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. 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 material safety data sheets (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 a pipeline construction site, erosion is mostly caused by heavy rain, which creates sediment laden runoff.

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 runoff.

Erosion control measures could include, but not be limited to, French drains. Figure 2.4-18 depicts a typical French drain. They may be installed across the RoW to restrict the movement of surface runoff. The collected runoff is discharged to the side of the RoW.

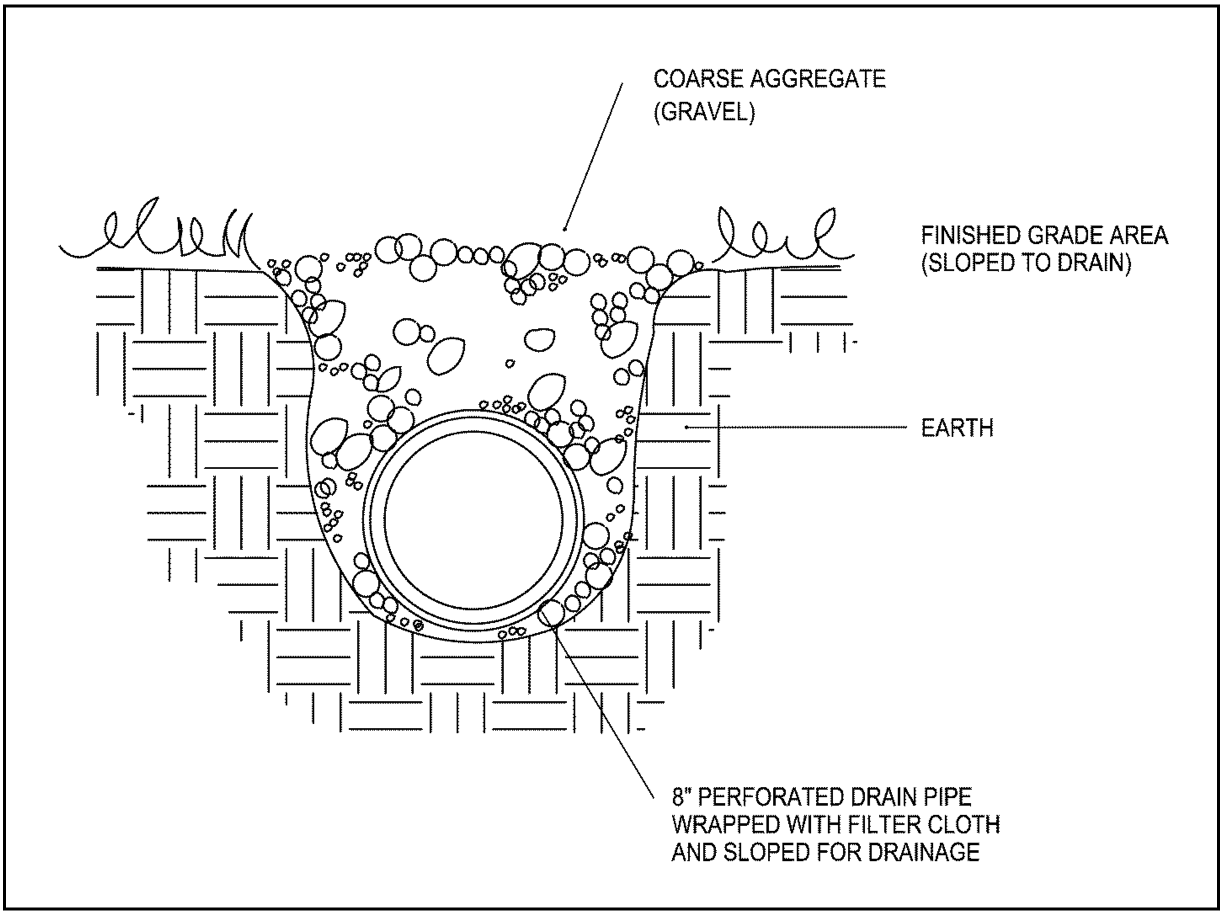

Figure 2.4-18 Typical French Drain

Sediment Control

Sediment control measures will be installed to remove sediment from runoff and could 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 2.4-19 depicts a typical straw-bale filter. The bales must be inspected often and replaced as required.

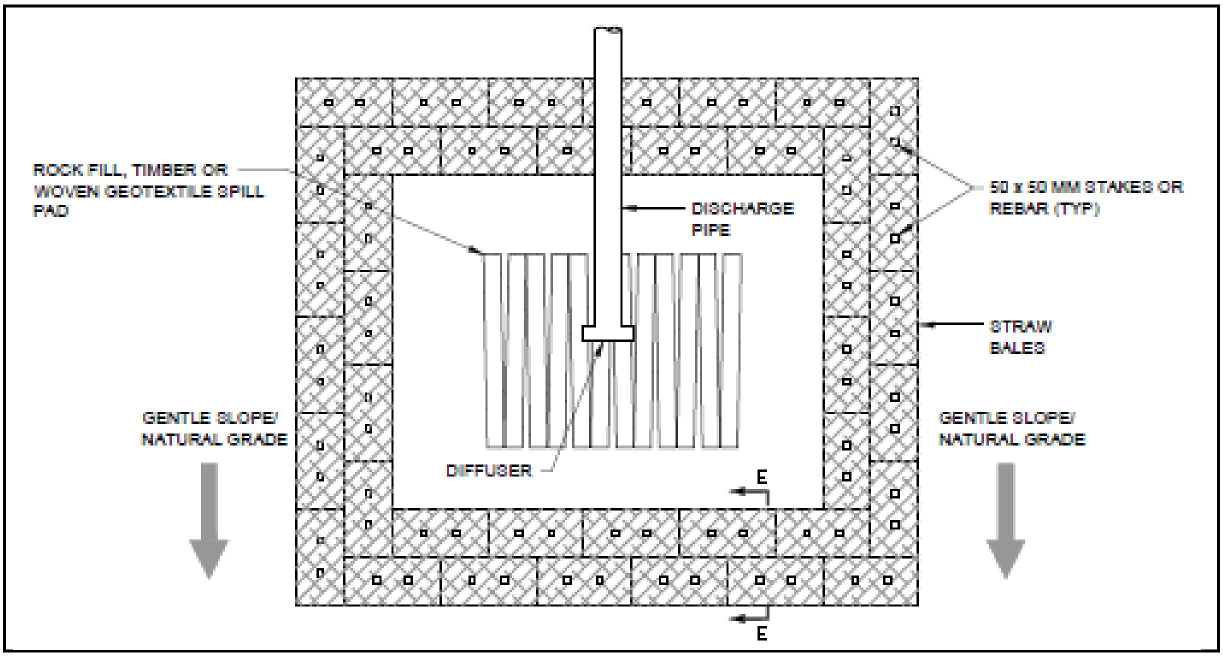

Figure 2.4-19 Straw Bale Filter

Silt fences could be installed at the side of the RoW and function as a runoff sediment filter. Figure 2.4-20 depicts a typical silt fence. Routine maintenance must be undertaken on the silt fences to remove sediments.

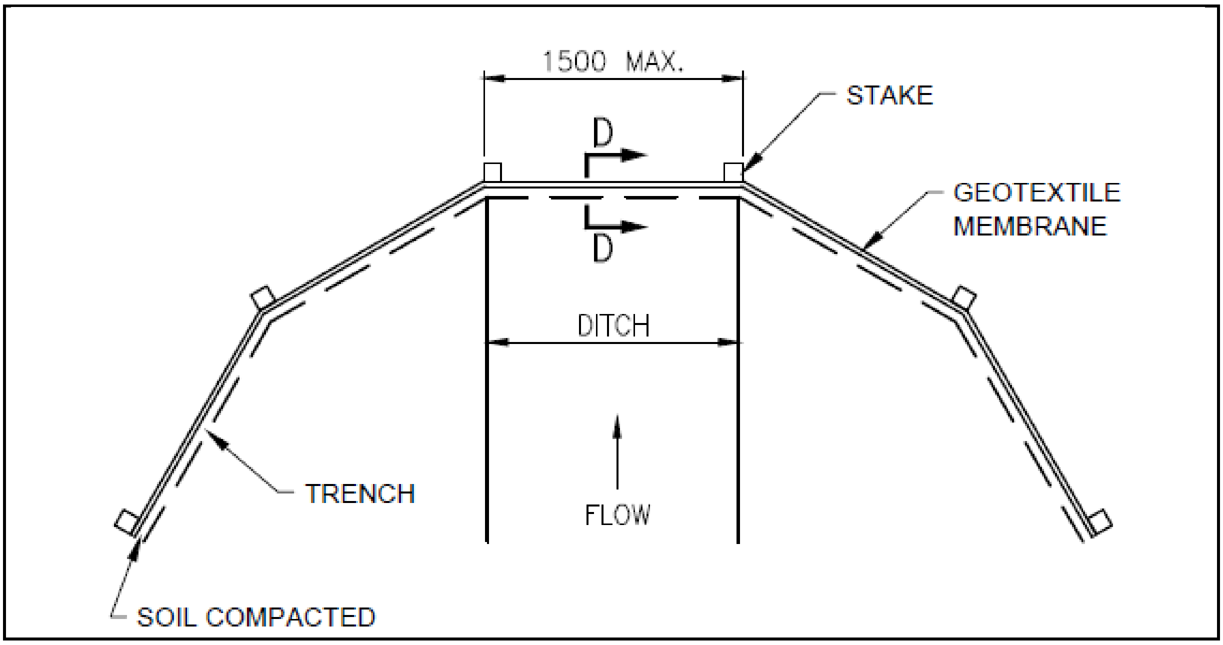

Figure 2.4-20 Typical Silt Fence

Sediment traps could be dug within the RoW to slow runoff and trap sediment. Figure 2.4-21 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.

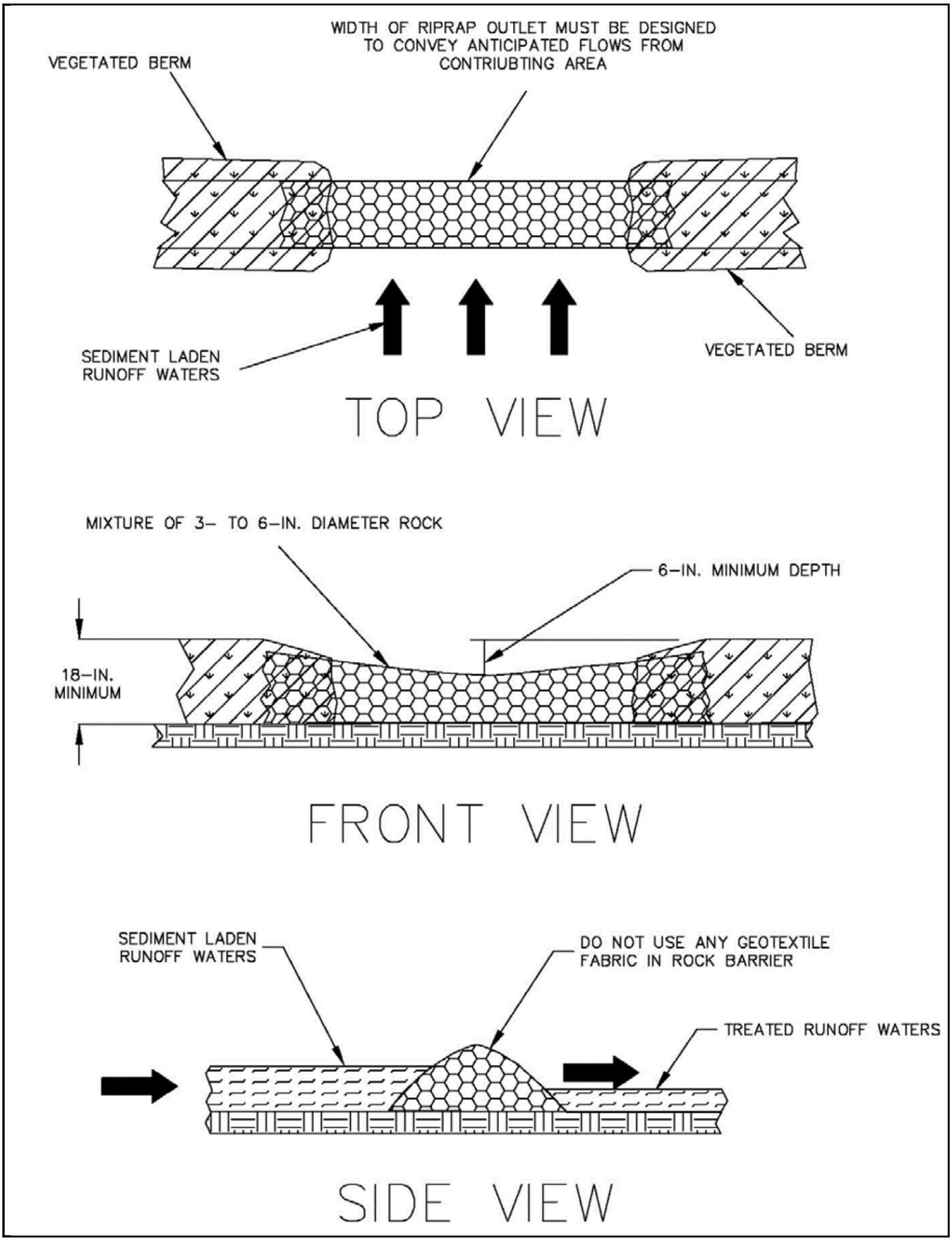

Figure 2.4-21 Typical Sediment Trap

Sediment basins are similar to sediment traps and can be used to collect sediment laden water and for settling of the sediment. Figure 2.4-22 depicts a typical sediment trap. When the basin is half full, the sediments will be removed, and, if necessary, the filter material must be cleaned or replaced.

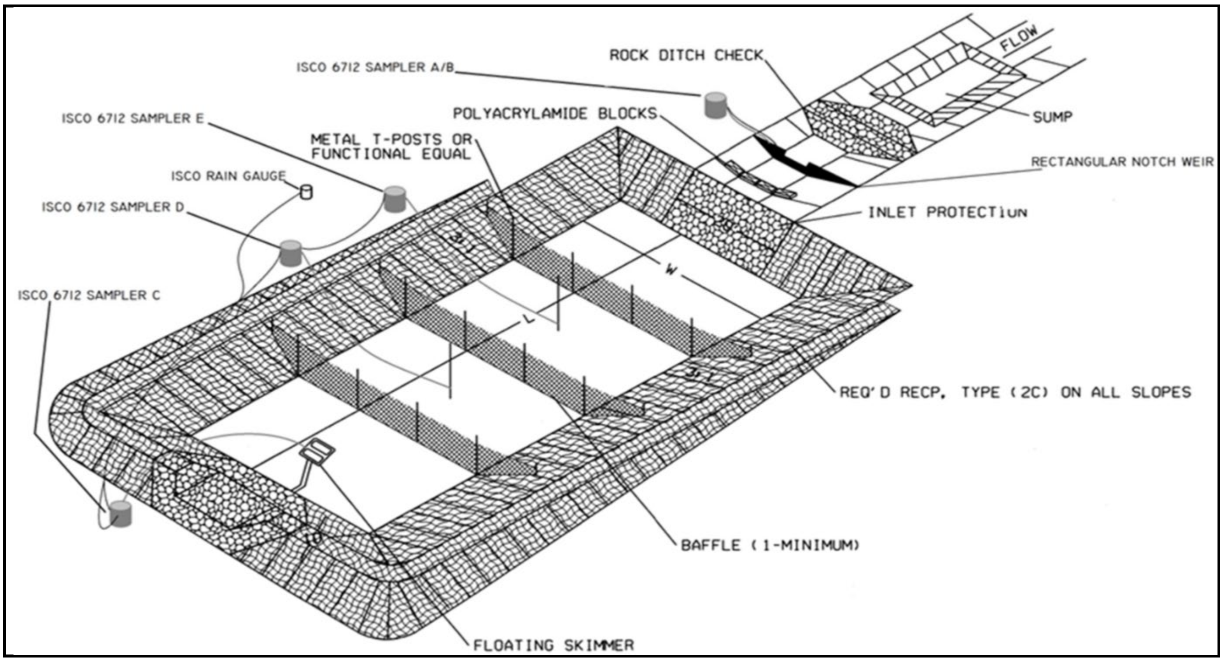

Figure 2.4-22 Sediment Basin

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
- 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, 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.

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 MST 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 and MST 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 it has gone through a suitable filtration process. 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.

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 MST 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 Kiswahili 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 and Marine Storage Terminal

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
Generator engines	Cooling system operates leak free Lube oil system operates leak free Engine, fuelled by diesel, operates within manufacturer's recommended parameters Crude oil fuel treatment system operates leak free and produces crude fuel meeting specifications Engine can switch to crude oil fuel and operate properly
Generators	Produces power meeting specifications
Pumps	Turn in correct direction
Process piping	Flushing, initial cleaning, hydrotesting, and cleaning and drying perform similar to description under 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., power generation and 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.

Pressure Reduction Stations

Each system will be checked for operational preparedness. Table 2.4-6 lists the major checks to be performed.

Table 2.4-6 Pressure Reduction Station Function Checks

System	Function Tests
Process piping	Flushing, initial cleaning, hydrotesting, and cleaning and drying performed similar to that described in Section 2.4.4.2
Pipeline pressure reduction control valves	Checked for proper operation Checked that control signals make proper settings
Alarms	Tested
Fire and gas detection	Tested

Performance testing of the pressure reduction function is completed on crude oil entering the PRS.

As for the PSs, stops and starts are to be expected as the systems are brought to operational capacity. Typical commissioning matters will arise that require attention. Operators, engineers, and construction personnel will be stationed at the PRSs to monitor commissioning.

Marine Storage Terminal

As for the AGIs, all preliminary checks, functional tests, piping tests and initial valve alignments for MST operation will be completed during commissioning. See Table 2.4-7.

Table 2.4-7 Marine Storage Terminal Function Checks

System	Function Tests
Generator engines	Cooling system operates leak free Lube oil system operates leak free Engine, fuelled by diesel, operates within manufacturer’s recommended parameters Crude oil fuel treatment system operates leak free and produces crude fuel meeting specifications Engine can switch to crude oil fuel and operate properly
Generators	Produces power meeting specifications

Table 2.4-7 Marine Storage Terminal Function Checks

System	Function Tests
Storage	Surge relief skid, tank and reinjection pump tested Storage tank operations: fill test Storage tank operations: recirculation and transfer pump testing Storage tank operations: tanker loading pumps testing
Export and offloading	Loading pump tests Recirculation and transfer pump tests
Process piping	Flushing, initial cleaning, hydrotesting, and cleaning and drying performed, similar to that described in Section 2.4.4.2, except that the water source will be the MST's water wells and disposal will be through the MST's water management system
Fuel tankage and piping	As for process piping, but with tank leak testing and level monitoring testing
Alarms	Tested
Fire-fighting generation and distribution	Tested

As for the PSs, stops and starts are to be expected as the systems are brought to operational capacity. Typical commissioning matters will arise that require attention. Operators, engineers, and construction personnel will be stationed at the MST to monitor commissioning.

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, including all PSs, electric substations and MLBVs, PRSs and the MST, will be managed from either of the MST CR or the CR in Uganda at the Tilenga Project CPF. Automation capabilities, with a special focus on remote start–stop control, will ensure emergency response in the event of unplanned incidents.

A tank gauging system will be installed at the tank farm to facilitate tank operations such as:

- monitoring oil movement and operations
- volume and mass assessment
- inventory control
- volume reconciliation
- overfill protection and leak detection.

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 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 following teams will be responsible for sections of pipeline, including electric substations and MLBVs:

- the Bukoba team at PS3 will be responsible for PS3 and 4
- the Shinyanga team at PS5 will be responsible for PS5 and 6
- the Tanga team at the MST will be responsible for PRS1 and 2, and the MST and LOF.

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 300 personnel are planned and will be positioned at the following project facilities:

- PS3 for PS3 and 4
- PS5 for PS5 and 6
- the MST for PRS1 and 2, and the MST and LOF.

Each team at the PSs and MST will have responsibility for the MLBVs and EHT for their pipeline section.

Local Content Management

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

- aim to maximise Tanzanian personnel
- identify areas and disciplines where Tanzanian 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 Tanzanian 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 Tanzanian companies, when possible, for the provision of goods and services
- prioritise, when possible, the purchase and use of goods produced or manufactured in Tanzania
- invest in training and technology transfer with the objective of enhancing the performance or capacity of local suppliers.

2.4.5.4 Emissions and Discharges

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

- power generation using oil-fired engines
- 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).

Appendix G3 shows emission rates and includes the air quality modelling and associated sources.

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.

2.4.5.5 Operations Waste Management

An operational waste management plan will be developed which identifies waste types, approximate volumes and the locations where waste may be generated.

Operations waste management will be based on the following elements:

- avoidance — establishing contracts to allow 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., reduce volume of waste materials)
- reuse and recycling — all categories of waste will be segregated to facilitate recycling and reuse. Waste materials which cannot be recycled 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.

Expected waste types 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 and the MST. 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 methods are not available, the waste will be safely stored while a method is developed.
- Sanitary – there will be minimal sanitary waste requirements at unmanned AGIs (PS4 and 6, and the PRSs). 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. PS3 and PS5, and the MST will be permanently manned and dedicated bio-oxidation treatment facilities that treat sewage and grey water will be installed. Food waste will be shredded, dewatered and composted for soil enrichment in an in-vessel composter.

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

Each AGI will include dedicated WMAs that meet the requirements of the types of waste 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 sign-posted. Only authorised personnel will have access to WMAs, WMA personnel will be fully trained and will use appropriate personal protective equipment supplied by the project or contractor as applicable. For hazardous waste, MSDS will be displayed at place of storage. WMA site lay-out 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 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 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

Wastes will be stored at the dedicated locations and collected by licensed waste 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 MST 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 SCADA system, described in Section 2.4.5.2 will be operated from the CR for centralised monitoring and control of process and safety systems for the pipeline, AGIs and the MST. A pipeline acoustic intrusion system will 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 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 an FBE anticorrosion coating applied to protect the pipe over the course of its operational life against external corrosion. This FBE 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 be provided for AGIs and the MST. For the pipeline, internal corrosion will be monitored by intelligent pigging, see footnote in Section 2.3.2, and monitoring for microbiologically induced corrosion.

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:

- CCTV and an intrusion detection system will be monitored from a security control room in the MST
- Long-range cameras and radar will monitor the maritime zone around the MST and LOF and will also be operated from the MST 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 10.7.1.18 and Appendix K.

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 2.3.7, 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 Tanzanian 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.

2.4.6.3 Marine Storage Terminal

When the MST is no longer required, it will be decommissioned based on Tanzanian regulations and standards, and international standards and protocols. 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
- environmental due diligence to ensure that substance-affected soil is managed
- terrestrial 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, an 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 part of the EACOP System. 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 2.3.7.2, 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 2.4.2.9 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.

As 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.

- The rural electrification of Tanzania is a government-funded electricity project that has been ongoing for several years and is moving into Phase 3 of implementation. A medium-voltage grid extension of 33 kV will be constructed and a low voltage of 11 kV provided to all villages in 158 districts in 25 regions in mainland Tanzania. The EACOP System in Tanzania traverses Missenyi, Bukoba Rural and Muleba districts in Kagera region.
- The Ngono Valley Multipurpose Water Resources Development Project is part of the Nile Equatorial Lakes Subsidiary Action Programme, which includes irrigation schemes at Kyabalamba and Izimbya wards along the Ngono River funded by the World Bank and Government. The project is in Bukoba Rural and Missenyi districts in Kagera region. (The focus of the scheme for the EACOP cumulative impact assessment is the abstraction of water from Lake Ikimba for irrigation.) Irrigation areas are along the Ngono West River to the north of Lake Ikimba.
- The construction of Geita Airport in the Nyabilezi–Bukome and Katende wards, Chato district, Geita.
- Construction of 50 new houses at Zongomera ward in Kahama district, Shinyanga.
- Construction of a 667-km, 400-kV alternating current transmission line split into three individual construction lots:
  - Iringa–Dodoma 225-km, 400-kV alternating current line
  - Dodoma–Singida 217-km, 400-kV alternating current line
  - Singida–Shinyanga 225-km, 400-kV alternating current line

  The African Bank Development Group funds the project as part of the 400-kV Kenya–Tanzania Power Interconnection Project.
- Extension water supply project from Lake Victoria to Tabora, Nzega and Igunga – a new water pipeline will be connected at Solwa village and will supply water to Nzega, Igunga towns, and Tabora municipality. The water supply pipeline is an extension to the KASHWASA (Kahama–Shinyanga Water Supply and Sewerage Authority) system. The project is expected to take three years.
- Upgrade of the Handeni–Kiberashi–Kijungu–Kibaya–Njoro–Olboloti–Mrijo Chini –Dalai–Bicha–Cha mbalo–Che mba–Kwa mtoro–Singida road (461 km) to bitumen standard.
- Waste facility at Mpirani Street, financed by the World Bank through the Tanzania Strategic Cities Project. The facility will be in Mpirani Mtaa, which is approximately 17 km away from Tanga city centre. The project footprint will be 30 ha.
- Small-scale and artisanal mining is taking place along the pipeline route. Specific locations have been mapped where a mining licence was applied for during 2017.

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 Tanzania 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												
Tanks												
Terminal/LOF												
Stakeholder engagement												