Chapter 5 Project Description

TABLE OF CONTENTS

Tables

Figures

5 PROJECT DESCRIPTION

5.1 Introduction

This chapter of the ESIA describes the activities that the SCPX Project proposes to carry out to design, construct, commission, operate, maintain and decommission the SCPX pipeline and its aboveground installations plus the 3 main Facilities that are planned to be located in the Republic of Georgia. It describes the current base case for the proposed Project design, taking account of the alternatives selected for the Project that have been discussed in Chapter 4 of this ESIA. The base case will be subject to refinement and potential change during the detailed engineering, but where design decisions have yet to be taken, this Project description describes more than one alternative. This chapter represents the proposed Project description as this document is subject to review and approval by the appropriate Georgian authorities.

Aspects of the Project design that have been developed specifically to mitigate potential environmental or social impacts associated with this Project are termed commitments and are identified in this chapter by a reference number in parentheses following the commitment. The reference number is prefixed by the letter D to denote that it is a design related commitment. An example is given in the box below, where D5-019 is the reference number.

Example commitment:
The compressor stations will have four gas compressors mechanically driven by dry low emission (DLE) gas turbines (D5-019).

Commitments referenced with numbers only (00-00) are topic-specific, generic construction-phase commitments. Commitments with a prefix X relate to a specific location and commitments relating to decommissioning are numbered with the prefix DE. Commitments with the D pre-fix are commitments made within the Project design. All the commitments have been included in the Commitments Register (Appendix E). Figure 10.1, Chapter 10 is a guide to how commitments in the ESIA are linked to the Commitments Register.

Where appropriate, this chapter presents details of the Project in a wider sense (i.e. beyond the confines of Georgia).

Where kilometre points (KPs) are mentioned to describe the location of certain features, these denote the nearest kilometre point on the new 56” pipeline loop. Where reference is made to the location of CSG2 and PRMS, where there is no new SCPX pipeline, the KP denotes the nearest kilometre point on the SCP pipeline.

The activities described in this chapter of the ESIA are the focus of the impact assessment presented in Chapters 10 and 12.

5.2 Project Objective and Overview

The objective of the SCPX Project is to increase the capacity of the existing SCP pipeline to enable the transport of an additional 16 bcma of gas from the Shah Deniz 2 development in the Caspian Sea in Azerbaijan to the Georgia–Turkey border. The gas will be supplied to domestic markets in Georgia and Turkey, with the majority of the gas being transported onwards to European markets.

To increase the gas transport capacity, the following modifications to the existing SCP pipeline system in Georgia are proposed for the SCPX Project:

- A new 56”-diameter (1,422mm) looped pipeline in Azerbaijan starting at SCPX KP0 (SCP KP57) and continuing to SCPX KP385. The pipeline will be routed parallel to the existing SCP and Baku–Tbilisi–Ceyhan (BTC) pipelines for much of its length
- A new intermediate pigging station will be constructed in Azerbaijan at the beginning of the looped section at SCPX KP0
- Five new block valves will be constructed in Azerbaijan, to be collocated with the existing SCP/BTC block valves
- A new 56” pipeline running beside the existing SCP pipeline from the Georgian border for 56km before reconnecting to the existing SCP pipeline
- A new block valve (BV) at KP28 and a pigging station located at KP56 where the new pipeline reconnects with the SCP pipeline
- A new compressor station (CSG1) collocated with the existing BTC facility near Rustavi at KP03. This will also contain an Azerbaijan border metering system, pigging facilities, and an offtake facility with pressure reduction and metering equipment to provide gas to the Georgian gas supply network (which will have an increased capacity compared with the existing SCP offtake)
- A second compressor station (CSG2) built on a greenfield site at KP142 on the existing SCP pipeline, west of Tsalka Lake, with a 16km access road from the Millennium Road
- A pressure reduction and metering station (PRMS) at the Georgian border with Turkey, collocated with the existing SCP facility.

Figure 5-1 presents a schematic of the SCPX pipeline and facilities.

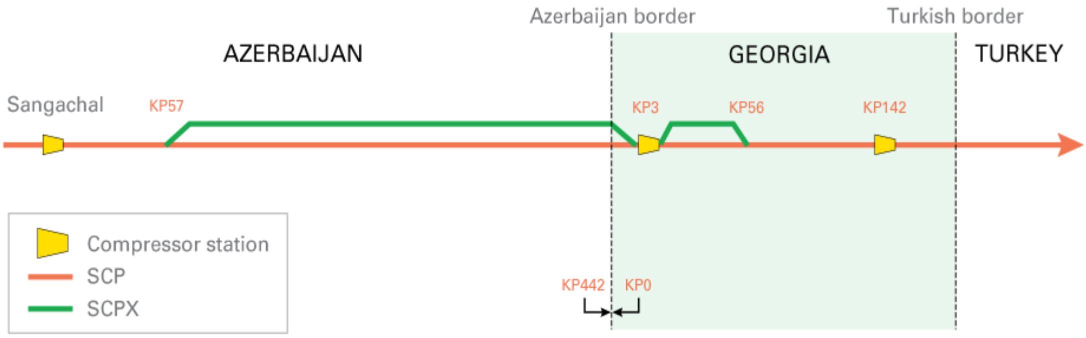

Figure 5-1: Schematic Diagram of SCPX Project

5.2.1 Project Schedule

The Project is currently nearing completion of the front-end engineering design phase that started in 2010.

Figure 5-2 presents the anticipated programme for design, construction and commissioning of the SCPX Project by the end of 2018.

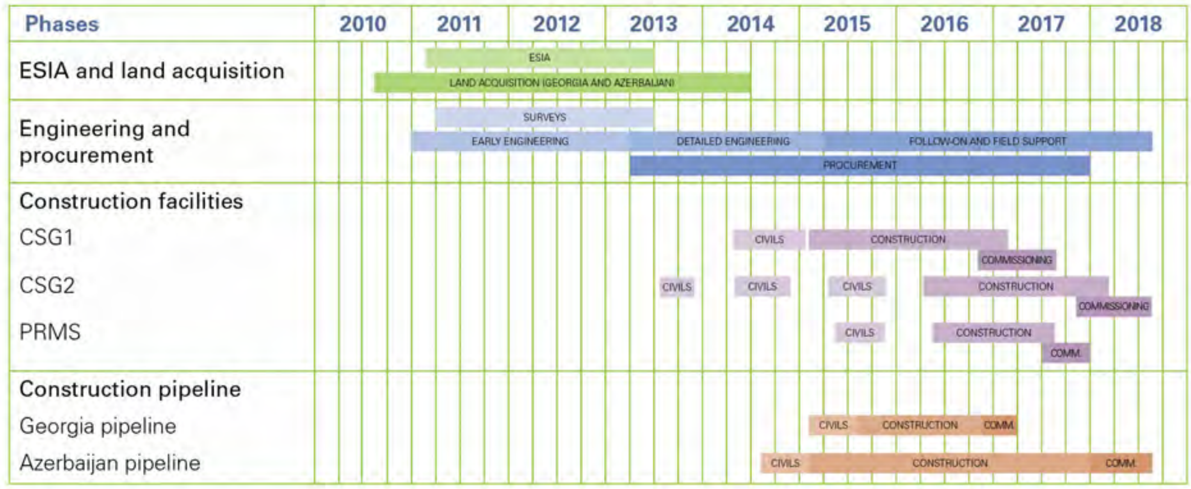

Figure 5-2: Anticipated SCPX Project Programme

The ESIA will be submitted to the Georgian Government for approval in early 2013. Pending ESIA approval, early works are planned to be carried out at CSG2 in support of the access road construction during 2013 with early works to prepare access roads, construction camps, lay-down areas and carry out earthworks at the CSG1 construction site, and some preparatory work at CSG2 (including the construction of the CSG2 access road) expected to be carried out in 2014. Early works are planned start at the PRMS in 2015.

The CSG1 facility is scheduled to be constructed and commissioned between 2015 and 2017. The CSG2 and PRMS facilities are scheduled to be built and commissioned between 2016 and 2018.

Work on the 56"-diameter pipeline loop in Georgia is expected to start in Q2 2015. Reinstatement of the pipeline right of way (ROW) is scheduled to be completed by the middle of 2017.

5.2.2 Project Development

The sequence of events leading up to the implementation of the SCPX Project is as follows:

- Identify and define the need
- Feasibility study
- Basic engineering (conceptual design)
- Front-end engineering design (FEED)
- Detailed design
- Site preparation and construction works
- Pressure testing (pipeline and Facilities)
- Commissioning
- Operation and maintenance
- Decommissioning and abandonment.

5.2.3 Project Need and Consideration of Alternatives

The need for the additional pipeline and associated aboveground installation (AGI) facilities is presented in Chapter 4 of this ESIA. Various strategic alternatives have been studied and evaluated to give the most efficient, cost-effective, safe and environmentally and socially acceptable scheme to provide the increased capacity required of this pipeline delivery system.

5.2.4 Feasibility Studies and Consideration of Design/Routing Alternatives

The Project concept as described in Section 5.2 above represents the culmination of a process of field investigations, design and environmental assessments over a period of many months to determine the best option that meets the Project objectives. The process is ongoing and will continue until the proposed scheme is implemented. The results of key feasibility studies and alternatives are discussed in Chapter 4.

5.2.5 Basic Engineering and Environmental Scoping

The basic engineering generated a conceptual design for the whole of the SCPX Project. An integral part of that process was an assessment of the optimum length of the pipeline and the location of the associated Facilities. The environmental baseline surveys, risk assessments and environmental scoping that were carried out informed the conceptual design for the Project.

5.2.6 Front End Engineering and Environmental and Social Impact Assessment (ESIA)

Front end engineering started in 2011. International ESIA consultants were appointed to produce this ESIA report, building on scoping studies and environmental and social work undertaken during the basic engineering. The route of the proposed SCPX pipeline loop, Facility locations and CSG2 access road has been walked and surveyed by engineers and environmental specialists, including topographical survey teams and ecologists.

As part of the ESIA, a social assessment has been undertaken to identify potential impacts and reduce potential disturbances to surrounding communities and the livelihoods of the inhabitants. Positive impacts, such as employment, are also identified and, where possible, enhanced. Stakeholders in Georgia were consulted to gain local knowledge of the proposed pipeline route and the locations of the Facilities. This allowed for improved identification and assessment of preferred locations for the pipeline route and Facilities.

5.2.7 Project Footprint

The ‘Project footprint’ is the total estimated physical area of land required by the Project or a component of the Project, such as a pigging station site. The SCPX Project will have a total estimated Project physical footprint (permanent and temporary) of approximately 313 hectares. The block valve, PRMS and the CSG1 have been collocated to minimise the requirement for additional development on greenfield sites (D5-096). Table 5-1 breaks down the physical footprint by area. Site assessments (taking into consideration ecology, cultural heritage, social, erosion risk, and water resources etc.) will be undertaken if the need for additional land is identified following submission of the ESIA (39-02). An environmental and social assessment report will be prepared by the Project if any additional land outside that described in the ESIA is to be used, the scale of which will depend on the proposed activities and sensitivities of the area (39-03).

Table 5-1: SCPX Project Estimated Footprint (Temporary and Permanent)

Temporary Footprint Facility/Location	Area (m^2)	Area (ha)
CSG1		
Construction camp and lay-down area	130,000	13.0
Rail offloading area at Rustavi (shared with the pipeline)	31,000	3.1
CSG2		
Construction camp and lay-down area	286,000	28.6
Potential rail offloading area at Beshtasheni	18,000	1.8
Access road construction camp	25,000	2.5
PRMS		
Construction camp and lay-down area	41,000	4.1

Temporary Footprint Facility/Location	Area (m^2)	Area (ha)
Potential rail offloading area at Akhaltsikhe	8000	0.8
Pipeline		
Pipeline ROW	2, 000,000	200
River, road and rail crossings	140,000	14.0
Pipe yard at Rustavi	106,000	10.6
Construction camp at Poladaantkari	65,000	6.5
Temporary access roads		
Total for all locations	21,000	2.1
Total Project temporary footprint	2,871,000	287

Permanent Footprint Facility/Location	Area (m^2)	Area (ha)
CSG1		
Facility and vent exclusion zone	530,000	53.0
Access road	2500	0.25
CSG2		
Facility area and vent exclusion zone	391,000	39.1
Accommodation	11,000	1.1
Access road	80,000	8.0
PRMS		
Facility and vent area	238,000	23.8
Pipeline		
Pigging station	3,000	0.3
Block valve and access road	1000	0.1
Total Project permanent footprint	1, 256,500	126

5.2.8 Project Land Requirements

The 'Project land' area is the total amount of land that will be acquired by the Project, but may not be directly used. Project land requirements will therefore be larger than Project footprint requirements. Land acquisition for permanent land needs is generally larger than the total footprint as additional areas have been purchased to accommodate land ownership. The land acquisition areas at the sites are as shown in Table 5-2.

Table 5-2: Facility Permanent Land Requirements Estimates

Location	Sub-Total (ha)
CSG1	75
Pigging station	1.9
Block valve	0.1
CSG2 and access road	115
PRMS	33
Total (in hectares)	225

This land will be purchased and will be occupied by the Project on a permanent basis.

It is currently estimated that the total surface of the land purchase corridor in Georgia is approximately 200 hectares (this is discussed in further detail in Section 5.4.7).
Temporary, construction-related land needs are as shown in Table 5-3.

Table 5-3: Temporary Construction Land Requirements Estimates

Item/Location	Sub-Total (ha)
Pipeline ROW	200
Pipeline construction camp	6.5
Pipeline storage dump	10.6
Rail spur and offloading areas	5.7
Temporary access roads	2
Crossings	14
Block valve	0.25
CSG1 construction camp	2.8
CSG2 access road construction camp	2
PRMS construction camp and access road	2.8
Total (in hectares)	247

This land will be occupied for the duration of construction of the relevant facilities, until they are no longer required (generally three years), and will typically be leased from its current owners, with the exception of the pipeline ROW which will be purchased (Section 5.4.7). After construction and reinstatement are complete or at the end of the lease, the land will be handed back to its owners, who will be able to resume previous utilisation, whether agricultural or other subject to safety zone requirements.

5.3 Pipeline Design and Route

5.3.1 Design

The Host Government Agreement (HGA) requires that the Project conform to a prescribed set of technical standards, and in the event that these standards are silent or inapplicable, then the current technical standards and practices generally used by the international community (within Canada, the United States or Western Europe) with respect to Natural Gas pipeline projects comparable to the Project, shall be applied.

Design codes and standards

The SCPX pipeline will be designed, fabricated, constructed, tested and commissioned in accordance with the American Society of Mechanical Engineers' (ASME) code B31.8 '*Gas Transmission and Distribution Pipeline Systems*' (2010 edition). The block valve and pigging station piping will be designed, fabricated, constructed, tested and commissioned in accordance with ASME code B31.3 '*Process Piping Design*'. Road, rail and track crossings will be designed in accordance with API RP1102.

Design Pressures and Temperatures

The pipeline is to have a design pressure of 95.5 barg and a maximum operating pressure of 90 barg, this being the same as the existing SCP. The adoption of a design pressure higher than the maximum operating pressure reflects a conservative approach to the design of the SCPX system.

The buried pipeline will be designed for a maximum design temperature range between -10°C to 74°C. The anticipated external temperature of the buried pipeline will be within this range even under extreme climatic and operating conditions. The design range for the aboveground pipeline will be between the temperature range of -46°C to 78°C.

Pipeline diameter and materials

The 56" pipeline will comprise X70 grade line pipe with a nominal 19.5mm wall thickness where the route crosses agricultural land. Increased wall thickness is specified where the pipeline route passes through lightly populated areas (23.4mm) or densely populated areas

(28.1mm). Where there is a high risk of damage to or interference with the pipeline, the pipe wall thickness may be further increased.

An increased wall thickness with a design factor of 0.6 will be applied at road, railway and river crossings and where the pipeline passes seismic faults to meet the requirements of API RP 1102 (D5-034) 'Steel Pipelines Crossing Railroads and Highways'. A wide range of other international codes and standards are also identified and these shall be applied, where appropriate, to specific elements of the Project design.

A design factor of 0.5 has been allowed, and heavy wall pipe will be used in KP39-41 where a number of dwellings are less than 200m from the pipeline (D12-01). A design factor of 0.5 has been allowed and heavy wall pipe will be used within KP22–KP43 around Rustavi to allow for future development and population expansion (D12-02) (see Chapter 12).

Corrosion protection

Even though the pipeline will be constructed of high-quality steel, if unprotected it would corrode over time, principally as a result of electrical currents that are naturally induced from contact of the metal pipe with the surrounding soil; such induced currents result in metal loss from the pipe, i.e. corrosion. Biological and chemical activity in the material surrounding the pipeline can also contribute to corrosion.

A high-integrity, three-layer polyethylene coating will be applied to the external surface of the pipe before delivery to the pipe storage yards. This coating will insulate the metal exterior surface of the pipeline from the surrounding soil, thereby reducing the potential for induced current corrosion and biological and chemical attack on the pipeline.

During pipeline construction, a coating will be applied to the pipe joints after welding. This field joint coating will be carried out at the location of the pipeline installation.

The entire coating of the pipe and the welds will be checked by non-destructive testing (NDT) to ensure integrity of the coating before the pipe is laid into the trench. Mechanised ultrasonic testing, which provides instantaneous results, is the preferred method for checking welds.

Internally the pipeline will be protected by an epoxy coating. The pipeline will be painted with a material that enhances its hydraulic properties.

The internal condition of the pipeline will be monitored regularly and be subject to ongoing maintenance to minimise the potential for corrosion. Following construction and commissioning it is proposed that the SCPX shall be internally inspected at the same time intervals and to the same extent as the SCP.

The SCPX pipeline will be protected from corrosion by an impressed current cathodic protection (CP) system (D5-001) specifically designed for the SCPX Project.

Design life

Once constructed, the new SCPX pipeline is expected to have a 30-year design life. An external three-layer high-density polyethylene (HDPE) coating will insulate the outer surface of the pipeline from the surrounding soil. This coating will reduce the potential for induced current corrosion and biological and chemical attack on the pipeline. After welding the pipeline sections together in the field, an additional coating will be applied to the pipe joints. Internally, the pipeline will be painted with a material that enhances its hydraulic properties. Additional maintenance measures can be applied on a routine basis during the operational period to ensure that all facilities can operate for an extended lifetime, if required.

Depth of cover

Where normal agricultural activities will be carried out over the pipeline, it will be buried in a trench allowing a minimum depth of 1.0m between the top of the pipeline and the ground surface. There will be increased depth of cover at crossings: road crossings will generally be installed with at least 2m cover, rail crossings have at least 3m and unpaved roads have at least 1.5m cover (D11-02). Where it is considered that there is a higher risk of the pipeline being damaged or interfered with, or where other services are crossed and at track and road crossings, the pipeline will be covered by concrete slabs at open cut crossings (D30-01).

Pipeline location identification

Subsurface warning tape will mark the position of the pipeline along its entire route. Low-level marker posts will be provided at all station sites, cathodic protection test stations, road, track, rail and water crossings, SCPX facility fences, and any other locations deemed necessary to provide identification of the pipeline route and to aid surveillance. Where appropriate, markers will be within line-of-sight of adjacent markers. All marker posts will be provided with identification plates that will include telephone contact numbers for members of the public to use to contact the operators in the event of a pipeline incident.

Aerial markers will be installed at intervals of up to 5km along the route to assist in aerial surveillance of the route.

5.3.2 Pipeline Route

The SCPX pipeline route (see Figure 5-3) runs north from the border with Azerbaijan near Jandari for approximately 20km towards the southern outskirts of Tbilisi. It then turns westwards, crossing the Mtkvari River north of Rustavi. South of Krtsanisi (KP40) the route turns to the south-west and heads towards the Algeti River, passing approximately 1km south of Lake Kumisi. After crossing the Algeti River the pipeline turns to the west for a few kilometres to reach the point near Marneuli (KP56) where it ties into the existing 42” SCP pipeline.

For most of this route, the pipeline follows the SCP/BTC pipeline corridor, in four places the route deviates from the SCP pipeline corridor (see Figure 5-4, Figure 5-5 and Figure 5-6):

- KP25 and KP27 because close proximity to the adjacent BTC/SCP pipelines leaves no room to align the 56” pipeline and thrust bore the road crossing at KP24.5
- KP28 and KP31 because the ridge followed by the BTC/SCP pipeline corridor in the steep slope down the Mtkvari River crossing (KP30) is too narrow to accommodate construction of a third pipeline
- KP45 and KP46 because the spacing between SCP and the existing canal and track is too narrow to accommodate the SCPX pipeline
- KP54 to avoid an existing Georgian gas pipeline while negotiating a steep slope down to the Algeti River crossing.

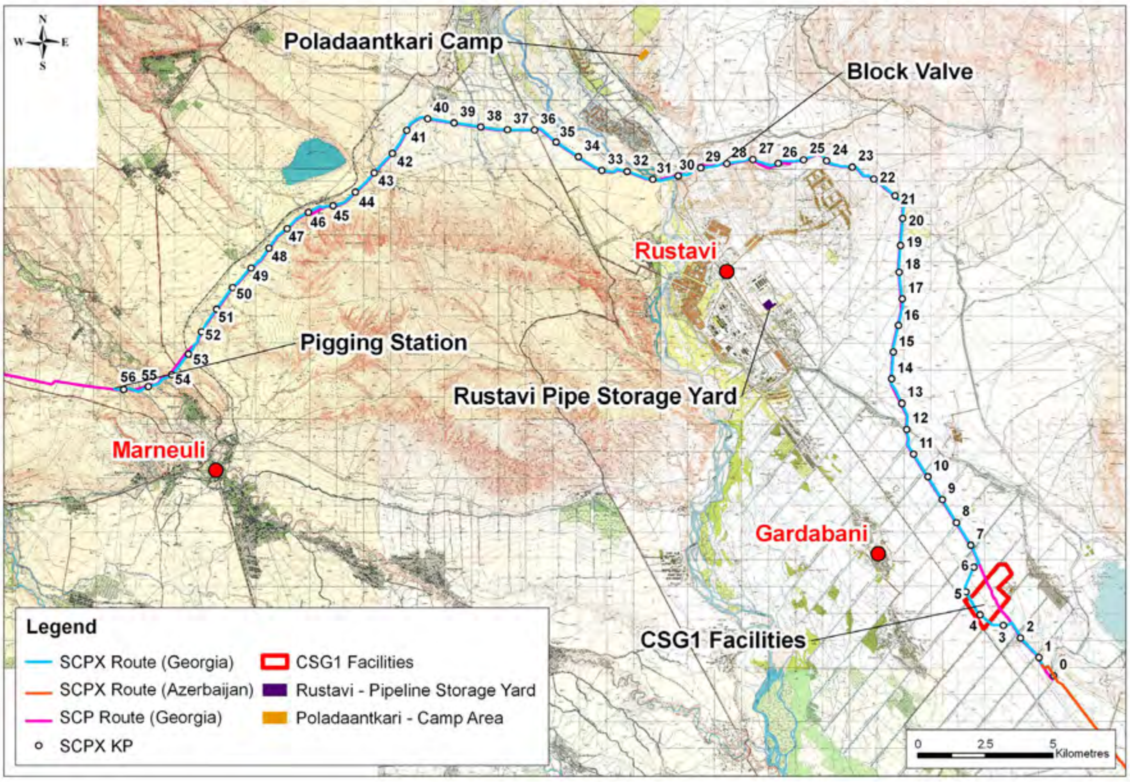

Figure 5-3: SCPX Pipeline Route

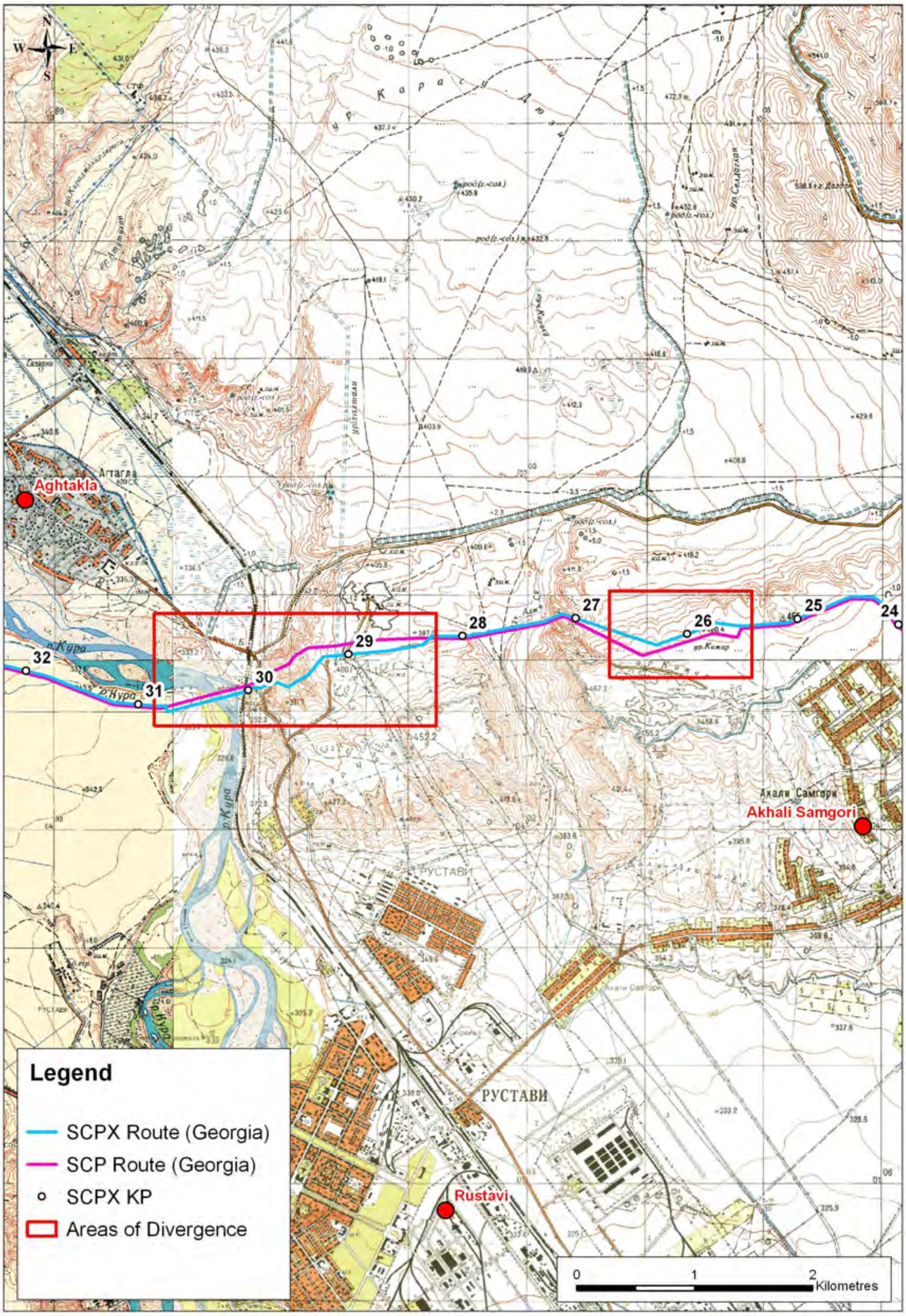

Figure 5-4: SCPX Pipeline Deviations from SCP Route KP25–27 and KP28-31

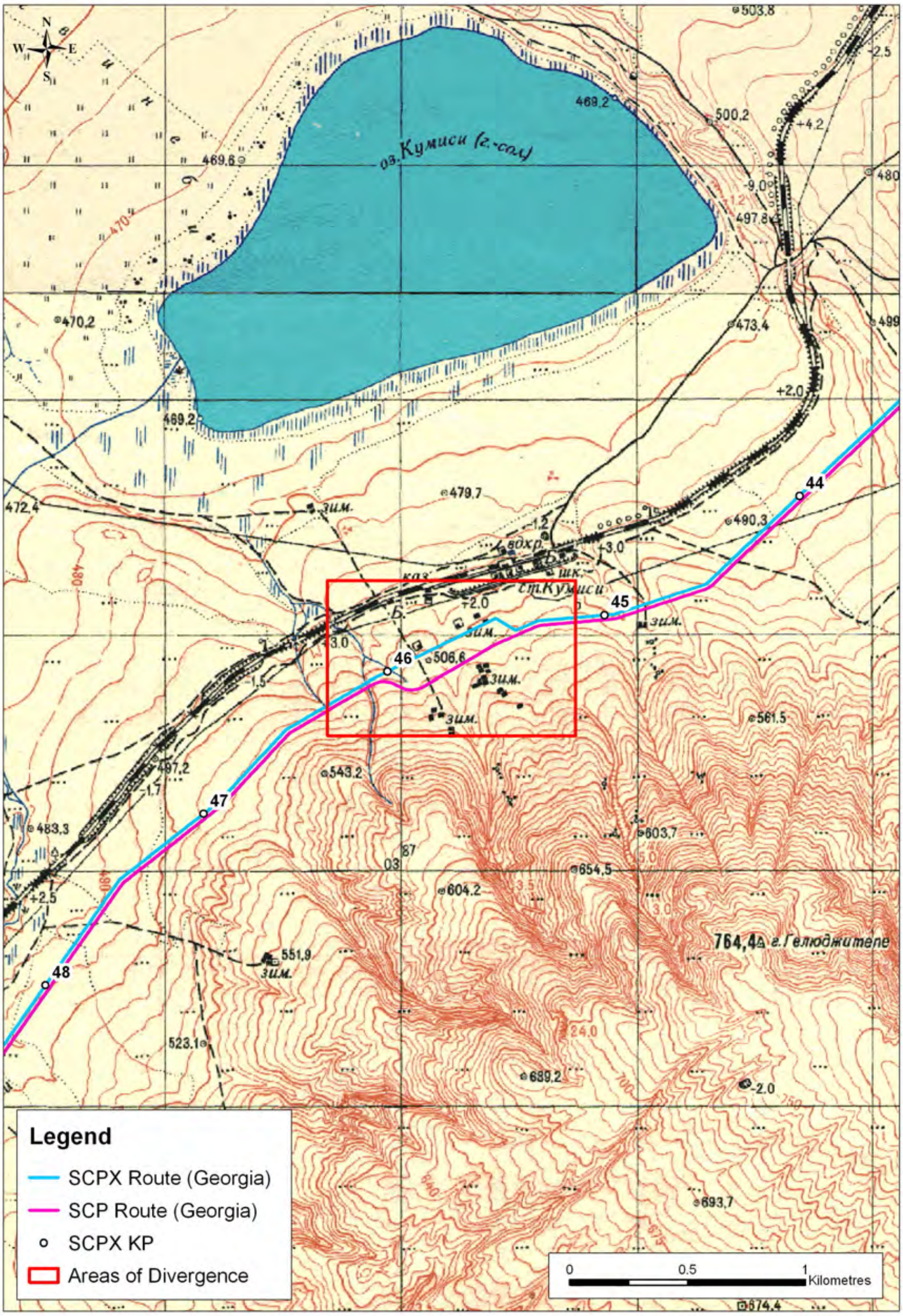

Figure 5-5: SCPX Pipeline Deviations from SCP Route KP46

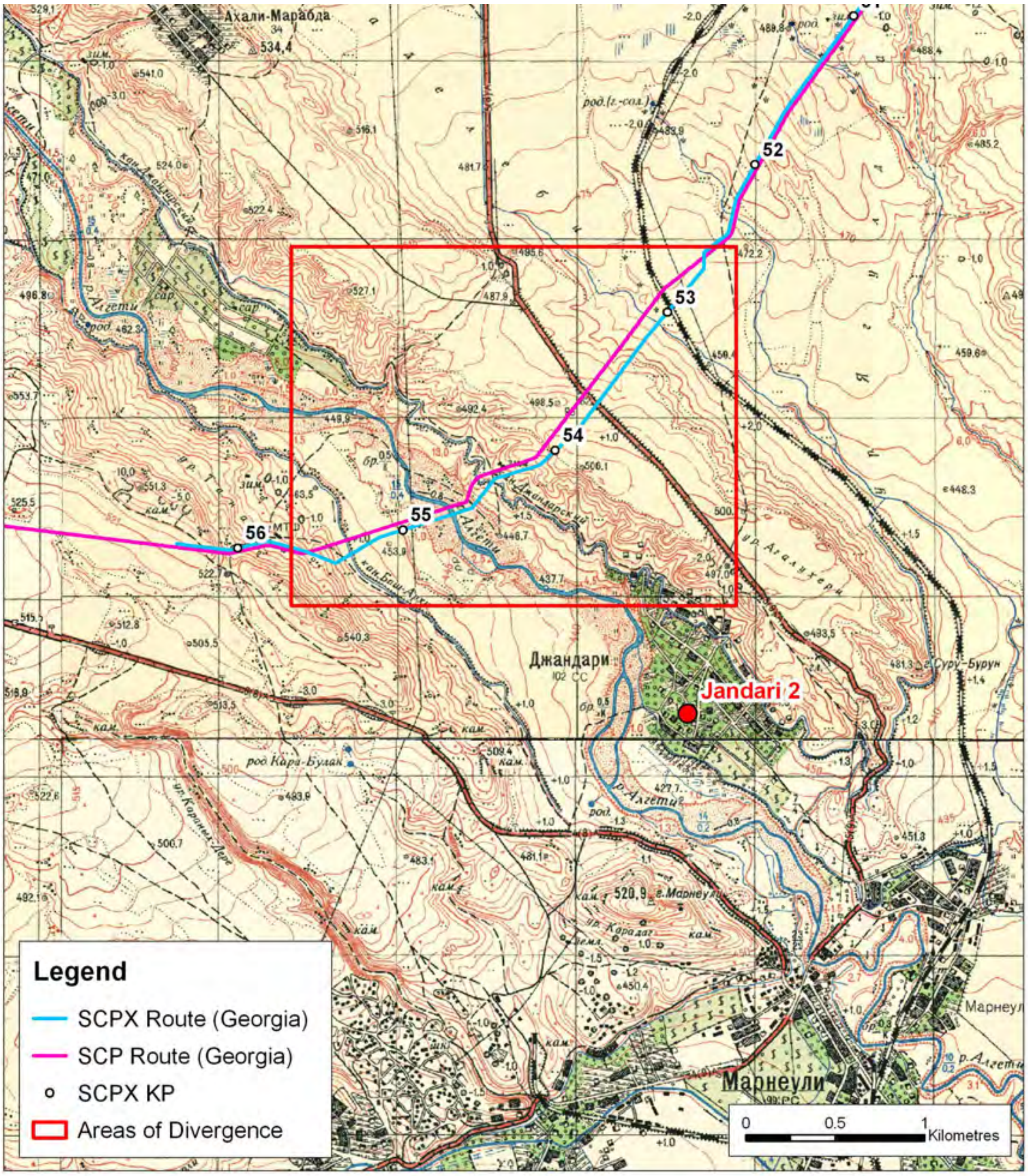

Figure 5-6: SCPX Pipeline Deviations from SCP Route KP54–KP56

Pipeline crossings

Crossings are defined as the intersection between the proposed pipeline route and pre-existing features such as watercourses, roads, tracks and underground services. Table 5-4 identifies features such as irrigation channels, rivers (RVX), roads (RDX) and railways (RLX), canals and tracks that the ROW will cross which have a crossing width greater than 10m and the corresponding construction technique. The major crossings are described in more detail and typical crossing drawings are provided in Section 5.4.11.

Table 5-4: Crossings Schedule

Crossing Feature	KP	Crossing Method
Nine irrigation channels	KP00-10	Open-cut
Main irrigation canal and adjacent road	KP12	Non-open-cut (trenchless)
Canal	KP17	Open-cut
Canal	KP21	Open-cut
Gully	KP22	Open-cut
Canal	KP25	Open-cut
Road	KP25.7	Non-open-cut (trenchless)
Aji River	KP27	Open-cut
River	KP29.7	Open-cut
Railway	KP30.2	Non-open-cut (micro tunnel or HDD)
Mtkvari River	KP30.4	
Track	KP35	Open-cut
Road	KP36	Non-open-cut (trenchless)
Canal	KP38	Open-cut
Road – x2	KP41	Open-cut
Track	KP42	Open-cut
Gully	KP45	Open-cut
Canal	KP45.6	Open-cut
Gully	KP46	Open-cut
Gully	KP46.5	Open-cut
Gully	KP47	Open-cut
Gully	KP48	Open-cut
Gully	KP49	Open-cut
Gully	KP50.6	Open-cut
Gully	KP51	Open-cut
Gully	KP51.2	Open-cut
Railway	KP53	Non-open-cut (trenchless)
Road	KP54	Non-open-cut (trenchless)
Algeti River	KP54.5	Open-cut
Track	KP56	Open-cut

5.3.3 Aboveground Installations on Pipeline Route

Block valve station

Block valves (BVRs) will be located along the proposed pipeline route to facilitate maintenance and to isolate sections of the pipeline in the event of a loss of containment. The valves will be under the control of the Sangachal Terminal control room operator who will be able to close individual valves remotely.

One stand-alone, remotely operated block valve (BV) is needed in Georgia and it will be located in a fenced compound measuring approximately 25m x 25m at KP28 adjacent to the existing BTC and SCP block valves (see Figure 5-7), so that utilities and access roads can be shared with the existing stations at that location. A risk assessment has determined that the minimum separation distance between SCP/BTC and SCPX BVRs shall be 28m (pipeline centre to centre) and for added safety the SCPX BVRs will be located 28m either side of any existing BTC/SCP BVR. All the pipework will be below ground, but the operating valve stem will come above ground. The BV station will be unmanned except during routine inspections and maintenance.

Figure 5-7: Existing BTC/SCP Block Valve at KP28

Pigging station

A pipeline integrity gauge (PIG) is a device that is used for internally monitoring and cleaning pipelines. All pigging operations require a means of loading pigs into the pipeline and retrieving them from it. These locations are respectively referred to accommodate as pig launchers and pig receivers, and collectively as pigging facilities.

A pigging station (see Figure 5-8) will be located at the end of the SCPX pipeline loop at approximately KP56, where the 56” pipeline loop connects to the existing 42” SCP pipeline. The pigging station will have a pig receiver (to receive pigs launched from CSG1) and an isolation valve, acting as a second block valve to isolate the 56” pipeline. The pigging station will be unmanned except when routine inspections and maintenance are carried out.

Power requirements for the pigging facility are planned to be supplied with eight thermal electric generator (TEG) units, with an individual output of approximately 0.55kW. The TEG units will generate electricity by using small quantities of the pipeline gas, which will subsequently be used to supply a trickle charge to batteries in the local equipment room.
Plug sockets will also be installed at the pigging station that will allow for temporary diesel generators to be connected to the switchboard during maintenance works.

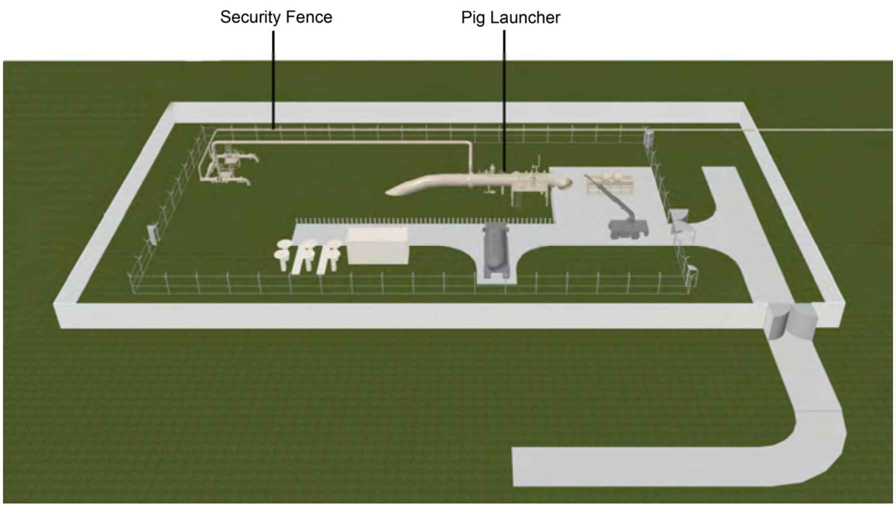

Figure 5-8: Proposed Layout of Pigging Station

5.4 Pipeline Construction

5.4.1 Pipeline Construction Overview

The pipeline will be constructed in accordance with the HGA and applicable government regulations, contractual requirements, applicable permits and authorisations, and Project-approved drawings, plans, procedures and specifications. However, within this regulatory and contractual framework, the selection of many of the detailed construction methodologies and plant for the proposed SCPX Project will be the responsibility of the successful construction contractor(s). As such, much of the more detailed approach in terms of construction methodologies has yet to be defined. This Section aims to present an indicative outline of the approaches that are likely to be adopted by the construction contractor(s), recognising that some details may change at a later stage of the Project.

Table 5-5: Provisional Pipeline Construction Schedule

Activity	2015												2016				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
ROW clearance	■	■	■	■	■	■	■	■	■	■							
Stringing	■	■	■	■	■	■	■	■	■	■	■						
Welding		■	■	■	■	■	■	■	■	■	■	■					
Trenching			■	■	■	■	■	■	■	■	■	■					
Lowering			■	■	■	■	■	■	■	■	■	■					
Backfill				■	■	■	■	■	■	■	■	■					
Tie-ins					■	■	■	■	■	■	■	■					
Bulk reinstatement					■	■	■	■	■	■	■	■	■				
Hydrotest												■	■				
Drying													■				
Final reinstatement														■	■	■	■
Final tie-in														■			
RVX micro-tunnel	■	■	■	■	■	■	■	■	■								
RLX (x2)	■	■															
Major RDX (x4)	■																

Pipeline construction involves simultaneous activities at more than one location on the ROW to make efficient use of the workforce and machinery and to work within constraints imposed by seasonal weather. There will be one main construction workforce (spread) on the pipeline loop, with dedicated teams carrying out more complex tasks at specific locations. For example, a specialist subcontractor will install the non-open-cut crossings of the Mtkvari River, main roads and railways. The main pipeline contractor will undertake the connection of the existing SCP pipeline to CSG1 and the SCPX pipeline to the SCP at KP56.

Prior to the commencement of each element of the construction programme, the construction contractor(s) will develop detailed designs, drawings and method statements for the work to be performed, which will be reviewed by the Project. These documents will incorporate the reasonable requirements of landowners and occupiers, the mitigation measures outlined in this ESIA and the requirements of the regulatory authorities in Georgia. These activities will be monitored by the SCPX Project team in accordance with the requirements outlined in Chapter 13 of the ESIA and also the ESMMP (see Appendix D).

Pipeline construction will involve the following activities:

- Setting up a temporary construction camp
- Import of line pipe and storage at a pipe yard
- Develop ROW access roads where necessary
- Mobilise construction plant to the ROW
- ROW preparation (land acquisition, survey, setting out, clearance and soil stripping)
- Pipe stringing, welding and inspection
- Trench excavation
- Pipeline installation
- River, road and railway crossings
- Trench backfilling
- Construction of pipeline AGIs
- Hydrotesting
- Reinstatement.

5.4.2 Pipeline Construction Camp

A pipeline construction camp will be established at Poladaantkari, north of Rustavi (see Figure 5-10). It is conveniently located for access to the ROW and close to rail offloading area and the pipe yard in Rustavi.

The pipeline contractor will mobilise its pipeline construction crews to the construction camp from Q2 2015 and construction workforce is expected to peak at approximately 500 personnel in early 2016 (Figure 5-9).

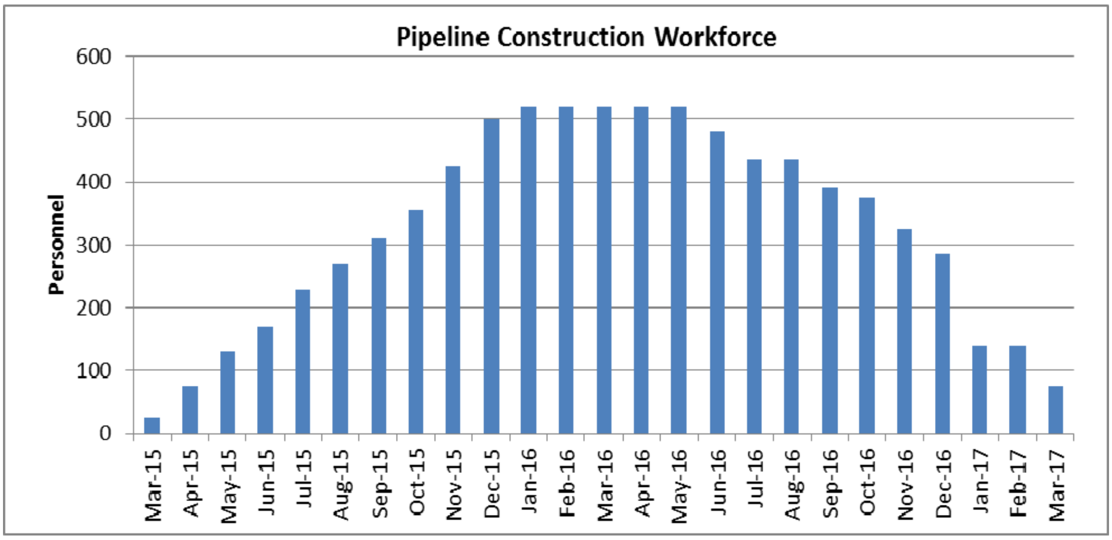

Figure 5-9: Estimated Pipeline Construction Workforce

The contractor will remove and store topsoil from the pipeline construction camp and install utilities and services similar to the facilities construction camps (see Section 5.6.2). The construction camp will also allocate space for Project offices, mechanical maintenance of construction plant, refuelling of vehicles, warehousing and storage of radiographic equipment (similar to those described in Section 5.6.2).

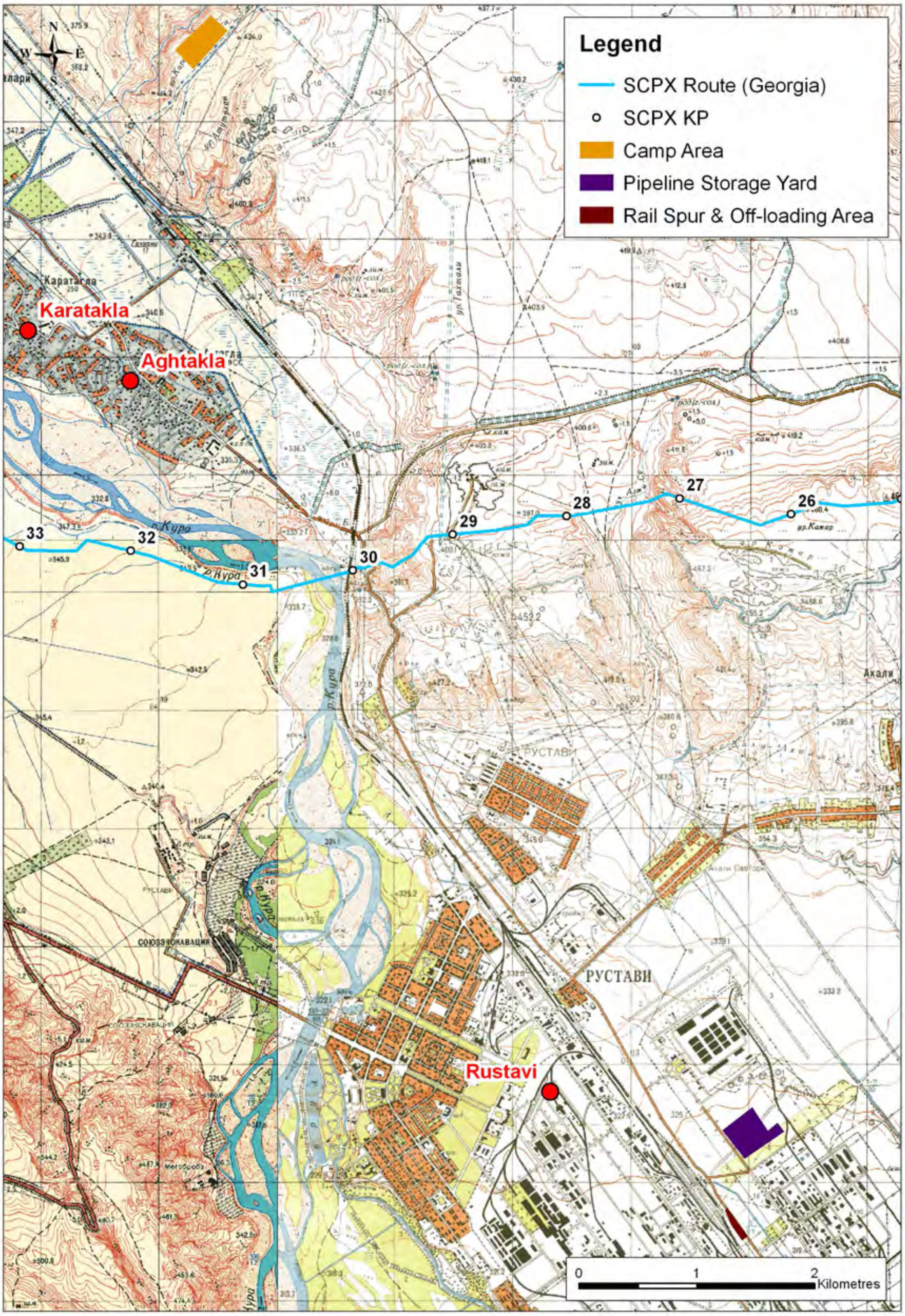

Figure 5-10: Location of Pipeline Camp, Rail Offloading Area and Lay-down Area

5.4.3 Pipe Yard

A pipe yard will be established a short distance from the rail offloading area in Rustavi. The pipe sections will be stored on a suitable storage material (such as sand or soil).

5.4.4 Delivery of Line Pipe to the Pipe Yard

Approximately five thousand 12m lengths of 56”-diameter line pipe will be imported into Georgia from pipe-fabricating/pipe-coating factories via the Black Sea port of Batumi. Each length of line pipe weighs a nominal 8.5 tonnes. The line pipe will be transported by rail to off-loading points. The rail offloading point will be located close to the pipe storage area to reduce the number of HGV movements (D5-036). The location of the railhead is shown in Figure 5-10.

Infrastructure surveys have determined that rail transport is not suitable for modules of process equipment, which will be transported by road. It will normally be offloaded directly onto rail cars at the port and secured with dunnage and strapping to prevent damage to the equipment during transit.

At the rail sidings in Rustavi, mobile cranes or lifting equipment will offload line pipe from the railcars onto trucks. In most cases, it will be driven the short distance to the pipe yard, where it will be unloaded from the trucks by a mobile crane and stored in stacks on the pipe racks in the pipe yard. If the pipe has not been pre-coated, it will be coated in the pipe yard. The trucks will only carry two lengths of pipe each, so transport to the pipe yard will require approximately 2500 short journeys.

The mobile cranes or lifting equipment may offload some of the line pipe directly to the pipe trucks for delivery to the ROW. Trucks will transport line pipe from the pipe yard to the ROW following the approved access routes and the haul road along the ROW.

5.4.5 Temporary Access Roads

The Project will use the existing access roads established for construction of the BTC and SCP pipelines to access the pipeline ROW as far as practical (37-18) (Figure 5-11). Where practical, a pipeline haul road within the ROW will be used to convey construction plant, line pipe and other construction materials from Rustavi.

The Project will undertake a road condition survey before construction begins in areas as defined by the Project (37-17).

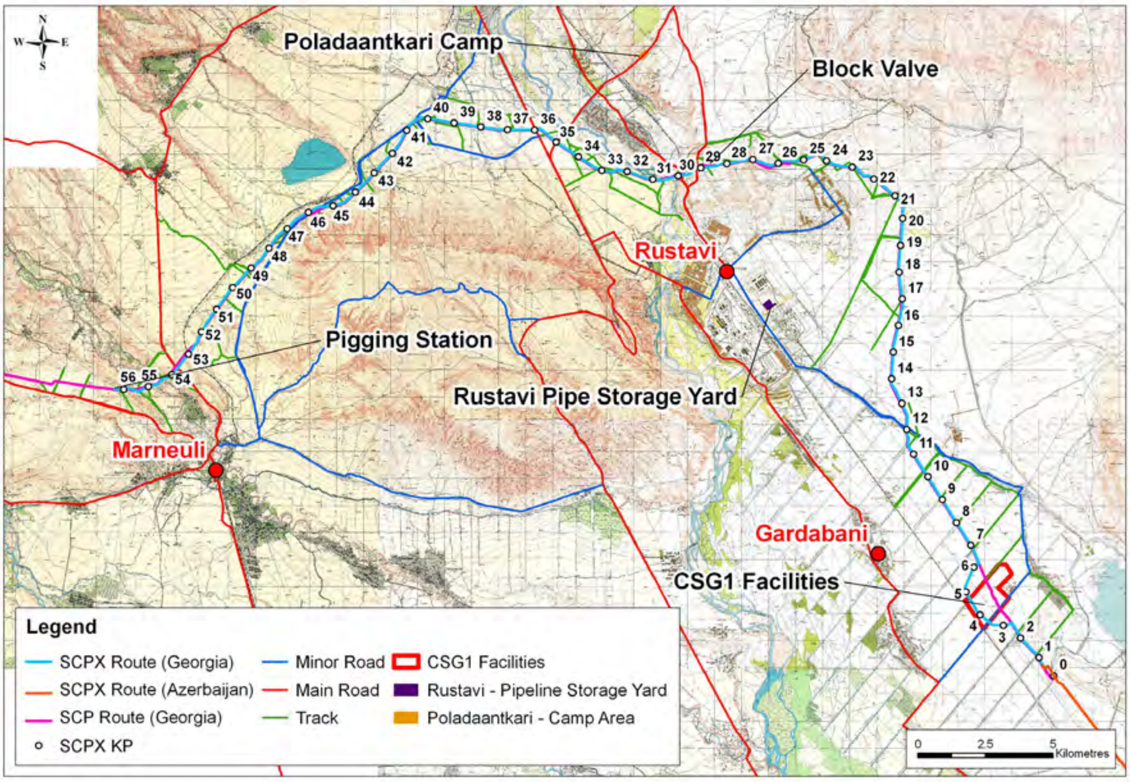

Figure 5-11: Pipeline Access Routes used for BTC Pipeline Construction

5.4.6 *Pipeline Construction Plant*

The majority of the pipeline construction plant will be imported temporarily into Georgia for the construction works. The pipeline construction is expected to utilise the plant listed in Table 5-6 with estimates of the number of each item of plant.

Table 5-6: Plant Requirements for Main Spread Activities

Plant	Number of Units
Tractors	6
Tracked loaders	2
Wheeled graders	1
Bulldozers	6
Tracked excavators	15
Lorries	10
Cranes	4
Sideboom tractors	15
Diesel generators	5
Welding kits	10
Screening equipment	1
Padding machine	2
HDD or tunnel boring machine	1
Trencher	1
Refuelling bowser	2
Low loader	2
Auger bore equipment	2
4x4 and personnel transport	40

5.4.7 *Preparation of Pipeline Loop Right of Way*

Land acquisition

The SCPX construction corridor is 36m in width, with potential extra width locally at river and other crossings and side slopes. Except in the few locations where the SCPX will deviate from the existing BTC and SCP corridor, part of the construction corridor will be situated on land already purchased by BTC Co. and SCP Co. for the BTC and SCP pipelines, thereby reducing the width of the additional SCPX corridor.

SCP Co. will purchase the following areas for SCPX, referred to as the "land purchase corridor":

- The construction corridor (36m in width or less on most of the route where the construction corridor overlaps with the BTC/SCP corridor)
- A zone 30m in width with the SCPX pipeline at the centre, in which re-use and planting restrictions are imposed to reduce the risk of damage to the pipeline during operation.

Dependent on the location of the SCPX pipeline in relation to existing SCP and BTC pipelines, the width of the land purchase corridor varies:

- 31m or 36m where SCPX will be running parallel of an existing pipeline (either BTC or SCP, see Figure 5-12 and Figure 5-13)
- 41m where the SCPX pipeline deviates from existing pipelines (Figure 5-4 to Figure 5-6).

It is currently estimated that the total surface of the land purchase corridor in Georgia is approximately 200 hectares. This is subject to some variation as engineering details are being refined.

After construction of the pipeline and reinstatement of the corridor are complete, SCP Co. will remain the legal owner of the land purchase corridor. However, the right to agricultural use will be returned to previous landowners, subject to certain restrictions.

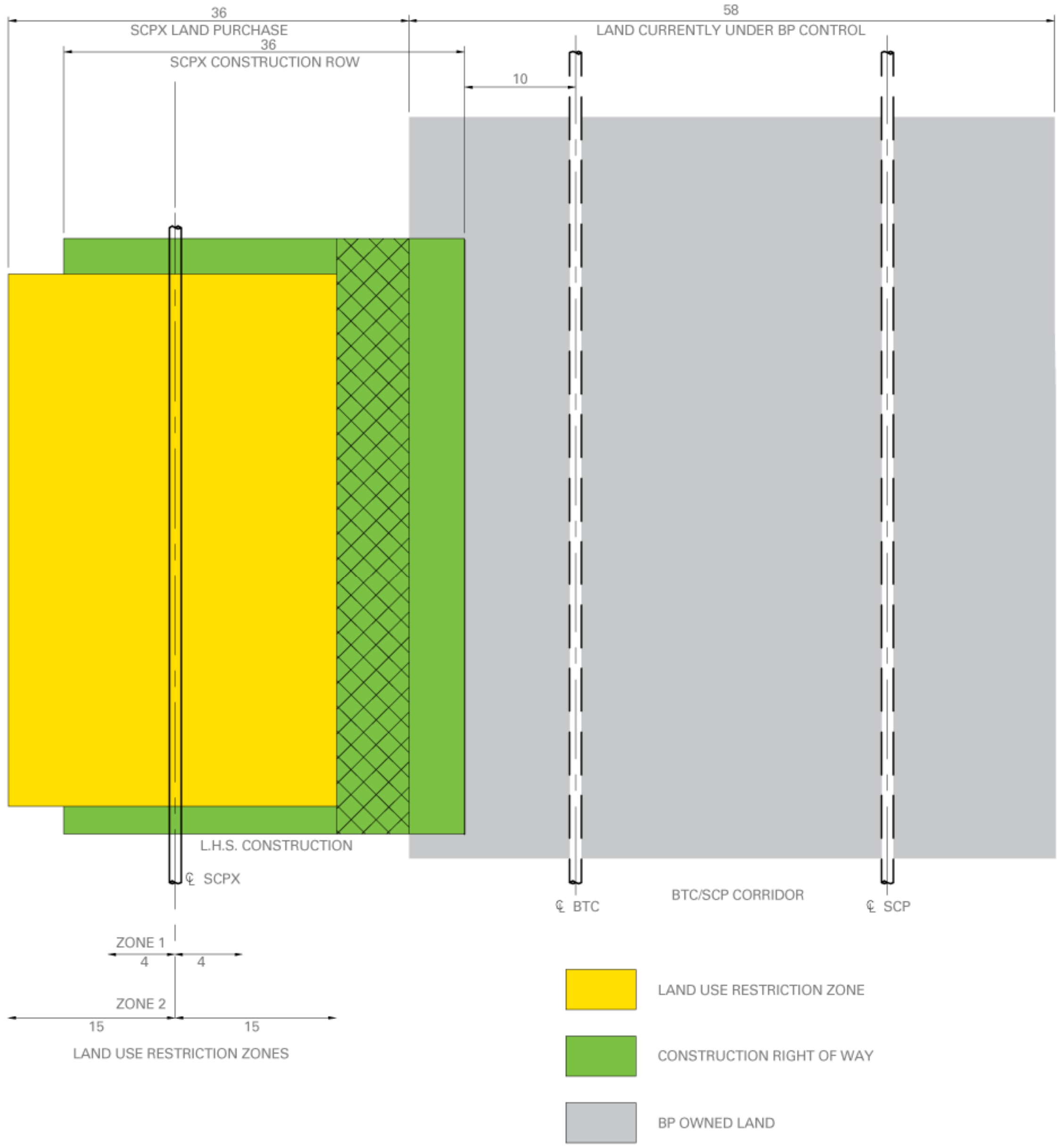

Figure 5-12: Layout of Left Hand Side Construction Corridor and Restriction Zones 1 and 2 – SCPX Parallel to BTC/SCP

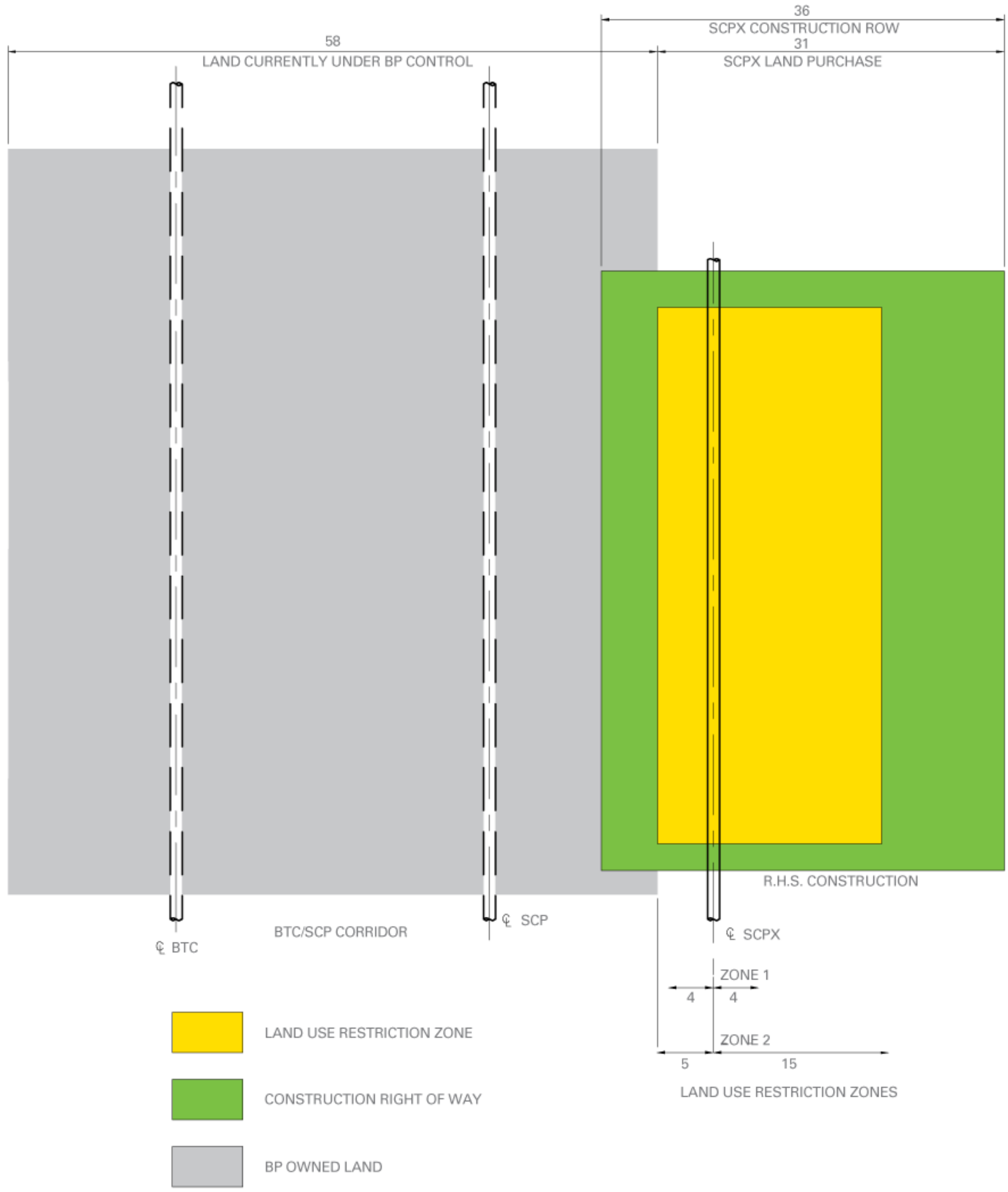

Figure 5-13: Layout of Right Hand Side Construction Corridor and Restriction Zones 1 and 2 – SCPX Parallel to BTC/SCP

A general minimum separation distance of 20m is applied between SCPX and SCP/BTC. At crossings, additional control of work measures will be applied (D11-04). At the block valve location (KP28) the separation distance between 56" SCPX pipeline and the 42" SCP pipeline will be no less than 28m (D11-05). The SCPX ROW will generally be 36m wide, including a 7m-wide topsoil stack on one side, a 14m running track in which construction vehicles will manoeuvre, and space for a trench and a subsoil stack. The SCPX will partly use the SCP and BTC ROWs but will require additional land where the SCPX ROW is outside of the existing ROW.

Where the SCP/BTC ROW occupies a ridge that is too narrow to allow the pipeline loop to be installed even with a reduced separation from the other pipelines or other constraints prevent parallel installation, the pipeline has been routed using an alternative route that diverges from the SCP and BTC ROWs (Figure 5-4 to Figure 5-6). In these situations the width of the land purchase corridor is 41 m.

Setting out/staking of the pipeline route

The ROW of the SCPX pipeline and any additional temporary workspaces will be surveyed and set out (i.e. marked out and, where necessary, fenced off). The Contractor will be required to keep within the designated footprint (30-23). Existing third-party services and sensitive receptors that need to be avoided during construction (e.g. cultural heritage sites or specific trees that are to be retained) will be marked (D5-045). Warning posts and bunting will be erected to mark overhead cables, and temporary crossing points (30-17). Areas of potential cultural heritage impact will be examined and any necessary excavations conducted prior to construction (27-02). A programme of archaeological surveillance (watching brief) will be implemented during topsoil stripping of the ROW, the facility sites, construction camps and equipment lay-down areas and ancillary areas, and ROW trenching. The Company will be empowered to temporarily stop works, pending archaeological examination, if artefacts are seen (27-05). A record will be made of the condition of access roads, construction camps, laydown areas and rail offloading areas and any special features on the RoW before construction to inform the reinstatement works (17-14).

Figure 5-14 shows an indicative layout of the construction ROW.

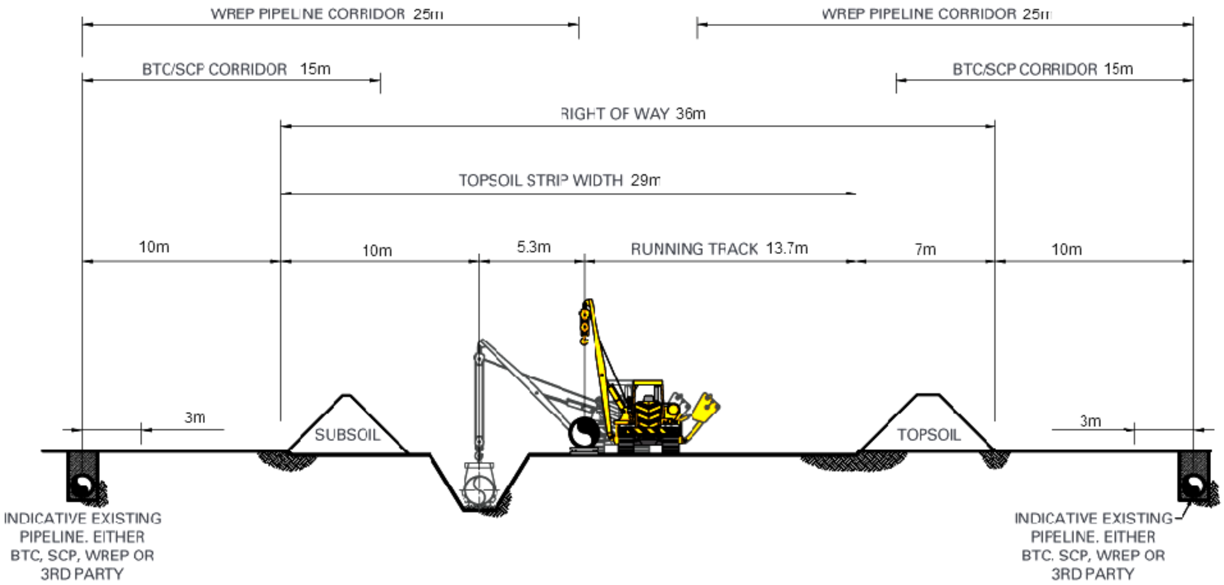

Figure 5-14: Indicative Layout of Construction Right of Way

Surface preparation and grading

The pipeline route will be cleared and graded to permit the safe installation of the new pipeline. This process will include the removal of trees, scrub and other surface vegetation, removal and storage of the topsoil and levelling of the ROW in sloping ground (known as ‘benching’), where the 20m pipeline separation specification permits.

The construction contractor(s) will produce method statements incorporating plans for erosion control, sediment control and reinstatement before work begins at river crossings (4-

12). Load-bearing materials, such as bog mats and geotextile membranes, will be used to support heavy loads in areas of soft ground (including wetland areas) unless deemed impractical by the Company (2-01).

Earth-moving equipment will strip the topsoil across the working width. It will be stored on the ROW. Topsoil stacks along the ROW will be free draining and stored in accordance with the Project Reinstatement Specification (4-05) and will be kept free from disturbance to reduce the risk of physical damage and compaction. Soil storage areas will be protected from vehicle movements to avoid soil compaction (4-06). Stored subsoil and topsoil will be segregated in a manner that avoids mixing (4-02). If topsoil is stored for more than six months, the stacks will be monitored for anaerobic conditions and manual aeration will be undertaken if they develop (4-04). This aims to provide sufficient fertility for reinstatement at the end of the construction period. Topsoil will be stored outside the running track used by construction plant, equipment and vehicles (4-03).

Where the Project considers that ground is sufficiently steep (generally greater than 25%), topsoil stockpiles will be protected with silt fence to help reduce washout and loss of topsoil during heavy rains (4-07). Topsoil stacks will be regularly inspected for compaction and erosion; corrective measures will be implemented if compaction or erosion is identified (4-13). The topsoil and subsoil stack surface will be compacted sufficiently with the aim of preventing erosion, without leading to the development of anaerobic conditions (4-08). Reinstatement will be undertaken as early as practicable and in accordance with the reinstatement specification (4-09).

Where benching is required, surplus subsoil will be stored on the ROW or, if disposal is necessary, it will be transported to an approved disposal site and/or approved borrow pits (1-11).

Where the ROW passes through riparian woodland by the Algeti River crossing, the SCPX ROW will be a reduced working width, and the topsoil will be removed from the ROW to a storage area (D5-054). The ROW width will be reduced to 36m through the areas of trees at this River crossing, from a nominal width at major river crossings of 60m.

Figure 5-15: Topsoil-Stripped ROW and Pipeline String Ready for Welding

5.4.8 *Pipe Stringing*

Line pipe shall be transported by trucks from the pipe yards to the ROW along approved access routes and then along the ROW to the required location (D5-055). It is anticipated that each truck will carry only two lengths of pipe, so approximately 2500 round trips will be needed to string out the pipe. Cranes will lift the lengths of line pipe from the trucks and lay them out offset from the centreline. Gaps will be left in pipe strings where safe to do so and necessary to allow people, wildlife and livestock to cross the ROW (32-08).

Factory-manufactured bends will be used for acute changes of pipe direction or elevation along the route. Less severe bends will be formed using pipe-bending machines in the field. The quality of the bends will be controlled by using approved bending procedures, and by witnessing trial field bends before production and inspection of completed field bends.

Figure 5-16: Pipeline Welded Together

5.4.9 *Trenching*

The pipeline contractor will excavate a trench to a depth that allows pipeline installation with a minimum of 1m of cover from the top of the pipe to the pre-existing ground surface. The presence of subsurface structures (e.g. other pipelines) or surface features such as roads and watercourses will require deeper installation of the pipeline at these locations.

The material (subsoil) excavated from the trench, where practical, will be stored immediately adjacent to the trench on the opposite side to the pipe string that is to be lowered into the trench. Stored subsoil and topsoil will be segregated in a manner that avoids mixing (4-02). Contaminated soil will be segregated from uncontaminated materials and stored at least 50m away from any surface water or seasonal surface water bed (7-05). The trenching operation will be undertaken using methods to suit the local terrain and ground conditions. Trenching equipment will include tracked excavators and rippers. The contractor may also elect to mobilise trenching machines and deploy these on specific sections of pipeline. At KP03, blasting will be needed to open a section of trench through rock, but rock hammers will be used to open the trench in the rocky area from KP55. In confined areas, such as adjacent to existing pipes, a combination of backhoes and hand tools will be used to open the trench.

The length of the continuous open trench (including trench with pipe installed but not backfilled and with a void space greater than 1m) will not exceed 10km per spread and the maximum length of the open trench will not exceed 15km per spread (21-01). Protective barriers will be erected at excavations at a road or river crossing, close to a community or that are flooded temporarily in accordance with the Community HS&S Plan; warning barriers/demarcation fencing will be deployed around areas of lesser risk to members of the public (30-04).

If water accumulates in the open trench (either from rainfall or because of a high water table), it will be pumped out before the pipe is lowered into the trench. All trench water will be discharged safely with the aim of minimising erosion (3-34). When discharge velocities have the potential to create erosion, energy dissipaters will be used to establish sheet flow. Trenches will be dewatered in such a manner that no heavily silt-laden water flows into any wetland or water body (3-30). Sediment control fencing, drainage channels and trench barriers will be installed where appropriate (10-12). The direct discharge of trench water to watercourses will be avoided, except where approved by the Company (10-02). The locations for discharge of hydrotest water and where possible trench water will be identified in the contractor's Pollution Prevention Implementation Plan (10-03). If discharge of trench water to a watercourse is unavoidable, discharge will be through a filtering medium (10-04).

Following excavation, the trench will be prepared to accept the pipe. Rocks or debris that could damage the pipe coating will be removed from the trench. Some excavated material will be screened to remove rocks and placed in the bottom of the trench as a layer of soft padding. Where excavated material is unsuitable for padding or backfilling, padding materials (e.g. sand or small-grained soils/gravel materials) will be bought or sourced from approved borrow pits (1-10).

5.4.10 Pipeline Installation

Pipe welding and inspection

The contractor will lift the lengths of line pipe that have been strung out onto wooden blocks (known as 'skids') to the correct height to allow proper alignment of the sections and safe welding. Internal clamps will be used to align pipe lengths. Pipeline welding sets will be used to connect the lengths to form a pipeline string. Following the welding of sections of the pipeline each welded joint is subject to a detailed inspection to examine the integrity of the weld. This can be carried out using either an X-ray or magnetic resonance imaging (MRI) system. These methods are known as a non-destructive test (NDT), which is carried out before the continuous welded sections of the pipeline are subjected to a hydrostatic test.

Field coating

Following the welding procedure each of the external welds (known as 'field joints'), along with the factory-made pipe bends, will be coated externally with a manually applied coating of a high-integrity specialist pipeline modified urethane liquid epoxy coating, so that no part of the pipeline remains unprotected.

Lowering-in

The contractor will use sideboom tractors to lift the welded pipeline and lower it into the prepared trench. Several sidebooms will work simultaneously to accomplish the lowering-in procedure.

Backfilling

The trench will be backfilled with the material taken from the trench, in the reverse order to which it was excavated, and will be consolidated by compacting in layers. This process aims to ensure that appropriate compaction of the material in the backfilled trench is achieved to reduce the risk of future settlement, washout and erosion. Organic debris, such as vegetation and branches, will be removed from backfill materials.

In sloping terrain (usually 10 degrees and over), trench breakers (e.g. bags filled with soil/ cement mix) will be installed across the width of the trench at suitable intervals up to the graded ground level (D5-065). These act as barriers to subsurface water flows that could channel through the pipe trench, washout the backfill material and potentially expose the pipeline.

Any surplus subsoil from trench excavations will normally be spread within the working width and within zones that exhibit similar subsoil types. The spreading work will be carried out in a manner that avoids the mixing of soil types to the greatest extent possible (D5-066). Care will be taken to ensure that the trench spoil is spread beneath the topsoil and is not left on the surface (1-12). The land drainage system will be reinstated to achieve pre-existing functionality (16-01).

5.4.11 Crossings of Linear Features

Crossings are defined as the intersection between the proposed route and pre-existing features such as:

- Rivers, stream, irrigation channels and canals
- Public roads and tracks
- Rail tracks
- Underground foreign services.

The crossing methodology for the main crossings is shown in Table 5-4 and crossing techniques for each of the above are discussed below.

Watercourse Crossings

With respect to crossings, watercourses include canals, irrigation channels, drainage ditches and natural streams and rivers.

The majority of watercourse crossings will be constructed using conventional open-cut (OC) methodologies as outlined below. The exceptions to this are:

- The Mtkvari River crossing which will be constructed by Horizontal directional drilling (HDD) or Micro-tunnelling and
- the main irrigation canal at KP12 which will be a non-open-cut (trenchless crossing).

These techniques are explained in more detail in the sections below.

River crossing design philosophy

The river crossing design philosophy is that:

- The pipeline will remain fully buried outside the predicted river active zone (the zone of potential lateral and vertical movements) for the pipeline design life
- The pipeline will not be exposed during at least a 1:200 year storm event
- Each major river crossing (i.e. the Mtkvari and the Algeti) will have a site-specific design which will be set to account for the maximum flow rates (1:200 year storm event), sediment movement patterns, anticipated changes to the riverbed contour and the predicted extent of lateral erosion (D12-06).

The major river crossings will be designed according to the process below:

- Hydrological analysis and hydraulic modelling (as appropriate depending on the underlying geology at the crossing)
- Acquisition of geotechnical information
- Prediction of extent of the river active zone
- Study of any current third-party activities and/or infrastructure within the vicinity of the pipeline crossing that could affect the river flow and pattern
- Review of the existing river crossing monitoring reports carried out as part of the operation of the BTC and SCP pipelines
- Determination of minimum depth of cover below the river and horizontal extent of crossing
- Determination of the appropriate crossing technique
- Determination of the need for any additional pipeline protection works to control the active zone of river movement thereby protecting the installed pipeline
- A review of watercourses prior to the finalisation of the approved-for-construction design will be undertaken.

There are no gullies considered likely to be prone to active or deep erosion along the pipeline SCPX route. With the exception of the two major river crossings described above, all other watercourse crossings along the pipeline route will be based on typical drawings for each crossing type, which will be validated via specialist river crossing engineers to confirm the final design. The final design will ensure the set-back distance and burial depth are adequate to prevent exposure over the pipeline design life.

Monitoring and maintenance activities will be undertaken at river crossings with the frequency and type of monitoring depending on the river type, crossing technique, burial depth and set-back distance, pipeline protection measures and third-party activities in the vicinity of the crossing. These are described in more detail in Chapter 12.

Open-cut crossings

River and stream crossings will generally be constructed using the conventional open-cut methodologies. All methodologies assume flowing water or the immediate potential for flowing water during construction. The open-cut trench technique will typically be used in conjunction with weighted (usually concrete coated) pipe. The purpose of the concrete coating is to ensure negative buoyancy of the pipeline and to provide additional mechanical protection. If concrete-coated pipe is not used, a concrete slab, or concrete filled bags, may be buried in the pipeline trench above the pipe.

To avoid interruption of the flow of the watercourse, open-cut crossings usually use wet-trenching or flumed water-crossing techniques.

The Algeti River crossing, irrigation channels (KP00–11, each approximately 5m wide x 2.5m deep) and other smaller streams, gullies and ditches will be crossed using open cut techniques.

At the Algeti River (KP55), which is shallow and 20m wide, open-cut crossing methods are proposed that will construct the crossing in approximately one day. The pipeline trench will be excavated to approximately 4m below the riverbed, so damming or fluming techniques are likely to be implemented.

Open-cut crossing techniques will involve the following:

- The trench line will be prepared by stripping the topsoil from the watercourse banks and ramping them down to allow the safe installation of the pipeline.
- If required, suitably sized flume pipe(s) will be installed. The size will be calculated so that the maximum anticipated flow will not exceed 80% of the flume pipe(s) capacity.

- The upstream end of the crossing will be dammed, forcing the flow through the flume pipe(s) or the water will be pumped over the dams if no flumes are used.
- The downstream end will then be dammed to prevent backflow into the open trench.
- Fish and other aquatic life caught between the dams will be transferred downstream of the crossing.
- The Algeti River crossing will be constructed outside of the fish-spawning season, which is May–June (X7-11).
- The pipe trench will be excavated between the dammed sections. At watercourses, bank and bed material will be stored separately, away from the active channels and will not be placed where water flow or drainage will be obstructed (3-23).
- The pipeline to be installed in the crossing will be welded, inspected and coated at a site near the crossing. At the Algeti crossing the pipeline will be concrete coated to provide negative buoyancy.
- The pipeline will be installed in the trench. In the irrigation channel and stream crossings it may be covered by a pre-cast concrete slab.
- At the Algeti River the trench will be backfilled with the excavated material and, where existent, the watercourse’s armour will be reinstated as soon as possible following pipeline installation (X5-04).
- Watercourse banks disturbed by Project crossings will be restored to near original condition, which will be assessed individually for each watercourse and defined in the Contractor's Reinstatement Implementation Plan. Any deviations (e.g. because hard reinforcement is required for erosion control) shall be subject to Company approval (10-14).
- The downstream dam, the upstream dam and the flume pipe(s) or pumps will be removed in that sequence once the crossing is complete.

The Algeti River will have a site-specific crossing design, and the smaller crossings will be based on typical drawings (Figure 5-17 and Figure 5-18) with the design verified in the field following the process described above.

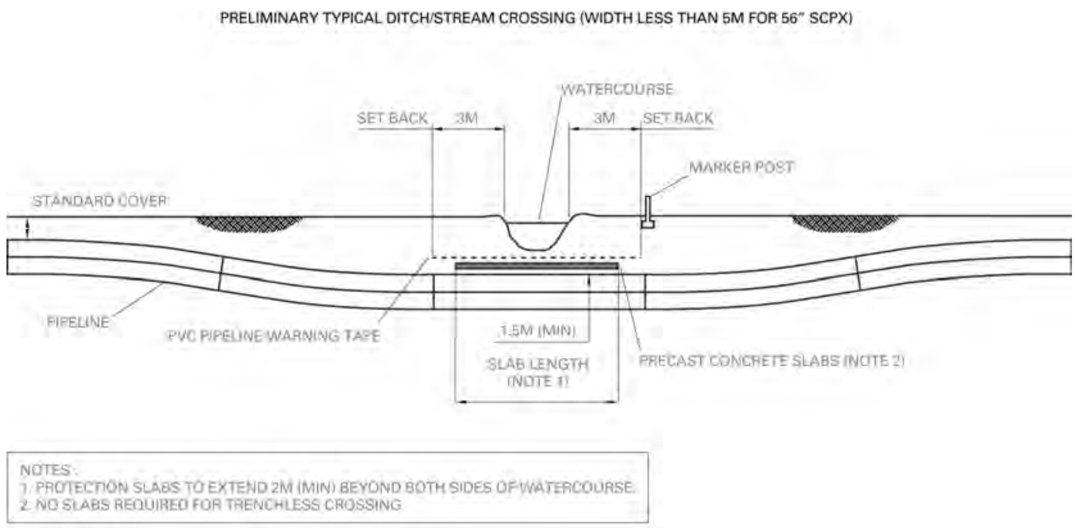

Figure 5-17: Preliminary Typical Ditch/Stream Crossing (width less than 5m)

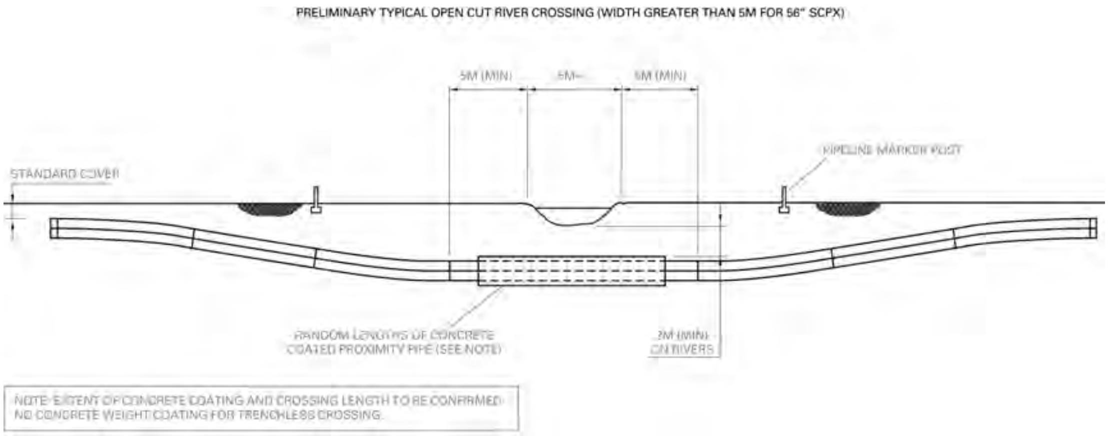

Figure 5-18: Preliminary Typical Open Cut River Crossing (width greater than 5m)

Non-Open Cut Crossings

The 150m wide Mtkvari River crossing (KP30) will be constructed by micro-tunnelling or horizontal directional drilling under the River (D17-04). It is very likely that micro-tunnelling will be the preferred construction technique. Using an HDD technique, as was done with the SCP pipeline, is still under consideration, although the nature of the alluvium below the River caused some problems on that occasion. A micro-tunnelling launch pit was excavated on the eastern bank of the Mtkvari crossing for the SCP, but it was never used and has since been filled and capped. If the pit is suitable, it may need to be deepened to accommodate the larger diameter pipeline and could be utilised for the SCPX crossing.

The selected pipeline route has avoided areas of known soil contamination, such as the known anthrax contaminated areas close to the Mtkvari crossing (D3-04). The Mtkvari River crossing will also have a site-specific crossing design.

Micro-tunnelling

The micro-tunnelling option would involve the following steps (see Figure 4.5):

- The existing micro-tunnelling shaft on the east bank of the Mtkvari is full of waste material that has not been classified. The waste will be dug out, assessed and managed in accordance with the Pollution Prevention Plan and Waste Management Plan (X3-03)
- Installing a thrust wall at the rear of the launch pit to resist jacking forces from the pipe-jacking equipment and to transfer them into the surrounding ground. A head wall may also be installed to seal the launch pit in front of the jacking frame and prevent ingress of ground water and retain annular lubricant used during the jacking process
- Installing a hydraulic jacking frame in the launch pit and a guide rail system for the initial alignment of the pipe-jacking equipment
- Lowering a tunnel boring machine (TBM) onto the guide rail system and pushing it through the head wall using the hydraulic jacks (Figure 5-19 and Figure 5-20). The steerable laser-guided TBM will be controlled by remote operation from the surface. It cuts the ground immediately in front of it while the hydraulic jacks maintain a thrust force so that the TBM advances
- Installing a cable and sensors at the surface on the east bank to establish that the TBM is on course for the receiving pit
- Lowering concrete pipes into the launch pit and jacking them into the tunnel so they form a continuous string maintaining a thrust force on the TBM and lining the tunnel behind it

- Removing spoil from the tunnel via the launch shaft and loading it into skips for disposal
- Removing the TBM when it reaches the receiving pit leaving a completed tunnel under the river lined by concrete pipe (Figure 5-21)
- Installing grouting lines in the tunnel
- Welding line pipe, pre-testing the pipeline and winching it through the tunnel under the river with a cable attached to a pulling head welded to the pipeline
- Integrity testing the pipeline in the tunnel
- Installing headwalls at each end of the tunnel and filling the space between the pipeline and the tunnel liner pipe with grout.

Figure 5-19: TBM Being Lowered into a Launch Pit

Figure 5-20: Jacking Frame in a Launch Pit

Figure 5-21: TBM at a Reception Pit

Horizontal directional drilling
The HDD option would involve the following steps:

- Setting up an HDD drilling rig on the east bank
- Mixing approximately 300m^3 of drilling mud
- Drilling a small-diameter pilot hole from the surface on one bank to the surface on the other bank while applying weight to lengths of drill pipe and a rotating drill bit and circulating drilling mud through nozzles in the drill bit
- Reaming the pilot borehole to a diameter large enough to accept the 56” pipeline
- Separating drill cuttings from the drilling mud and collecting them in skips for disposal
- Welding line pipe to form a pipeline section long enough to reach under the river, pre-testing it and winching it through the bore-hole under the river in one piece with a cable attached to a pulling head welded to the first section of line pipe.

Trenchless Crossings
At the main aboveground concrete irrigation channel at KP12 (approximately 18m wide x 5m deep), which coincides with a road crossing, it is proposed that a non-open-cut (trenchless) crossing be used. The trenchless methodology is described below in the Road, rail and foreign service crossings section.

Road, rail and foreign service crossings

The main roads at KP25.7, KP36 and KP53.5 and the railway at KP53 will be crossed using a trenchless technique (either pipe jack or thrust/auger bored). The railway crossing at KP30 will be part of the Mtkvari micro-tunnel or HDD crossing.

For a trenchless crossing, pits are excavated either side of the road or railway and a casing or carrier pipe is driven between them using hydraulic jacks, and a rotational head is used to cut the earth from the front of the casing/ carrier pipe. The earth is removed through its exposed end and collected in skips for disposal. A typical crossing drawing for thrust/auger boring is shown below.

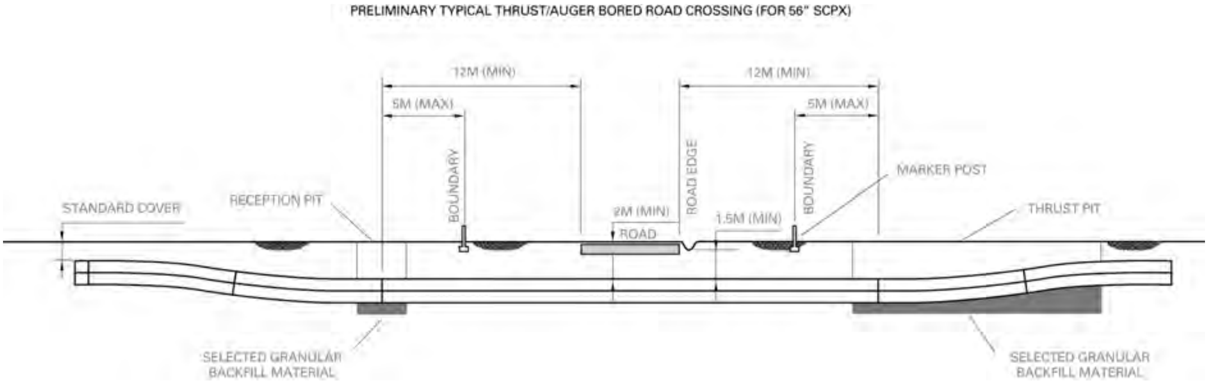

Figure 5-22: Preliminary Typical Thrust/Auger Bored Road Crossing

The large irrigation channel, drainage ditch and road at KP12 will form part of a single trenchless crossing (D5-009), which will minimise potential effects on channel ecology. Spoil will be collected in skips for disposal. Sections of line pipe will then be welded, coated and winched through the casing.

Minor road and track crossings will be accomplished by open trenching as shown in the typical drawing (Figure 5-23).

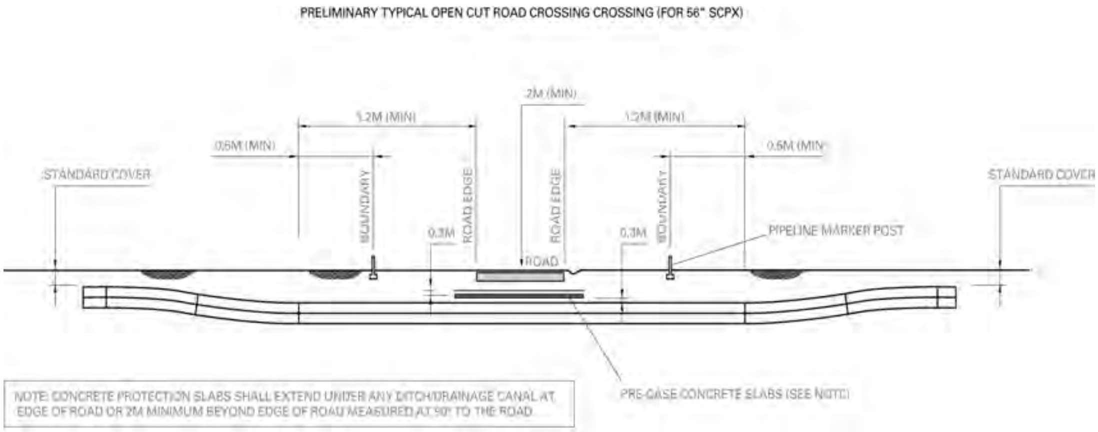

Figure 5-23: Typical Open-Cut Road Crossing

Other service crossings will be accomplished with open-cut or trenchless techniques, as necessary, as shown in typical drawings Figure 5-24 and Figure 5-25.

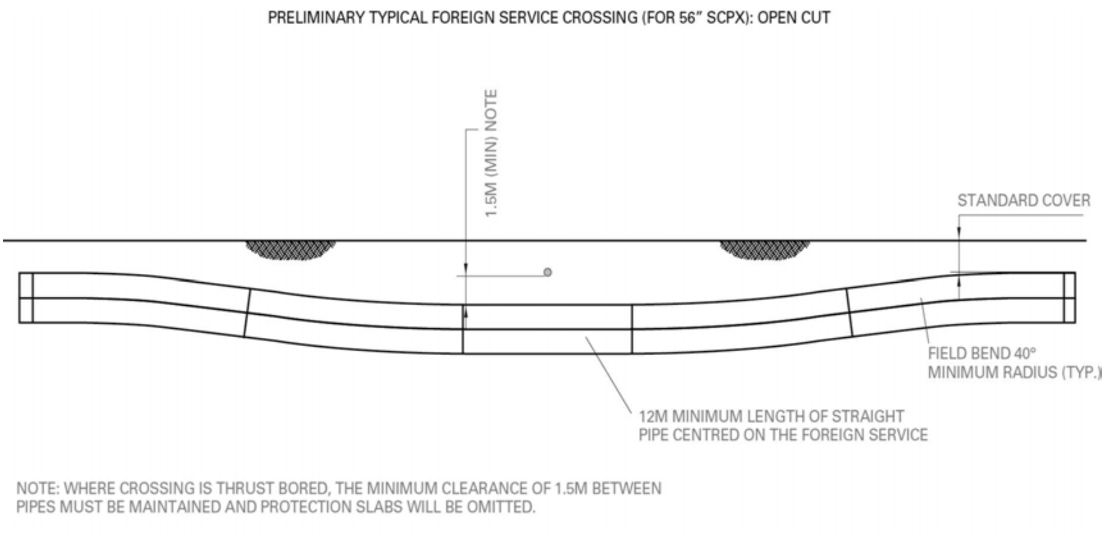

Figure 5-24: Preliminary Typical Open-Cut Service Crossing

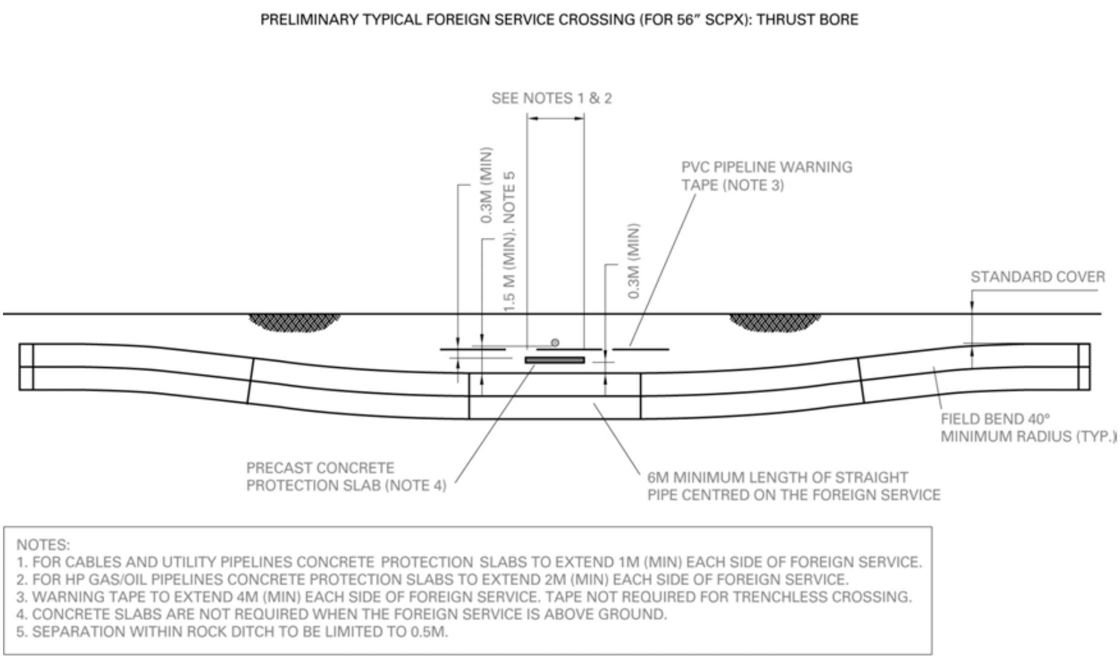

Figure 5-25: Preliminary Typical Trenchless Service Crossing

The pipe to be installed in the crossing will be welded, inspected and coated nearby. One of the following options will then be selected:

- Where it is necessary to maintain traffic flow, the crossing will be made in two stages, and only one half of the road width will be used at a time. Steel plates will be laid to maintain one lane of through traffic (37-14). The trench will be excavated, only removing material directly over the width of the pipe trench. This material will be kept separate from other stripped or excavated material. The welded pipeline will be lowered into the trench in the road. One half of the road will be backfilled at a time using a lean-mix concrete or other readily compacted fill.
- Where a suitable temporary traffic bypass can be identified, the crossing may be installed as described above but with the whole crossing opened at once and without the need for steel plates.

- Following consultation with local officials, residents and relevant landowners, smaller rural roads and tracks may be closed temporarily to through traffic during trenching and installation. This will remove the need for steel plates.

5.4.12 Fault Crossing

The active fault crossings for the existing SCP pipeline were reviewed to confirm the results of the fault identification process, methodology for determining the potential rupture zones and characterisation of the faults. The section of the pipeline trench that crosses the Rustavi fault will be excavated in a trapezoidal shape, double lined with geotextile membrane and filled with non-cohesive, graded aggregate (D5-006). This will allow free and unrestricted movement of the pipe with the ground surface during a potential seismic event and avoid causing a rupture. Figure 5-26 illustrates a typical fault crossing design.

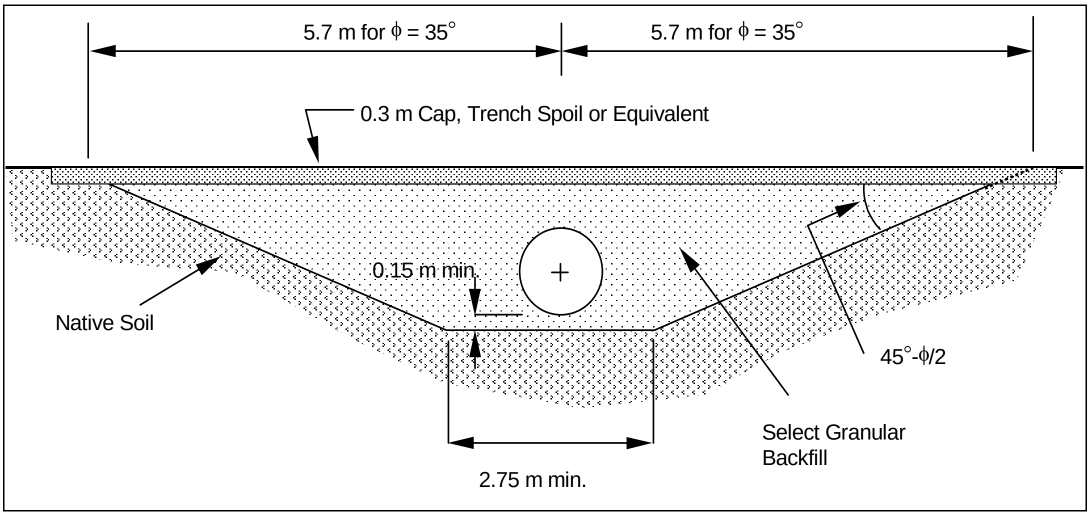

Figure 5-26: Typical Trench for a Fault Crossing

5.4.13 Construction of Pipeline AGIs

At the pigging station (KP56) and the BV station (KP28.5), concrete foundations will be constructed. A 2.5m-high perimeter fence and a 3m-high security wall will be installed. The BVs will be pre-tested. The sites will be surfaced with gravel.

5.4.14 Estimated Emissions from Pipeline Construction

Table 5-7 presents the calculated fuel consumption and estimated atmospheric emissions from the number, type and running time of off-road construction plant and road vehicles used to construct the 56” pipeline.

Table 5-7: Estimated Emissions from Pipeline Construction

Source	Diesel Consumption (tonnes*)	Emissions (tonnes*)					
		CO	NO_x	PM	CO_2	SO_2	HC
Pipeline							
Non-road plant	13,000	330	435	57	38,700	40	60
Road vehicles	1000	17	45	4	4000	1	7
Totals	14,000	347	480	61	42,700	41	67

* Data rounded to the nearest 100 when greater than 1000 tonnes

5.5 SCPX Facilities Design

The SCPX Project includes three major facilities:

- Compressor station CSG1, which will be collocated with the BTC pumping station PSG1 at KP03
- Compressor station CSG2 at KP142
- The PRMS, which will be an extension of the existing SCP Area 80 at KP247.

5.5.1 CSG1

The CSG1 main facilities will occupy an area of approximately 53 hectares. CSG1 will be equipped to perform the following functions:

- Custody transfer metering for the Azerbaijan/Georgian border crossing
- Pipeline pigging
- Offtake of gas for the Georgian supply network
- Compression of the gas to be transported by the SCP and SCPX pipelines
- Offtake of gas to supply fuel to PSG1
- Vent and exclusion area.

Metering, offtakes and pigging facilities

CSG1's metering and pigging equipment will replace the existing pigging facilities located in SCP Area 72 (adjacent to PSG1). All the gas that crosses the Azerbaijan/Georgian border will pass through filters and custody metering at CSG1 that are sized for the maximum throughput of the pipeline. Pigs launched in Azerbaijan will be removed by pig receivers in CSG1. Pigs launched from CSG1 will travel to the PRMS along the existing 42" SCP pipeline or to the pigging station at KP56 on the 56" pipeline.

Downstream of the custody metering is the Georgian offtake, which will replace the existing offtake facilities at SCP Area 72. Some pipeline gas will pass to a pressure reduction package that will reduce the gas from the pipeline operating pressure, a maximum of 90 barg to 10–20 barg before it enters the Georgian gas transmission network. This degree of pressure reduction will cool the gas considerably, and heating is required to raise the temperature of the gas to meet the Georgian offtake specification. The existing capacity of the Georgian offtake will be increased by an additional 0.76 bcma by the SCPX Project.

Heat for the Georgian offtake at CSG1 will be supplied via a gas fired water bath heater, with a rated output of approximately 5MW. Two heaters will be installed, with one running normally and the other acting as a back-up. The first section of an existing 12km-long, 30"-diameter gas offtake pipeline that feeds into the Georgian gas distribution system will be relocated from the existing SCP Area 72 to CSG1, so that gas can be taken off for use in Georgia.

Gas compression

Each compressor station is required to generate 66MW of power to compress the gas when the pipeline is operating at its maximum throughput. The compressor stations will have four gas compressors mechanically driven by dry low emission (DLE) gas turbines (D5-019) to reduce NO_x emissions and will be fuelled by gas that has been taken from the pipeline and has passed through a pressure reduction package. Each gas turbine will have an ISO-rated power output of 30MW and an exhaust height of 20m. The turbines will be sized appropriately to aim to operate within their low-NO_x operating range for as much of the year as reasonably practical when considering ambient temperature variation and variation in pipeline throughput (D5-097). Each train will be fed pipeline gas via an inlet pipe that incorporates a pressure control valve and an inlet filter (i.e. the suction scrubber) that cleans the gas stream and matches its pressure to the operating envelope of the compressor. The compression trains (i.e. gas turbine plus compressor) are designed to compress the gas from 48 barg to approximately 90 barg. The gas absorbs heat energy as it passes through the compressors and must be air-cooled to a maximum of 48°C by after-coolers (i.e. fan heat exchangers) to improve pipeline hydraulics and to protect the pipeline coating from overheating. Compressed gas from the operating compression trains is co-mingled and sent to the SCPX/SCP export pipelines.

Up to three compression trains will be run at any one time to supply the maximum pipeline throughput with one train on standby.

Seal gas that leaks from the compressors will be recovered during normal compressor operation (i.e. excluding start up and shut down) and returned to the process system (D23-01), which will reduce methane emissions and overall greenhouse gas emissions. Local vents will be installed that will release the compressor seal gas to the atmosphere at a safe location if the seal gas recovery system fails (D5-100).

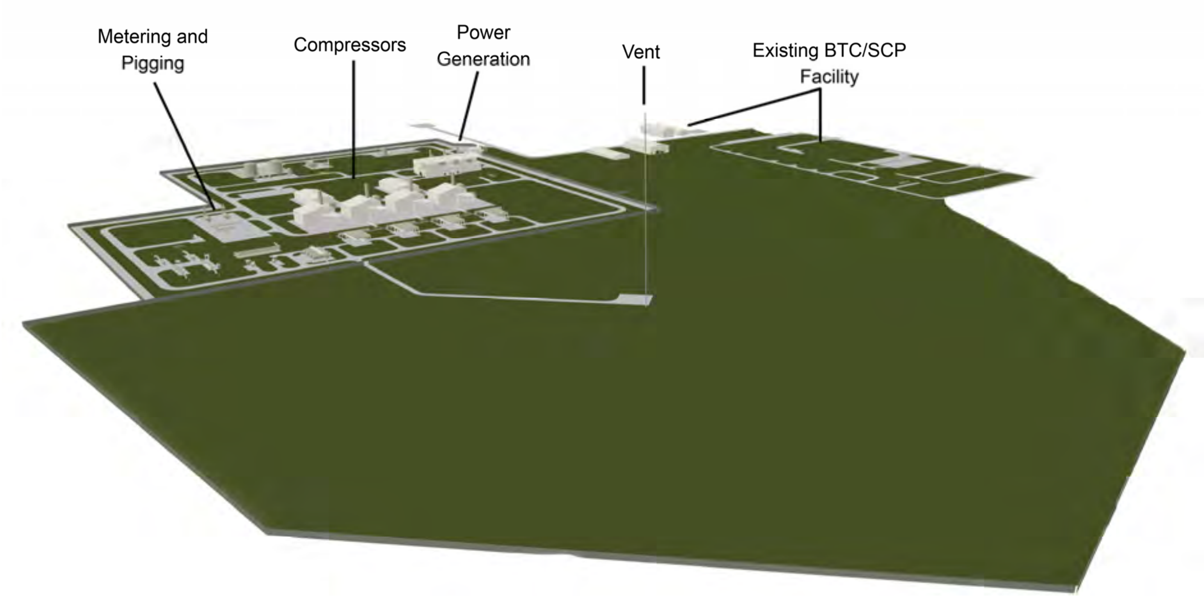

Figure 5-27: Layout of CSG1

Utilities

CSG1 will have three gas turbines for on-site power generation (two running and one standby) fuelled by gas from the SCP/SCPX pipeline. Each turbine will have an ISO-rated power output of 5MW and an exhaust height of 20m. The power generation plant at CSG1 will be in a building with a heating ventilation and air conditioning (HVAC) system.

A connection to the Georgian national electricity grid will be installed at CSG1. The grid will initially be used as a back-up power supply and the Project intends to gather reliability information on the electrical connection with the aim of moving to using the electricity grid as the primary source of site power (i.e. for heating and lighting etc.) in the future, provided there is no impact on the pipeline operation (D5-098).

The compressor station will also have:

- A high-pressure vent stack 80m high for emergency and maintenance depressurisation of the process equipment (D5-021)
- Water supplies: service water and fire water (opportunities for integration with the existing PSG1 service water and fire water storage and distribution systems are currently being evaluated) and water demineralisation equipment for technical service water (see Section 5.5.5 for waste water)

- Air compressors, filters, driers and membrane units to supply instrument air and nitrogen
- Accommodation and offices
- A site control room servicing both CSG1 and PSG1.

CSG1 will use the existing PSG1 diesel storage and will be integrated with the existing distribution system.

Noise attenuation measures

At CSG1 the buildings housing the gas turbine and compressor units will utilise high-performance acoustic louvres to allow for natural ventilation and retain a high performance acoustic design for the cladding (D5-039). High-performance silencers for each of the compression and power generation gas turbine exhaust stacks will reduce noise power levels from approximately 115 dB(A) to 100 dB(A) (D5-040). Silencers will also be included in the combustion and ventilation air inlet system to control noise power level emissions (D5-041). High-performance acoustic insulation will be installed on the compressed gas pipework and the design for compressor after-cooler fans will also achieve reduced noise power level emissions (D5-042).

5.5.2 CSG2

The CSG2 main facility will occupy an area of approximately 39 hectares. CSG2 will be equipped to increase the pressure of the gas to be transported over the mountains to the PRMS in the 42” SCP pipeline. Construction of CSG2 facility and lay-down areas will avoid building on the larger area of wetland at the site (D17-01) (see constraint maps in Appendix A).

Gas compression

Each compressor station is required to generate 66MW of power to compress the gas when the pipeline is operating at its maximum throughput. The compressor stations will have four trains of gas compressors driven mechanically by dry low emission (DLE) gas turbines (D5-019) fuelled by gas that has been taken from the SCP pipeline and has passed through a pressure reduction package. Each gas turbine will have an ISO-rated power output of 30MW and an exhaust height of 20m. The turbines will be sized appropriately to aim to operate within their low-NO_x operating range for as much of the year as reasonably practical when considering ambient temperature variation and variation in pipeline throughput (D5-097). Each train will be fed pipeline gas in the same way as the compressors at CSG1. The compression trains are designed to compress the gas to approximately 90 barg and after-coolers will be needed to cool the compressed gas to a maximum of 34°C. Compressed gas from the operating compression trains will co-mingled and sent to the PRMS via the 42” SCP export pipeline.

Up to three compression trains will be run at any one time to supply the maximum pipeline throughput with one train on standby.

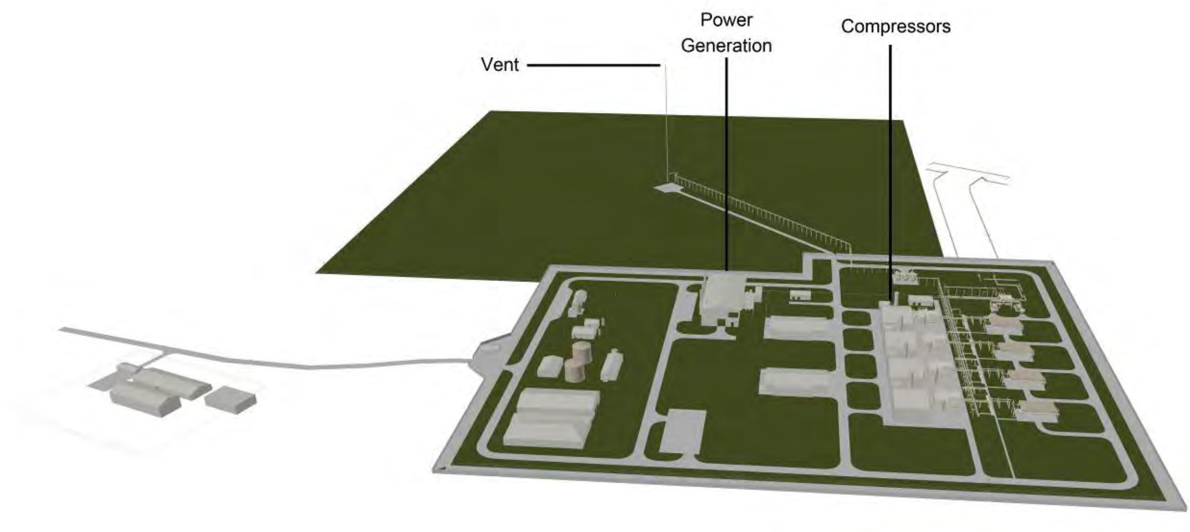

Figure 5-28: Layout of CSG2

Seal gas that leaks from the compressors will be recovered during normal compressor operation (i.e. excluding start-up and shutdown) and returned to the process system (D23-01). Local vents will be installed that will release the compressor seal gas to the atmosphere at a safe location if the seal gas recovery system fails (D5-100).

The compression trains will be in fully clad buildings to protect the equipment from winter weather. The buildings will have heating, ventilation and air conditioning systems.

Utilities

CSG2 will have three gas turbines for on-site power generation (two running and one standby) fuelled by gas from the 42" SCP pipeline. Each turbine will have an ISO-rated power output of 5MW and an exhaust height of 20m. The power generation plant at CSG2 will be in a fully clad building with an HVAC system.

The compressor station will also have:

- A high-pressure vent stack 40m high for emergency and maintenance depressurisation of the process equipment (D5-024)
- Water supplies (service water, and fire water) and water demineralisation equipment for technical service water (see Section 5.5.5 for waste water)
- Air compressors, filters, driers and membrane units to supply instrument air and nitrogen
- A 180m^3 diesel storage tank. Diesel will be used to run the emergency power generators and the fire water pump
- Accommodation and offices
- A site control room.

Noise attenuation measures

At CSG2, the buildings housing the gas turbine and compressor units will typically be fabricated with 150mm-thick sandwich panels to control noise transmission (D5-038). Additionally, a moderate amount of absorption is included within the building itself.

High-performance silencers for each of the compression and power generation gas turbine exhaust stacks will reduce noise power levels from approximately 115 dB(A) to 100 dB(A) (D5-040). Silencers will also be included in the combustion and ventilation air inlet system to control noise power level emissions (D5-041). High-performance acoustic insulation will be installed on the compressed gas pipework and the design for compressor after-cooler fans will also achieve reduced noise power level emissions (D5-042).

CSG2 access road

An all-weather road will be constructed to provide access to the CSG2 site during construction and operation of the facility. It will leave the Millennium Road at a junction between Nardevani and Aiazmi and run northwards for 16km to CSG2. The route of the CSG2 access road (see Figure 5-31) includes sections of existing roads that will need to be upgraded or widened and sections where new road will be constructed. The CSG2 access road route has been selected to follow existing roads and tracks and to avoid pine plantations, wetlands and cultural heritage sites as far as practicable (D17-02). The CSG2 access road design has a carriageway 6m wide with a 1m-wide gravel hard shoulder on either side and the maximum gradient will be designed to accommodate the large equipment transporters required during the construction phase. Drains will be installed on the uphill side of the CSG2 access road, pass through culverts under the road and discharge via holding ponds or other energy reduction techniques into local streams (D36-01). During detailed design, the CSG2 access route has been adjusted to avoid the majority of the wetland area near Kuschi and to route the permanent and temporary footprint away from the area of active corncrake habitat between Kuschi and Berta villages (D17-08). The Project will aim to maintain the existing level of access to unaffected land parcels adjacent to the CSG2 access road by providing junctions/crossing points connected to the main existing tracks (D32-01).

The CSG2 access road has been routed to avoid the majority of known cultural heritage features including:

- Nardevani settlement
- A number of small stony mounds that could potentially be archaeological features and several probable Bronze Age burial mounds (D27-02).

Portions of the CSG2 Access Road drainage and embankments have been specially designed to protect and preserve in place possible archaeological features (D27-04).

A hydrology study will be undertaken during the detailed design of the CSG2 site and access road to determine catchment areas, flow rates and water quality in the stream crossings and wetland areas (D6-03).

5.5.3 CSG1 and CSG2 Fire Water Systems

Both the compressor stations are equipped with a fire water system provided for tackling utility and building fires and the cooling of hazardous equipment adjacent to a fire during plant depressurisation.

A basic fixed firewater system involving firewater tanks, pumps, firewater ring main and hydrants is to be provided at the individual compressor sites. This is supplemented by localised fixed monitors that can be remotely operated.

5.5.4 PRMS

The PRMS facility will extend SCP's Area 80 facility by an area of approximately 20.3ha. It will be equipped to perform the following functions:

- Custody transfer metering for the Georgian/Turkish border crossing
- Reduction of the gas pressure from the 42" SCP pipelines to meet the Turkish pipeline specification.

Custody transfer metering and pigging

A gas inlet pipe will take gas from the 42" SCP pipeline into the PRMS, where it will pass through custody metering filters and a custody metering package.

Pressure reduction

The gas pressure is reduced from a maximum of 90 barg in the Georgian pipeline to between 56 and 75 barg in order to meet the specification for the Turkish gas transmission network. During the pressure reduction process, the gas loses heat energy and must be warmed by gas-fired water bath heater packages. Two new water bath heaters, one operational and one stand-by, will be installed at the PRMS and will be used in addition to the utilisation of the existing water bath heaters at Area 80 to meet the Turkish pipeline's temperature specification. Each water bath heater will have an output of 4.7MW and an exhaust stack height of approximately 9.6m.

Figure 5-29: Layout of PRMS and Area 80 Facilities

Utilities

The PRMS will be powered by electricity supplied from the existing gas engines at Area 80, two of which are normally operating, with an individual output of up to 0.9MW.

A connection to the Georgian national electricity grid will be installed at the PRMS. The grid will initially be used as a back-up power supply and the Project intends to gather reliability information on the electrical connection with the aim of moving to using the electricity grid as the primary source of site power (i.e. for heating and lighting etc.) in the future, provided there is no impact on the pipeline operation (D5-099).

The PRMS will also have:

- A high-pressure vent stack 40m high for emergency and maintenance depressurisation of the process equipment (D5-027)
- Water supplies (service water, and fire water) and water demineralisation equipment for technical service water
- Air compressors, filters, driers and membrane units to supply instrument air and nitrogen.

The PRMS will be operated from the existing control room at Area 80.

No new accommodation is planned at the PRMS. The existing accommodation at Area 80 will be used.

All of the facilities will be designed, fabricated, constructed, tested and commissioned in accordance with ASME code B31.3 '*Process Piping Design*'.

5.5.5 CSG1, CSG2 and PRMS Facilities Waste Water and Sewage Treatment

Each facility is equipped to deal with both surface water and treated effluent as described below. Waste water systems will be integrated with the existing facilities at CSG1 and PRMS (D6-01).

Oily water recovery system

Due to integration at CSG1 with PSG1, the PRMS and Area 80 there is no requirement for a diesel storage tank at either of these sites. At CSG2 the diesel storage tank bund will be routed to the storm water drainage system via an oily water separator (OP02).

At the facilities, fixed, external equipment containing oil and the water bath heaters will be bunded locally and bunds will be manually discharged to the storm water drainage system if clean. Any visible contamination will be recovered prior to discharge or the oily water will be removed for treatment at an oily water separator (OP05).

Storm water

Storm water contained within bunded areas may be released to the storm water system, if deemed free of oil contamination, for controlled discharge off-site. Surface run-off from uncontained catchment areas within the facility site areas (e.g. roadways, and other surfaced areas) will flow into the storm water drainage which will be discharged off-site via a weir, to surface or ground (OP04).

Sewage treatment

Raw sewage (black water), together with domestic waste water (grey water), is collected in small underground 'sealed' sumps. Typically, these are located close to the source of the effluent and the effluent is either routed by gravity or pumped to a central collection sump.

The effluent is fed to a biological treatment plant that reduces the effluent into an inactive 'soup', which is then separated into a neutral sludge and clear supernatant fluid called treated effluent water.

At CSG1 wastewater will be routed to the existing PSG1 biological treatment plant and discharged using the current route – to a surface water via a reed bed.

At CSG2 a new biological treatment plant will be installed with treated effluent water discharged to ground via a soakaway or to surface water in accordance with the Project standards. The design of the waste water system at CSG2 is still being developed, although the options currently being assessed include a rotating disc (BioDisc®) water treatment plant (or similar) with discharge of treated effluent into surface water or alternatively via a soakaway (D5-032).

At the PRMS there are no new facilities that require connection to the sewage system, as the Project will utilise existing offices and accommodation where wastewater is currently discharged to a soakaway through a biological treatment plant.

Draft discharge locations for the sewage treatment system are shown below (Table 5-8), but may change as the Project design evolves. The applicable discharge permits will be obtained for any new planned liquid discharges, prior to the discharge commencing (14-09).

Table 5-8: Proposed Liquid Discharges and Locations at the Facilities

Facility	Discharge Type	Description	Location
CSG1	Treated sewage effluent	Treated at existing PSG1 STP, no new discharge location required	Discharged at the existing PSG1 discharge location; discharge to local water channel via reed bed
CSG2	Treated sewage effluent	New discharge location	Discharged to a minor watercourse to the north-west of the site (preliminary location E8403708, N4615042)
PRMS	Treated sewage effluent	Treated at existing Area 80 STP, no new discharge location required	Discharged at the existing Area 80 discharge location; discharge to soakaway via a reed bed

A monitoring programme will be developed for sanitary and industrial discharges, which will be monitored at the point of discharge to confirm compliance with the Project standards. Monitoring will be carried out monthly for the first year of operation, after which the frequency and suite of determinants will be reviewed and revised dependent on the first year's results (OP41). Monitoring and maintenance of the water treatment facilities will be integrated with the existing SCP Georgia emission management procedures (OP42).

5.6 Facility Construction

Geotechnical, geophysical and topographical survey have already been undertaken to allow the locations of the construction site, construction camp(s) and equipment lay-down areas to be defined.

As described for pipeline construction, prior to the commencement of each element of the construction programme, the facility construction contractor(s) will also develop detailed method statements for the work to be performed, including the mitigation measures outlined in this ESIA. These activities will be monitored by the SCPX Project team in accordance with the requirements outlined in Chapter 13 of the ESIA and also the ESMMP (see Appendix D).

Figure 5-30, Figure 5-31 and Figure 5-32 show the locations of construction camps and equipment lay-down areas in relation to the construction sites at CSG1, CSG2 and the PRMS respectively. The Project has selected construction camp locations on the same sites as, or very near to, the major facilities (D33-01).

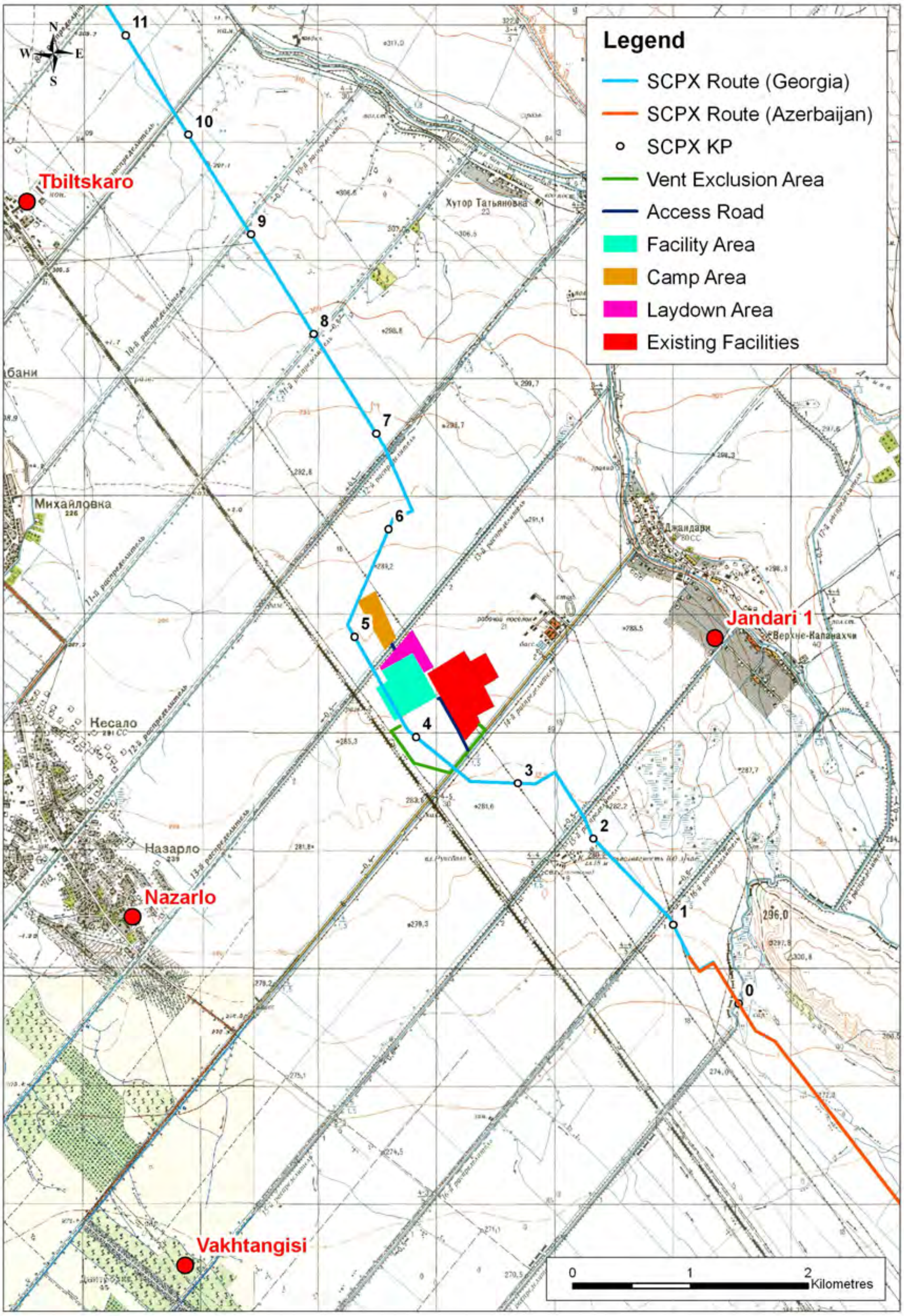

Figure 5-30: CSG1 Construction Site, Construction Camp and Lay-down Area

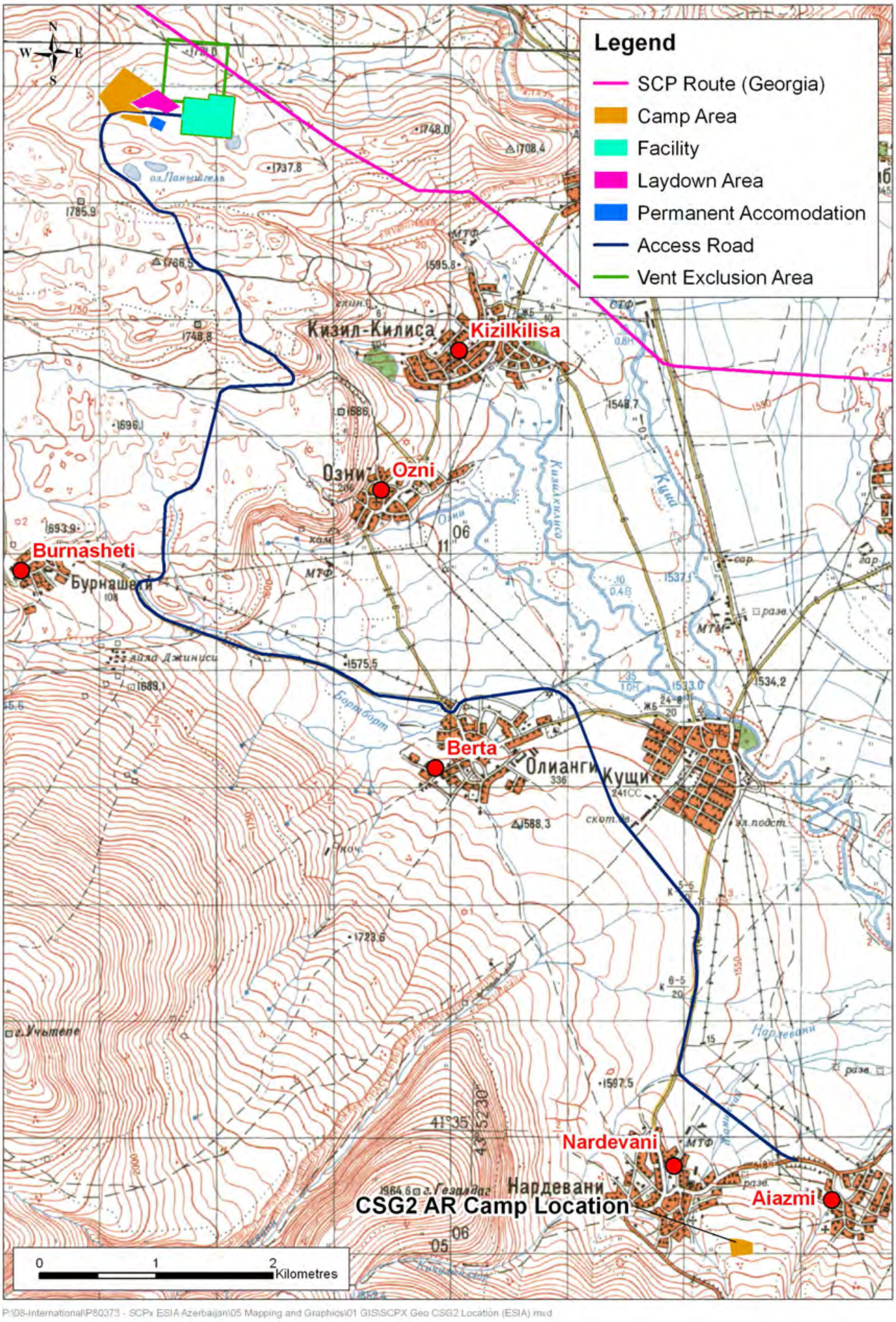

Figure 5-31: CSG2 Construction Site, Construction Camp and Lay-down Area

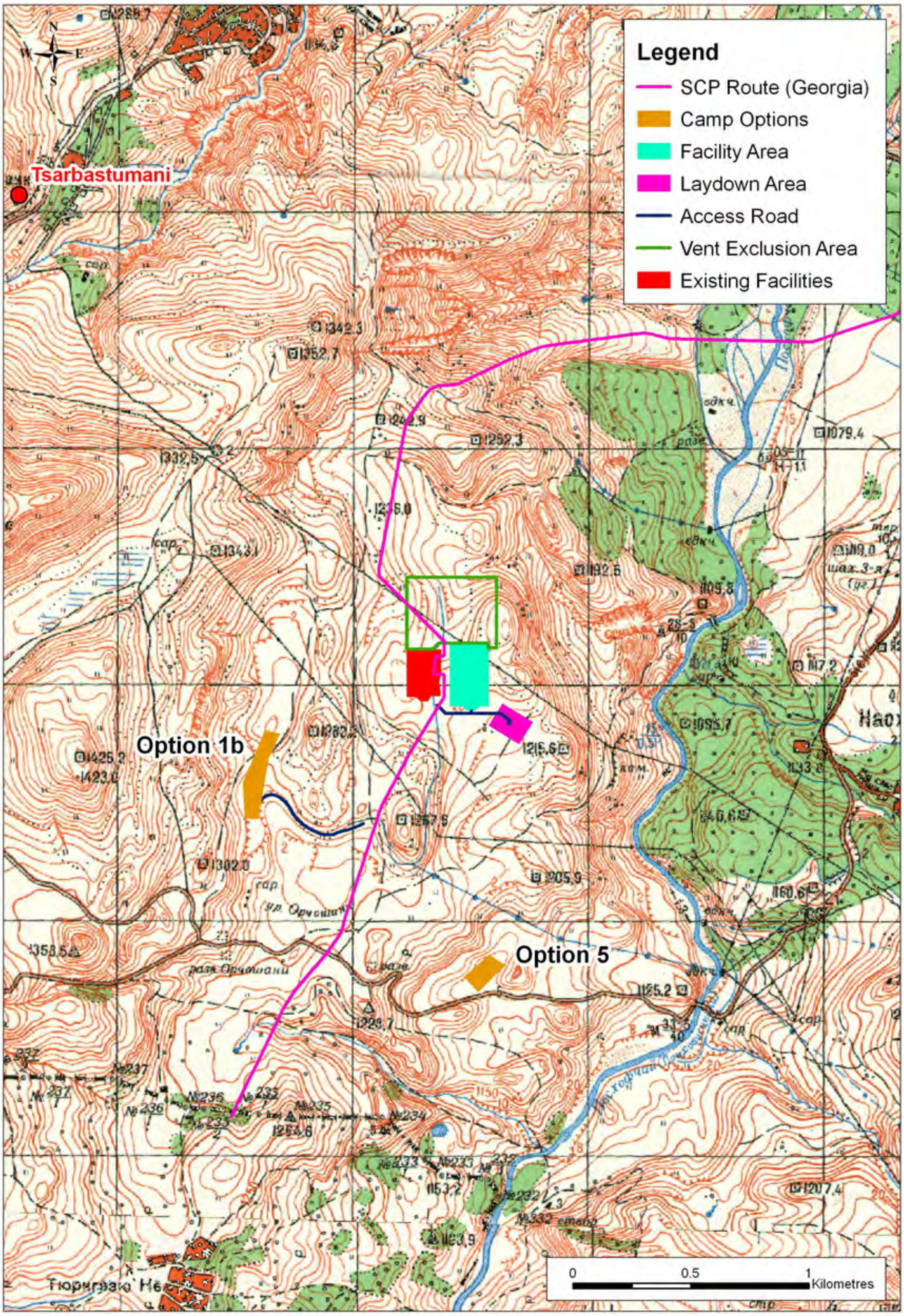

Figure 5-32: PRMS Construction Site, Construction Camp Options and Lay-down Area

5.6.1 *Early Works*

At each facility, a pioneer camp may be set up as close as possible to the designated main camp location at each facility (to accommodate the early works contractor) who will carry out the following works starting in Q1 2014 and continuing in 2015:

- Construct an access road to the construction camp site (if required)
- Carry out earthworks at the construction camp
- Construct an access road to the construction site (including the permanent CSG2 access road)
- Carry out earthworks at the construction site
- Carry out earthworks at the lay-down areas
- Fabricate the foundations for buildings and equipment at the facilities
- Placement of ground slabs to support each building and key items of equipment.

In the case of CSG2, the early works contractor will set up a pioneer camp in the vicinity of the start of the CSG2 access road as a base for the construction of the road and the preparation of the CSG2 site the following year. The location of this camp has now been determined (Figure 5-34) and the process for its selection is described in Chapter 4.

The location of the PRMS construction camp is yet to be determined and currently there are two potential options (Figure 5-32). The location of the PRMS construction camp will be selected based on a multidisciplinary evaluation of the potential options considering H&S, social, technical and environmental criteria. This evaluation will consider the results of pre-construction ecological surveys which will be undertaken at the potential locations in spring (D5-046).

In the case of CSG1, CSG2 and the PRMS, the early works contractor will also carry out earthworks to prepare the potential rail offloading areas at Rustavi, Beshtasheni and Akhaltsikhe, respectively.

Table 5-9 presents the estimated manning levels to be accommodated in pioneer camps during the early works.

Table 5-9: Early Works Peak Manpower Levels

Location	Peak Manpower Levels
CSG1	145
CSG2	120
CSG2 access road construction	120
PRMS	110

Typically, the early works carried out will involve:

- Locating, marking and isolating pre-existing underground services
- Perimeter demarcation and setting out
- Establishment/upgrading of external access roads and internal facility roads
- Establishment of temporary fences and gates
- Topsoil and subsoil removal and storage in suitable locations for use in reinstatement
- Preliminary grading
- Blasting (at CSG2 and the PRMS)
- Site excavation and placement to achieve the required elevation profile for the facility
- Soil improvement and slope stabilisation, if required.

To construct the access roads, the early works contractor will typically deploy excavators, backhoes, bulldozers, graders and compactors. At the CSG2 access road construction camp both concrete- and asphalt-batching units may be established.

To prepare the camps, construction sites and lay-down areas the early works contractor will typically deploy excavators, mobile cranes, and compactors and a concrete-batching unit for site preparation.

Topsoil removed from the facilities (and any excess subsoil) will be stored in designated areas within the site area for potential use in the landscape works (3-01) to prevent the seed bank in the topsoil being diluted by mixing with the subsoil. Topsoil from the access road will be stored in allocated areas along the access road and used preferentially for reinstatement of road banks. Surplus topsoil from the CSG2 access road construction will be spread at agreed locations or on municipal land (X3-01). It is estimated that there will be approximately 32,000m^3 of topsoil available for blending the road into the existing areas.

Areas of potential cultural heritage impact will be examined and any necessary excavations conducted prior to construction (27-02).

The facilities sites at CSG2 and PRMS aim to achieve a balance of cut-and-fill material wherever possible so that the amount of imported materials such as aggregate will be limited as required for hard standings, roadways and where there is a requirement for fill material to achieve a level site. At CSG1 the site level is to be raised above grade to avoid flooding at this low-lying site. It is proposed that the Project will review the flood protection philosophy at CSG1 with the aim of reducing the volume of imported material (D13-01). The CSG2 access road will require import of an estimated 203,500m^3 of aggregate to form the sub-base of the road. Table 5-10 provides an estimate of the quantities of imported fill material required for each of the facilities and the numbers of deliveries required to import the fill to site.

Table 5-10: Amount of Earthworks and Import Materials (including temporary works areas)

Location	Topsoil Strip m^3	Total Import m^3	No. of Deliveries (20-tonne truck)
CSG1	133,000	513,000	24,700
CSG2	91,635	48,171	2,400
CSG2 access road	48,000	203,500	10,200
PRMS	28,000	52,000	2,595
Pipeline camp	50,000	53,000	2,650
Totals	351,000	870,000	43,500

During the detailed design phase the Project plans to investigate options for terracing the CSG1 and CSG2 facility sites and optimising the design of the temporary works areas with the aim of reducing the amount of earthworks and imported material required.

Detailed geotechnical assessments have been carried out to inform the design of the foundations for plant and buildings at the facility. Drainage systems, underground piping and utility lines will be installed. The CSG2 access road will incorporate drainage culverts under the road designed to run 75–90% full in a 1-in-20-years storm.

5.6.2 Construction Camps

The construction contractor will deploy accommodation units to set up a main camp in the camp areas prepared during the early works at each facility. At CSG1 the camp will be close to the site of the facility (see Figure 5-30). At CSG2, the construction camp will be located west of the proposed construction site to maximise use of the available areas of flat level ground (see Figure 5-31). At the PRMS, the camp will be located on flat land to the west of the construction site or to the south west, and a temporary access road will be constructed (see Figure 5-32).

The manpower levels to be accommodated in the main construction camps will vary as work progresses. Figure 5-33 shows the estimated Project construction manpower levels by facility.

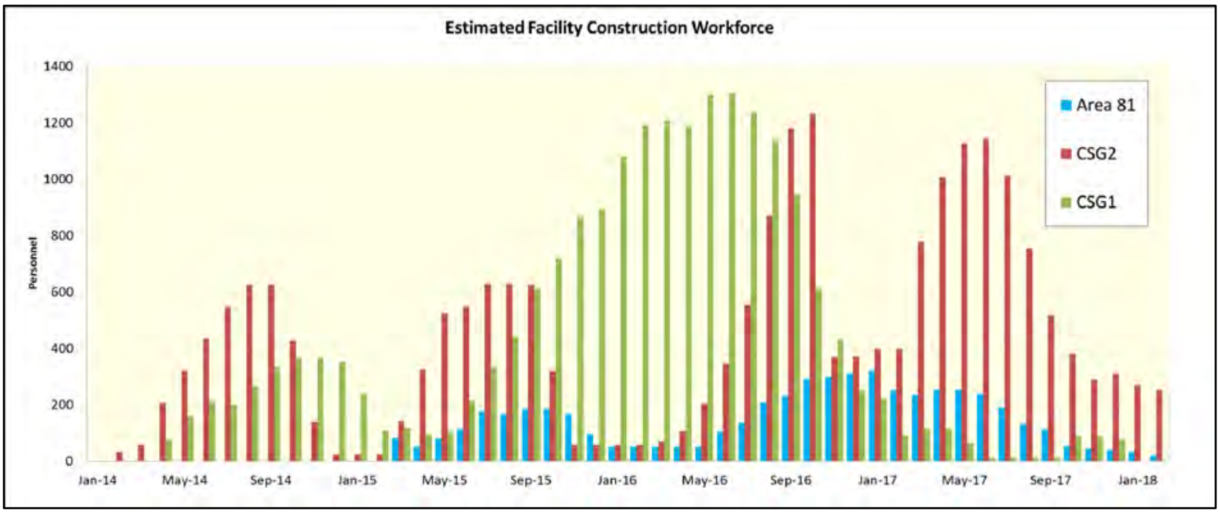

Figure 5-33: Facility Construction Manpower Levels

The main construction camps will provide at least the following facilities:

- Boundary fences/walls with gate, security office and traffic barrier
- Paved roads, hardstanding for lorries and car parking and paved walkways serving all buildings
- Equipment storage and maintenance areas
- Vehicle refuelling and washing facilities
- Accommodation with water and electricity supplies
- Kitchens and cold storage for food
- Dining rooms
- Laundry
- Medical treatment room
- Recreation facilities and shop
- Offices with telephones, data and postal services
- Diesel generators
- Fuel tanks with secondary containment and a refuelling station
- External lighting to roads and walkways
- Waste accumulation and storage area (WSA) and waste handling facilities
- Sewage treatment plants (STPs)
- Water treatment units
- Storm-water drainage
- Emergency muster point.

All camps will remain in operation while construction continues at the respective sites Reinstatement will be undertaken as early as practicable and in accordance with the Reinstatement Specification (4-09). Temporary works areas will be reinstated to near original condition (as compared to pre-construction survey reports or adjacent areas) (17-05). When camps and lay-down areas are taken out of service, the existing aggregate will be used, as approved by the Company, to landscape areas of the site before topsoil is spread; where this is not possible, the aggregate will be returned to borrow pits/Company approved disposal areas (1-08).

Estimated discharges and waste from camps

In accordance with the SCPX Waste Management Plan (see Appendix D), solid wastes generated by construction activities will be collected in waste storage areas (WSAs) located at the camps (D5-028). Waste will be segregated into the following categories: inert and non-hazardous, liquids, medical, and hazardous. The camp will discharge domestic wastewater treated by a sewage treatment package designed to meet the Project standards and permit requirements (D5-106).

All wastes from the SCPX Project will be managed with the aim of minimising (a) impacts to the natural environment and (b) health hazards to personnel. Where appropriate, waste materials will be reused or recycled, with disposal to landfill as a last resort. In this case, inert and non-hazardous waste will be disposed of to the licensed BP operated landfill site near Rustavi (D5-029). Hazardous waste will be forwarded to a waste disposal contractor licensed to receive and treat hazardous waste (D5-030).

Table 5-11 presents a forecast of waste generation by facility, including wastes from construction camp operation and waste generated on the construction site and collected at WSAs in the camps. The estimate for CSG1 includes waste from the pipeline construction and camp at Poladaantkari.

Table 5-11: Estimated Discharges and Waste from the Construction Camps

Waste	Unit	CSG1 and Pipeline Camps	CSG2	PRMS	Non-hazardous	Hazardous	Liquids	Medical
Waste from camp operation								
Food/kitchen	tonne	950	700	150	x			
Domestic waste	tonne	630	460	100	x			
Domestic paper	tonne	80	60	10	x			
Domestic plastic	tonne	20	20	5	x			
Sewage	m3	203,800	149,800	33,000			x	
Vehicle wash-down water	m3	1720	1420	310			x	
Medical waste (beds)	kg	1500	1320	330				x
Medical waste (first aid)	kg	650	490	110				x
Waste from construction operations								
Spoil/inerts	m^3	125,100	-	-	x			
Grit blast	tonne	110	70	20	x			
Industrial packaging	tonne	640	480	110	x			
Waste wood	tonne	180	210	50	x			

Waste	Unit	CSG1 and Pipeline Camps	CSG2	PRMS	Non-hazardous	Hazardous	Liquids	Medical
Waste metal	tonne	260	150	40	x			
Concrete	m^3	1930	1660	380	x			
Paints sludges and waste	tonne	30	20	5		x		
Solvents and chemical waste	tonne	20	20	5		x		
Paint and solvent cans (20 litre)	m^3	100	70	170		x		
Coating drums (200 litre)	drums	50	-	-		x		
Oil filters	kg	2870	2130	470		x		
Oil and lubricants	tonne	70	50	10		x		
Batteries wet cell	Number	290	180	40		x		
Tyres	Number	1470	920	200		x		
Oily absorbents/ rags	tonne	30	30	5		x		
Oily soils	tonne	40	30	10		x		
Wash-down water	m^3	70	130	20			x	

5.6.3 *Delivery of Facility Equipment*

Once the site civil works have been completed, process equipment will be delivered to the lay-down areas at each facility. Some equipment will be broken into smaller sized packages for transport taking account of the limitations of the road and rail infrastructure. Delivery by truck from ports in Poti or Batumi will include the oversize heavy loads listed in Table 5-12.

Table 5-12: Facility Equipment Delivery

Equipment	Number of Loads		
	CSG1	CSG2	PRMS
Compressors and turbines	6	6	
After-coolers	8	8	
Suction scrubbers	8	8	
Knock-out drum	1	1	
Gate valves	6	4	
Check valves	1	1	
Ball valves	6	1	
Power generation skids	6	6	
Diesel generator skids	11	11	
Pressure reduction skids	11	11	
Filter vessels		2	
Gas metering			5

Equipment	Number of Loads		
	CSG1	CSG2	PRMS
Total	64	59	5

The locations of rail spurs and access routes to the CSG2 and PRMS are shown in Figure 5-34 and Figure 5-35.

At the lay-down areas, the equipment will be unloaded from the delivery trucks using cranes.

At CSG1, the lay-down area is close to the construction site (see Figure 5-30). At CSG2, the lay-down area is located east of the construction site to use the available areas of level ground. Construction of CSG2 site and lay-down areas will avoid building on the larger area of wetland at the site (D17-01). At the PRMS, the lay-down area will be located next to the construction site (see Figure 5-32).

The lay-down areas will have the following facilities:

- Material and equipment storage areas
- Offices
- Maintenance building
- Plant workshop
- Power generators and diesel fuel storage tanks with secondary containment
- Cleaning equipment with water tanks.

The tanks will be supplied by diesel tankers and water tankers.

While the equipment is in the lay-down areas, it may be removed from transport packaging, examined for damage during transport, cleaned if necessary and prepared for placement on the construction site.

Temporary works areas will be reinstated to near original condition (as compared to pre-construction survey reports or adjacent areas) (17-05) once construction is complete.

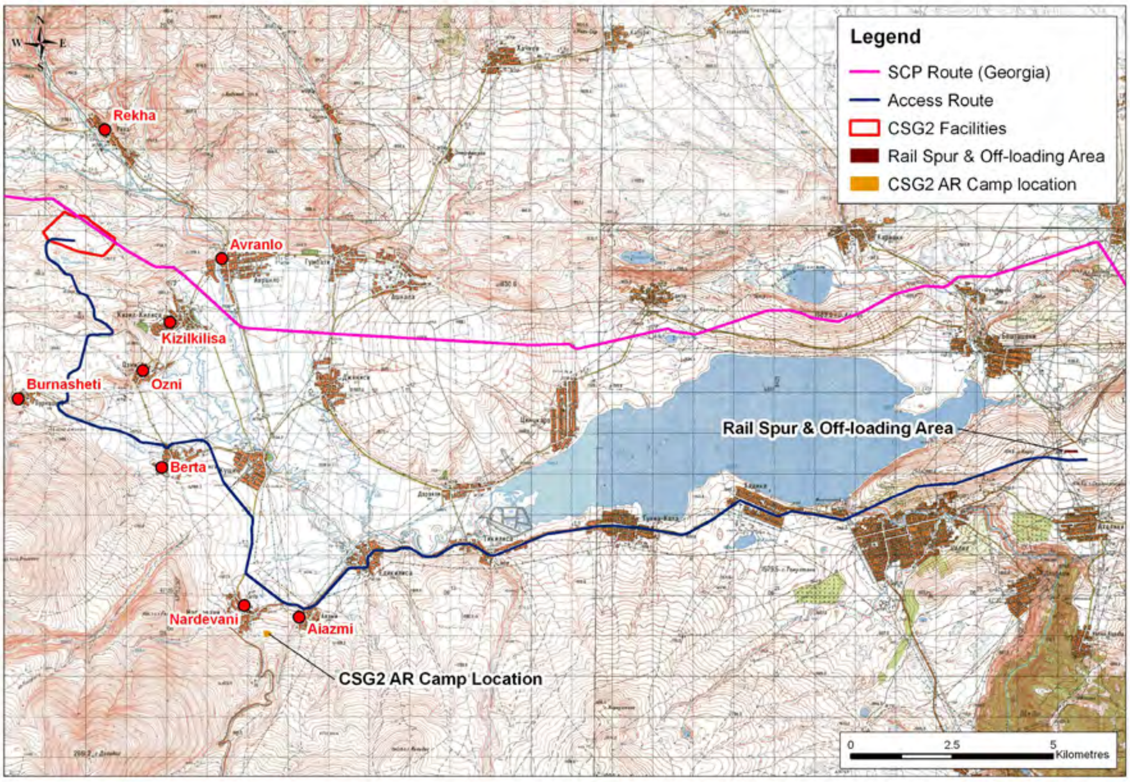

Figure 5-34: Location of Beshtasheni Rail Spur, Access Route to CSG2 and Access Road Camp Location

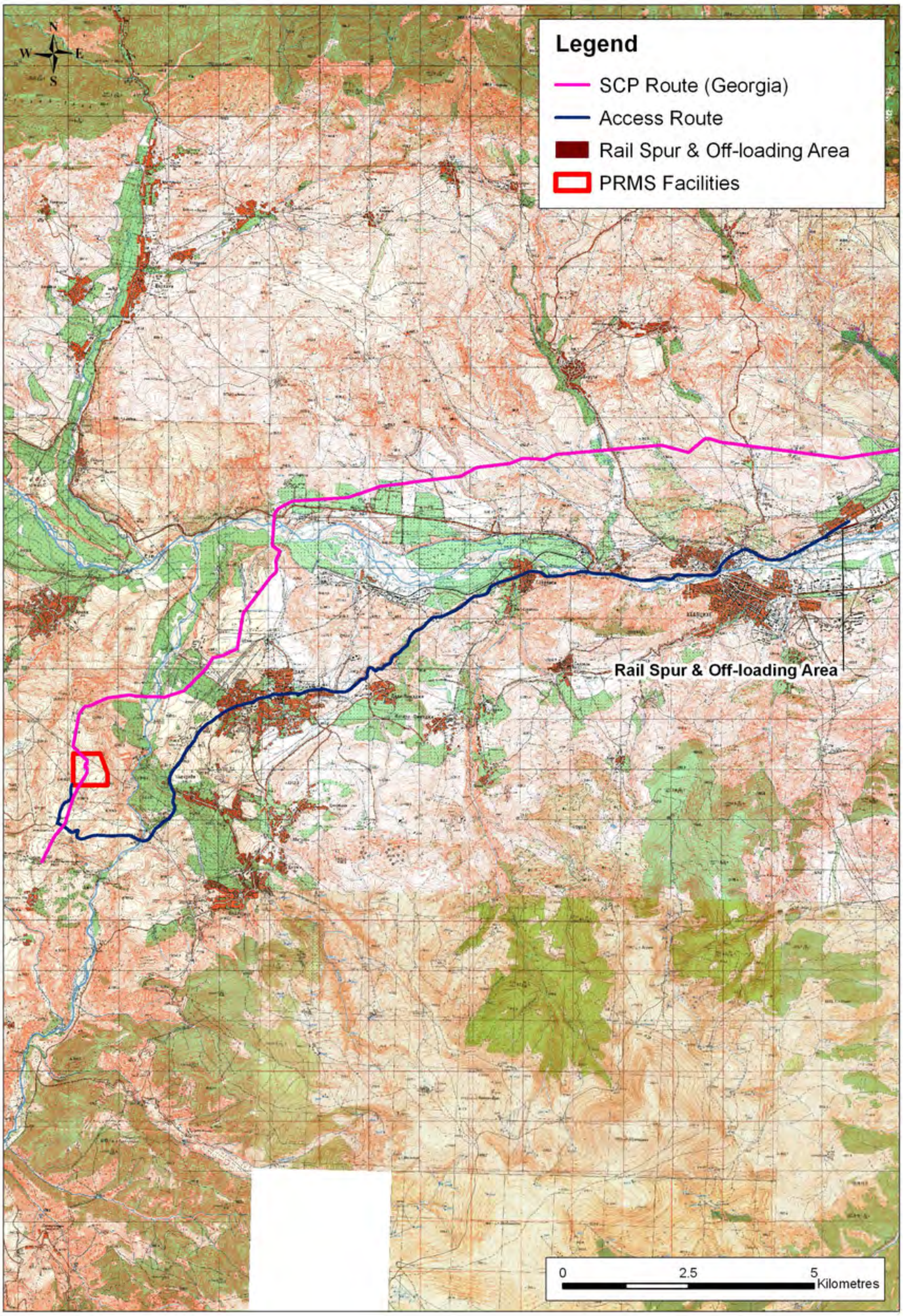

Figure 5-35: Location of Rail Spur and Offloading Area at Akhaltsikhe and access route to PRMS

5.6.4 Erection of Buildings and Process Equipment

The construction contractor will carry out the following activities at the construction site:

- Placement of prefabricated structures and modular equipment using heavy lift cranes
- Assembly of equipment using heavy lift cranes to lift equipment into place while it is assembled
- Construction of compressor housings, buildings and ancillary equipment
- Tie-in of the facility to the SCP pipeline (and in the case of CSG1 to the SCPX pipeline)
- Installation of all above ground utilities and services (including security, lighting, fire fighting, process control and telecommunications systems)
- Installation of the perimeter security wall and gates
- Placing of granular surfacing on all unpaved areas.

Works on the construction site will involve the use of:

- Flatbed trucks to bring equipment from the lay-down area
- Lifting equipment (mobile cranes, crawling cranes and forklift trucks)
- Welding sets and their power generators
- Air compressors and their power generators
- Cable drum trailers for electric cabling
- 'Cherry picker' man lifts
- Water trucks.

Concrete batching plants (if no approved plants are available locally) will be located close to the facility construction sites.

5.6.5 Estimated Emissions from Facility Construction

Table 5-13 presents the calculated fuel consumption and atmospheric emissions from forecast estimates for the number, type and running time of off-road construction plant and road vehicles used to construct the facilities.

Table 5-13: Estimated Emissions from Facility Construction

Source	Diesel Consumption (tonnes*)	Emissions (tonnes*)					
		CO	NO_x	PM	CO_2	SO_2	HC
CSG1							
Non-road plant	11,400	240	400	51	35,300	75	50
Road vehicles	960	11	37	3	3,000	1	6
CSG2							
Non-road plant	11,500	240	400	51	35,500	75	50
Road vehicles	810	9	31	2	2500	1	5
PRMS							
Non-road plant	7400	160	260	35	22,800	37	32
Road vehicles	635	7	24	2	2000	1	4
Totals	32,705	667	1152	144	101,100	190	147

* data rounded to the nearest 100 when greater than 1000 tonnes

The applicable air emissions permits will be obtained for combustion equipment, prior to the emission commencing (14-10).

5.7 Project Commissioning and Reinstatement

According to the Project programme (see Figure 5-2), construction of the CSG1 facility will be completed in early 2017 with commissioning continuing into 3Q 2017. Construction of the CSG2 facility is scheduled for completion a year later and commissioning will continue into 3Q 2018. The PRMS construction is scheduled to be complete in 3Q 2017 with commissioning complete by the end of 2017. The three facilities will undergo similar testing and commissioning.

5.7.1 Commissioning of Facilities

The equipment that will have been installed at the facilities, in most cases, will have undergone rigorous testing for certification by the manufacturer before it is delivered to the site.

After confirming that all systems and sub-systems have been built, aligned and documented in accordance with the design specifications, drawings, codes, safety standards and statutory requirements a dedicated commissioning team will undertake a commissioning programme that aims to prove that the facility functions as expected. The commissioning programme also provides an opportunity for the operational staff to become familiar with the operation of the new equipment.

The commissioning programme includes on-line, on-load functional testing of individual systems using inert non-hydrocarbon fluids such as water to simulate process fluids. Table 5-14 presents an estimate of the quantity of water that will be needed to hydrotest pressurised piping and vent headers at the facilities.

Table 5-14: Proposed Hydrotest Water Volumes for Facility Commissioning

Location	Pressurised Piping (m^3)	Vent Header (m^3)	Totals (m^3)
CSG1	1640	280	1920
CSG2	1200	260	1460
PRMS	670	50	720

Piping will be dried and pressure tested with a nitrogen and helium mixture. Testing with water and inert gases will allow gas leaks to be corrected safely. The hydrotest water will be discharged and the pressurised inert gas used to test piping will be vented. Some critical sections of pipework will require chemical cleaning for the equipment to meet the required cleanliness levels for operation.

The utility systems will be energised, and parts of the plant will be tested using natural gas. At some stages of commissioning, venting may be needed to depressurise equipment containing natural gas.

After commissioning, the process systems will be ready for the introduction of natural gas.

5.7.2 Pipeline Hydrostatic Testing

The 56” SCPX pipeline will be hydrotested to ensure that it is free from material defects and is suitable for the containment of hydrocarbon gas at the design operating pressure.

During construction, each test section will be pigged several times using cleaning pigs to remove construction debris and clean the pipeline internally and gauging pigs will be used to check the internal geometry is within specified limits.

The pipeline will be hydrotested in sections, chosen so that the maximum change in elevation along the test section is 100m. Certified test ends will be welded onto each end of the section of pipeline to be tested, and it will be filled with water. If the 56 kilometres of the 56” pipeline in Georgia were tested in a single section, approximately 83,000m^3 of water would be needed to fill it. It is likely that the Georgian pipeline will be hydrotested in at least two sections, and that some of the water could be retained for use in more than one test. Hydrotest water will be re-used between sections, where practical, to minimise the volume required (10-09).

If water is sourced from rivers (or channels), no more than 10% of the water flow will be extracted at any time (D5-078). Before extracting water the Project will consider the presence of any IUCN/Georgian Red List fish species particularly during fish spawning season (which normally occurs within the period May to June) and the mitigations such as 10mm fish screens will be determined by a site assessment and approval by the Company (D5-079). Depending on how far away the water source is, the water may be transported to the hydrotest pump location by tanker or temporary surface-laid pipe, where it will pass through a settling tank with a 50-micron filter before being pumped into the pipeline test section.

A risk assessment will be undertaken before any chemical additives are used in hydrotest water (10-08).

When the test section has been filled, the water will be left for a period to allow the temperature of the water and the pipe to stabilise. The hydrotest water will be pressurised to at least 1.25 times the pipeline’s maximum operating pressure for a continuous period of 24 hours. A correlation must be made between pressures, temperatures, water added and water removed to demonstrate that the pipeline is not leaking. Otherwise the fault must be rectified and the hydrotest must be repeated.

The pipeline will be depressurised and dewatered, and any hydrotest water that is not to be retained for other tests will be discharged via a soakaway or to a river or lake. Water to be discharged could potentially be pre-treated (e.g. in settling ponds). The pipeline will be swabbed to remove as much water as practicable, and then dried using techniques to be determined by the contractor (e.g. nitrogen drying, super-dry air drying) to meet a dew point specification.

Following successful hydrostatic testing and dewatering, closing welds will be carried out to link the new sections and tie them in to pipework at CSG1 and the SCP pipeline at KP56.

5.7.3 Reinstatement and Landscape Works

Before the construction programme commences, the construction contractor will be required to develop a Project-specific Reinstatement Implementation Plan based on the Reinstatement Management Plan in the ESMMP (see Appendix D) and the Project reinstatement specification. The full width of the ROW and all other temporary Project areas will be re-instated in accordance with the reinstatement plan on completion of the works. The construction contractor will also be required to incorporate reinstatement measures into relevant method statements for each critical element of the construction programme (e.g. watercourse crossings, site clearance, re-grading).

The key areas that need full reinstatement are the ROW, and the pipeline and facility construction temporary areas (e.g. camps and storage areas).

Reinstatement philosophy

The Project reinstatement specification is based on the following principles:

- Disturbed areas will be reinstated to pre-construction conditions to the greatest extent practicable
- There will be very limited vehicular access along the ROW, which will not normally be permitted, although there will be a continuing requirement for access for maintenance and in case of emergency

- Disturbed areas will be stabilised to protect the integrity of the pipeline and minimise potential impacts associated with erosion, transportation and sedimentation of material from disturbed areas
- Disturbed areas will be re-vegetated (with active re-seeding as necessary, e.g. where soils are poor or there is a high erosion potential) to achieve conditions similar to those that exist immediately adjacent to the ROW or other temporary areas
- Regular monitoring of all reinstated areas will be undertaken until environmental requirements and goals are achieved (see Ecological Management Plan in Appendix D).

Pipeline erosion control

An assessment of the route has been undertaken to identify areas of potential erosion and to support the development of appropriate erosion control measures for such areas. Based on the erosion assessment and the technical objectives of the Project, the following goals have been set:

- No risk of exposure of the pipe
- Very low risk of off-site pollution and sedimentation
- Lower risk of damage to biorestoration by erosion of soils containing seed-bank resources, vegetative material and plants.

Further details of the erosion assessment and the classification of the soils along the route are provided in Section 7.3.3.

Erosion control measures will be implemented at all locations where the erosion class is expected to be above Class 3 (moderate <10t/ha/year), as defined by Morgan (1995). This is a value agreed and adopted on earlier work on BP’s pipelines in Georgia. If this is achieved, continuous networks of channels over the slopes will be prevented, ensuring that the depth of material above the pipe is not reduced.

A suite of erosion control measure ‘tool boxes’ was used on the BTC and SCP pipelines and has proved effective. These erosion toolboxes are methods of erosion control that define the detailed requirements at specific locations. The toolboxes are used to design the location-specific erosion control measures that are included on the pipeline alignment sheets. The measures are summarised below and will be implemented along the new pipeline loop according to the erosion risk at each location in order to meet erosion class 3 for the reinstated sections:

1. Top soil management
2. Subsoil and spoil management
    - 2 – Standard reinstatement
    - 2S – Special reinstatement
3. Re-vegetation
    - 3G – reseeding
    - 3P - replanting
4. Erosion mats
5. Diverter berms
6. Outlets
    - 1a – low erodible conditions
    - 1b – erodible conditions
    - 1c – for use on made-up ground.

Timing of reinstatement

Reinstatement will be undertaken as early as practicable and in accordance with the Reinstatement Specification (4-09). For the ROW, this will be after the trench backfilling and prior to hydrotesting. For the facilities and pipeline camp and lay-down areas, this will be after removal of the camp and lay-down area equipment.

Site clean-up

Before demobilisation of construction personnel and equipment, clean-up activities will be conducted in accordance with the Project environmental standards and industry good practice. Clean-up activities will consist of the removal and/or disposal of temporary buildings, equipment, tools and excess material brought on site or generated during the construction and commissioning programme. Any disposal will be in accordance with the Project waste management plan (see Appendix D).

Reinstatement

Re-contouring should be sympathetic and in keeping with the surrounding landscape, and as approved by the Company, where this is not precluded by risk to integrity of the pipeline or erosion considerations (9-01).

The first stage of the reinstatement programme will comprise the re-grading of all working areas to achieve a final surface that is sympathetic to the natural landform contours where practical. Any permanent erosion control measures (e.g. diversion berms) will also be installed at this time.
To facilitate natural re-vegetation of the ROW, the separately stockpiled topsoil and vegetation debris will be spread over the surface of the ROW following completion of grading, as appropriate (D5-086).

Figure 5-36: Reinstatement over Existing SCP Pipeline

The construction contractor(s) will be required to comply with all requirements for the reinstatement and will be required to submit a reinstatement schedule and methodology which, as a minimum, complies with the Project reinstatement specification and the ESIA requirements (see Chapter 10 and Appendix D, ESMMP). In some instances, areas of sensitive natural habitats or high erosion potential may be seeded with a mixture of native plant species to facilitate re-vegetation. If considered necessary by BP, additional surface stabilisation measures may be adopted in areas of high erosion potential. Figure 5-36 shows reinstatement over the existing SCP pipeline.

The approach to reinstatement is summarised below:

- Minimise reduction in soil quality and structure through predetermined stripping, handling and storage procedures
- Use of appropriate temporary erosion control measures (including erosion matting, sediment traps, silt fences, and filter berms)
- Use of permanent erosion control (including diverter berms, and trench breakers)
- Reinstate all third-party assets affected by Project activities in accordance with pre-entry agreements
- Reinstate all redundant spoil disposal sites. These will be closed, capped and landscaped in accordance with the relevant requirements of the Project reinstatement plan and waste management plan (see Appendix D)
- Reinstate watercourses and locations prone to erosion, as soon as practicable after installation of the pipeline
- Undertake joint inspections of all reinstated areas (i.e. involving construction contractors' reinstatement personnel and Project representatives) to verify that all necessary measures have been undertaken
- Reinstatement of uncultivated areas to facilitate re-establishment of natural (pre-existing) vegetation communities (including, as appropriate, final grading, ripping, cultivating, reseeding and planting of trees and shrubs). Agricultural land will be tilled and left for re-seeding by land users
- Where erosion control seeding is needed, target a minimum cover of pre-existing ground vegetation established within one year of final reinstatement
- An aftercare, monitoring and corrective action programme will be developed and implemented based on examining the bio-restoration process periodically after reinstatement.

Following construction, the Contractor will repair roads to at least their pre-construction condition (37-07). Surface of frequently used access roads will be subject to regular inspections and repair, with the aim of ensuring they are maintained in a good condition particularly where fragile buildings are close to roads (subject to site specific survey) (37-08). Any disrupted irrigation or drainage systems will be reinstated on completion of construction to a standard at least equal to their original condition (35-08).

Before construction personnel and equipment are demobilised, temporary buildings and equipment, tools and any excess material brought on site or generated during the construction and commissioning programme will be removed (D5-093).

Upon completion of subsoil and topsoil reinstatement, the Contractor and Company personnel will inspect disturbed areas jointly for signs of erosion, slope stability, relief, topographic diversity, acceptable surface water drainage, capacity and function, and compaction. Remedial measures will be implemented, if necessary, at locations where reinstatement does not meet the Project criteria (3-15).

Any fences, services, structures, roads, tracks, pavements or other facility affected by the works connected with the Project will be repaired or replaced to a condition that is at least as good as that found prior to construction.

Watercourse reinstatement

Watercourse banks disturbed by Project crossings will be restored to near original condition, which will be assessed individually for each watercourse and defined in the Contractor's Reinstatement Implementation Plan. Any deviations (e.g. because hard reinforcement is required for erosion control) shall be subject to Company approval (10-14). The construction contractor(s) will produce method statements incorporating plans for erosion control, sediment control and reinstatement before work begins at river crossings (4-12).

As a minimum, the method statements will include information on the following:

- Recording of the original channel width, depth and slope prior to disturbance to allow reinstatement as near to the original as is practicable
- Re-contouring of banks to match surrounding slopes
- Installation of erosion protection measures at areas susceptible to washout or run-off. These may include the provision of riprap, gabions or impervious membranes. An ecological survey may be undertaken before any reinforcements are constructed, with appropriate mitigation measures identified and implemented
- Replacement of the channel substrate
- Replacement of the bank topsoil
- Reseeding of the banks.

Facilities landscaping

The permanent facility areas will be subject to landscaping in accordance with the Landscape Management Plan in the ESMMP (Appendix D), and the contractor's Landscape Implementation Plan.

The areas of the facilities that will be occupied permanently will be left with surfaces of materials specified in the design (e.g. gravel, asphalt, pavement).

When camps and lay-down areas are taken out of service, the existing aggregate will be used, as approved by the COMPANY, to landscape areas of the site before topsoil is spread; where this is not possible, the spoil will be returned to borrow pits/Company approved disposal areas (1-8). Sensitive material and colour finishes will be used for the external facades of buildings (D8-02). The Project will use sensitive lighting design to minimise light pollution and sky glow, including directional, task-specific, low-level, hooded, photosensitive lighting at CSG1, CSG2 and PRMS (D8-03).

5.8 Project Operation and Maintenance

5.8.1 Operational Environmental and Social Management

An environmental and social management system will be developed to maintain compliance with the ESIA during operations. This is described further in Chapter 13 and, as far as practicable, this system will be integrated into the existing SCP management systems.

5.8.2 Facility Operation and Maintenance

Manpower

The facilities will be permanently manned. CSG1 and CSG2 will each have a normal operational staff of approximately 40 people (mostly Georgian nationals) including:

- Site controllers, operations supervisors, operations advisor, control room technicians, site operators and operations support coordinator working day and night shifts
- Maintenance supervisors and maintenance technicians (electrical, mechanical and instruments) working a day shift only (operations technicians will not carry out maintenance on night shifts, but will be expected to carry out isolations and preparation for maintenance activities for day shift maintenance teams)
- HSE advisor, holiday relief personnel and trainees
- Doctor and ambulance driver (shared with PSG1 at CSG1)
- Cleaners
- Security guards working day and night shifts.

The PRMS has a normal operational staff of approximately 25 people (mostly Georgian nationals) including:

- Production technicians working day and night shifts
- Electrical, mechanical and instruments technicians working day shift only
- Doctor and ambulance driver (shared with Area 80)
- Cleaners
- Security guards working day and night shifts.

Operation and maintenance

The pipeline and facilities will be operated within the intended design conditions (OP124) and the pipeline and facilities will be regularly inspected and maintained (OP123). Monitoring of areas of geotechnical instability and erosion potential will be continued during operations (OP136).

Each facility will have a water supply. It is expected that at CSG1 and the PRMS water will be supplied using the existing groundwater abstraction wells that serve these facilities or through the installation of new wells. At CSG2 the source of water is still under investigation and may include the installation of a groundwater abstraction well or, depending on groundwater availability, the supply of water by road tanker. Table 5-15 gives estimates for water use at each facility during operation.

Table 5-15: Estimated Facility Water Use during Operation

Location	Type	m^3/year
CSG1	Potable water	3415
	Utility stations	20
	Gas turbine washing	10
	Firewater system testing	50
CSG2	Potable water	3415
	Utility stations	20
	Gas turbine washing	10
	Firewater system testing	50
PRMS	Potable water	620

Monitoring and maintenance of the water treatment facilities (see Section 5.5.5) will be integrated with the existing SCP Georgia emission management procedures (OP42). Additional tertiary treatment shall be investigated at CSG2, including reed beds, to identify a solution suitable for the climatic conditions (D6-04).

The following design features will be in place at each of the facilities to help avoid the release of fuels and chemicals into site wastewater:

- The diesel storage tank at construction camps and CSG2 will be located in suitably sized bunded areas that are designed to be impervious to water and fuel. The bund volume will be designed to no less than 110% of the tank volume. Loading and off-loading connections will be located over secondary containment (7-10).
- At CSG2 rainwater from the diesel storage tank bund will be manually drained and routed to the storm water drainage system via an oily water separator (OP02).
- After visual inspection and sampling of water (if required, to determine it meets the Project standards), the oily water separator water will be discharged directly in to the environment (OP03).

- Hazardous chemicals will be securely stored on site in special containers in a designated storage area (7-11).

Regular inspections and maintenance will be carried out of secondary containment areas at camps and Facilities and emissions control techniques at Facilities, to confirm they are functioning effectively (7-12).

Control systems

The control systems for the SCP pipeline will be expanded to control the facilities. CSG1 and CSG2 will be operated primarily from the main control room at Sangachal Terminal, but they will have local emergency shutdown (ESD) and safety systems that will not rely on telecommunication from Sangachal to operate. The main control room will use an integrated control and safety system (ICSS) to monitor the status of process systems (i.e. turbines, compressors and fuel gas supply systems).

Utility systems at the facilities (e.g. power generators, nitrogen package, instrument air) will normally operate in 'station control mode' and be monitored and controlled by an ICSS operator at the facility. If a turbine compressor drive has to be taken offline or started up, process systems at the facility may be switched to 'station control mode' and operations will be controlled from the station control room at the facility. While maintenance and repair work is carried out on a particular piece of process equipment, it may be operated in 'local control mode' from control panels on the device itself, while the facility is in 'station control mode'.

The pipeline and facility control systems are discussed in more detail in Section 5.8.5.

Emergency response

The existing SCP pipeline has a Government-approved emergency response plan (ERP), which will be updated to integrate the SCPX pipeline and the new facilities before they become operational (OP128). In accordance with Appendix 4 Clause 3.6 of the HGA, the revised ERP will be submitted to GOGC (representing the Georgian Government) (OP129).

All personnel are required to understand their roles and responsibilities described in the ERP and undertake training and instruction as necessary to ensure that they are competent to carry out their roles and responsibilities. Regular drills, musters and training are detailed in the annual emergency response exercise programme that will be updated to include SCPX-specific training and emergency drills (OP130).

5.8.3 Estimated Waste and Emissions from Facility Operation

Table 5-16 presents the estimated annual fuel gas consumption and atmospheric emissions from running the compression turbines, power generation turbines and water bath heaters at the Facilities and the thermoelectric generators at the pigging station. It presents also the expectations for venting of pipeline gas at the facilities and for the fugitive losses of pipeline gas at each facility.

At each manned Facility along the pipeline, emergency depressurisation systems are included in the design. This allows the operator to vent (a manual operation that the operator initiates) all the facility or isolated sections of the facility (e.g. single compressor train) in a controlled manner to 7 barg. The design ensures that venting to the 7 barg pressure occurs within 15 minutes, operations may then choose to continue venting to reach atmospheric pressure. This would add approximately another 25 minutes, making an approximate total depressurisation time of 40 minutes. The emergency venting of the entire facility is a worst-case scenario (i.e. total facility blowdown).

For routine maintenance events (e.g. compressor train break for corrective maintenance) the equipment will be sectionalised by isolation valves and blowdown of the smaller sections will occur. The duration of the blowdown would remain the same, but the volumes would be significantly smaller.

Table 5-16: Estimated Annual Emissions from Facility and Pipeline Operation[1]

Source	Gas use as fuel or direct emission (tonnes*)	Emissions (tonnes*)					
		CO_2	CO	NO_x	CH_4	VOC	N_2O
CSG1							
Compressor turbines	90,800	249,800	2000	392	84	3	20
Power generation turbines[1]	152	419	0.5	1	0.1	-	-
Water bath heater	1,100	3,000	0.1	3	0.1	-	0.2
Vent	201	1	-	-	175	24	-
Fugitive emissions	984	6	-	-	855	-	-
Sub-total	93, 200	253,200	2,000	396	1,100	27	20
CSG2							
Compressor turbines	93,700	257,800	2600	299	86	3	21
Power generation turbines	9200	25,400	28	67	8	0.3	2
Vent	159	1	-	-	138	19	-
Fugitive emissions	984	6	-	-	855	-	-
Sub-total	104,100	283,200	2600	367	1100	23	23
PRMS							
Power generation engines[1]	24	65	-	1	-	-	0
Water bath heaters	2000	5500	1	5	0.2	0	0.4
Vent	58	0.3	-	-	51	7	-
Fugitive emissions	32	0.2	-	-	28	-	-
Sub-total	2114	5566	1	6	79	7	0.4
Pipeline							
Pipeline fugitive emissions	3	0.1	-	-	3	-	-
Pigging Station	108	310	0.3	0.6	-	-	-
Sub-total	111	310	-	-	3	-	-
Total	199,525	542,300	4,601	770	2,282	57	44

* data rounded to the nearest 100 when greater than 1000 tonnes
[1] Assuming approximately 87% of Georgia's electricity is generated from hydroelectric power (IEA, 2011).

[1] The emissions figures in this table are estimates, which are based on the information available at the current stage of the Project design and assumptions regarding operational regimes, which are used for the potential Project impacts assessment. Maximum allowable mass emissions will be agreed with the MoE, as applicable, following national permitting requirements.

Total emissions are currently estimated at 599,500[2] tonnes of direct CO_{2eq} emissions per year plus 4,000 tonnes of indirect CO_{2eq} emissions per year (from the grid electricity supply), totalling 603,500 tonnes of CO_{2eq} emissions per year .

The stand-by generators at the facilities will run on diesel and largely will only be used in an emergency when gas turbine powered generators have to be shut down (D5-094), so these have not been included in the above estimate.

Table 5-17 presents the total annual waste generation during the operations phase from the Project.

Table 5-17: Annual Operations Phase Waste Estimates

SCPX Annual Operational Waste Estimates	Unit	Total	Non-hazardous	Hazardous	Liquids
General Waste	tonne	205	x		
Food waste	tonne	12	x		
Plastic bottles	tonne	16	x		
Paper/cardboard	tonne	17	x		
Glass	tonne	8	x		
Metal	tonne	6	x		
Wood	tonne	8	x		
Fibreglass	tonne	6	x		
Air filters	tonne	19	x		
Used oil	m^3	1		x	x
Oily cans	m^3	5		x	
Hazardous/oily drums	m^3	7		x	
Used antifreeze/glycol	m^3	5		x	x
Chemicals and lubricants	m^3	2		x	
Empty cylinders	m^3	1		x	
Dry-cell batteries	m^3	3		x	
Fluorescent lights	m^3	1		x	
Paints, paint sludge	m^3	1		x	
Used cartridges	m^3	0.2			
Other hazardous solids	m^3	15		x	
Concrete	m^3	1	x		x
Waste water	m^3	1385		x	x
Sewage sludge	m^3	295		x	x
Medical waste	m^3	0.03		x	

5.8.4 Pipeline Operation and Maintenance

As per the existing 42” pipeline the 56” pipeline will have cathodic protection from corrosion, and gas pressures and flow rates in the pipelines will be monitored to detect leakage.

[2] Total rounded up to the nearest 500 tonnes

The Pipeline Integrity Management System (PIMS) for the SCP pipeline will be extended to cover the SCPX pipeline loop. PIMS provides for:

- Identification of areas of third party damage or potential damage
- Detection of corrosion
- Location of areas of ground movement and mechanical damage
- Identification of building activity in the pipeline protection zone.

Under PIMS, a comprehensive pipeline inspection and maintenance programme provision for active pipeline surveillance, planned maintenance of the AGIs, emergency maintenance of the pipeline and repairs is undertaken.

The entire pipeline will be walked or ridden periodically to provide assurance that no unauthorised activities are taking place that could damage or otherwise affect the integrity of the pipeline. Sensitive sections of the pipeline will be patrolled at the highest frequency (OP20) and the condition of marker posts, ground cover and road, rail, and river crossings will be recorded.

When the 56”-diameter pipeline is operating, regular patrols of the pipeline by ROW horse patrols, vehicular patrols (using existing access tracks) and security patrols will lessen the risk of third-party interference (OP121). ROW patrols will monitor river crossings to provide assurance of the integrity of any river protection works and riverbanks. This will include a visual inspection for riverbank erosion or changes to channel morphology (OP131).

In-line inspection pigging operations will be carried out on a regular basis to provide information on the line integrity (OP132). As they travel along inside the pipeline, the intelligent PIG applies a strong magnetic field to the pipeline wall and its sensor detects changes in the induced magnetic field of the pipeline wall. Under normal circumstances, for a uniform pipe, the sensor will detect a uniform response, but where metal has been lost from the pipe, the intelligent pig will detect magnetic flux losses and its integral computer will record them as material defects, wall thickness changes or corrosion. Intelligent pigs are able to locate the damage to within 1.5m. This enables the integrity of the entire underground pipeline to be mapped.

If inspections, pigging and surveys indicate that remedial works or pipeline repairs are needed, the mobile pipeline maintenance team will plan and carry out the necessary tasks.

The Project will maintain liaison with all landowners along the pipeline route and with authorities and utility companies to track proposals for third party building activities that could affect the pipeline (OP133). The SCPX Project will inform the relevant authorities in the case of planned or actual third-party development within the relevant pipeline and facility protection zones (OP125).

5.8.5 Pipeline and Facility Control Systems

Integrated control and safety system (ICSS)

The existing ICSS system will be upgraded and expanded to cover the SCPX pipeline and facilities. The system monitors the entire pipeline using equipment which implements control at CSG1 and 2, PRMS and all block valve stations. The ICSS measures process parameters including flow rate, pressure and temperature, and controls these parameters within the system’s acceptable operating conditions.

The ICSS will be designed and configured to maximise availability for critical process and safety functions with the use of redundancy within communications, processing, power and field cabling diversity to avoid single point failures.

The ICSS system includes the process control system, the emergency shutdown system and the fire and gas detection system.

Emergency shutdown (ESD) systems

The two compressor stations and the PRMS will include ESD systems that automatically and autonomously ensure station safety.

The objective of the ESD system will be to avoid any harm resulting from hazardous situations and to reduce the consequences of such an event on the pipeline or surrounding environment.

The ESD systems will be functionally and physically independent from the process control system (PCS) taking predefined safety actions in the event that the ESD system detects abnormal conditions via fully independent dedicated ESD field instrumentation.

Leak detection system (LDS)

The existing leak detection system will be updated with the latest hardware and software and will be configured to cover the expanded pipeline and facilities. The system operates independently from the above systems but uses available pressure, temperature and flow measurement data from the ICSS.

The system includes online and offline computer models of the pipeline, and a statistical leak detection system. The system alerts the operator in case of unacceptable deviations and possible leaks but does not initiate a shutdown or have any other control or executive actions. The decision on how to proceed in the event of a suspected leak being detected is taken manually by the operations team.

The philosophy for the new LDS will be the same as defined for the original system as detailed below.

The LDS will be capable of continually monitoring the pipeline to high accuracy and with a high confidence level.

The LDS will interface with the Project ICSS at the Sangachal pipeline control centre. Integration of the LDS into the ICSS will be operationally seamless, with all the dynamic variables used in the system being secured from data transfers via the ICSS dual redundant communications network.

The LDS will provide:

- Suspected leak alarms
- Location of leaks.

Communications systems

The existing SCP and BTC pipelines share a dedicated telecommunications system based on a multi-core fibre-optic cable (FOC) placed within a high-density polyethylene (HDPE) conduit that is installed alongside the buried BTC pipeline, in the same trench.

The ICSS will communicate with the block valve stations and AGIs through the existing optical fibre communications network.

In the event of optical fibre communications failure, stations will continue to operate in stand-alone mode retaining previous set points, and critical pipeline data will be transmitted between relevant sites via dial up telecommunications.

In addition to providing ICSS communications, the telecommunications systems provide voice, data and security services. The FOC is fully backed up via a satellite communications system. The existing voice, data and security telecommunications system will be upgraded for the new and expanded SCPX stations.

5.9 Decommissioning

5.9.1 *Decommissioning of SCP Facilities*

SCP Area 72

Owing to the construction of CSG1, with the new Georgian offtake and pressure reduction and metering facilities, the existing SCP offtake and metering facilities at Area 72 are not likely to be required. The redundant equipment at Area 72 is therefore likely to be decommissioned and the following above-ground equipment may be removed.

- Pig receiver and pig launcher
- Georgian offtake and cross-border filters and metering
- Georgian offtake water bath heater (drained of the glycol and water mixture)
- Fuel gas and nitrogen supply
- Service water and vent systems.

Underground pipework will remain in place after isolation, draining (if required), purging and capping. All aboveground civil structures will remain including fencing, roads, kerbs, storm drains, pipe supports and equipment bases. All underground electrical and instrumentation cables will be disconnected, weathered and earthed, and decommissioned. The site perimeter lighting and security systems will remain in operation.

At Area 72, the section of SCP pipeline under the road will be cut either side of the crossing, injected with suitable grouting and capped to prevent collapse (DE-01). The glycol and water mix drained from the Area 72 water bath heater during decommissioning will be disposed of in accordance with the Project waste management plan (DE-02).

An environmental risk assessment will be undertaken prior to decommissioning of Area 72 to identify the potential environmental risks, including to soil and groundwater. The mitigations developed will be incorporated into the Decommissioning plan (DE-03). Scrap metal removed from Area 72 will be sent to recycling facilities where available (DE-04).

5.9.2 *SCPX Decommissioning*

Legal basis

The HGA requires the SCP Partners to submit an abandonment plan at the end of the agreement period, which describes the proposed action in relation to:

- Removal of all surface installations
- Disconnection of the pipelines from supply of gas, and abandonment in place or removal where abandonment causes a risk to the environment
- Filling all abandoned underwater pipelines with water or inert material and sealing the ends
- Re-vegetation of the pipeline corridor consistent with the terrain features and other prevailing conditions.

Within 30 days of termination of the Host Government Agreement a plan must be prepared describing how abandonment will be achieved. This abandonment plan will be subject to approval by the Government. An ESIA will be prepared prior to implementation of the abandonment plan to assess and minimise potential environmental and social impacts arising from the abandonment operations. This abandonment ESIA will be submitted to the Government (DE-05).

Upon completion of the abandonment operations an assessment of contaminated land will be prepared recording the final contamination status of the location of the Project facilities. This assessment will be subject to governmental approval (DE-06).

The exact details of how facilities will be abandoned will be determined prior to abandonment, and agreed with the Government. Therefore, it is not possible to determine at this stage exactly what techniques will be used. However, these will be in accordance with recognised international standards.

5.10 Conclusion

This chapter has described the activities proposed to be carried out for the Project and has presented current estimates for fuel use and atmospheric emissions, water use and waste generation.

The aspects of the Project as described here that can impact on the environmental and socio-economic conditions are identified and assessed in Chapter 10 and 12 of the ESIA.