Chapter 7 Environmental Baseline

TABLE OF CONTENTS

Tables

Figures

Photographs

7 ENVIRONMENTAL BASELINE

7.1 Introduction

This section of the ESIA presents information on the baseline condition of the physical and biological environment within the proposed SCPX Project area. This information is also presented in the Environmental and Social Baseline Report (ESBR) for the proposed SCPX Project (RSK, 2011), and where appropriate this chapter contains references to data appendices from the ESBR. This section covers the following topics:

- Geology, geomorphology and geohazards
- Soils and ground conditions
- Landscape and visual receptors
- Surface water resources
- Groundwater resources
- Ecology
- Climate and air quality
- Noise
- Archaeology and cultural heritage.

This chapter also contains a summary of the key environmental sensitivities for the proposed SCPX Project. Figure A7-1 (Environmental Constraints Maps) within Appendix A highlights the location of key environmental sensitivities as described in this chapter.

Within this chapter reference is made to temporary camp and pipe storage areas that have been considered as part of the proposed SCPX Project. The sites that were initially selected for further investigation, including desktop study and field surveys, were subjected to a review against a new philosophy that gave increased priority to safety (primarily the avoidance of road accidents) and construction logistics (in particular optimising site selection in relation to access to the ROW).

Following the Project review, several of the sites discussed within this chapter were subsequently rejected and have not been progressed. A list of the current proposed camp and pipe storage areas that are still being considered can be found in Chapter 5. Temporary sites identified but later rejected are identified below with an asterix (*) and sites selected for acquisition and development have no asterix.

7.2 Geology, Geomorphology and Geohazards

7.2.1 Introduction

This section describes the geology, geomorphology and geohazards that may be crossed by the proposed South Caucasus Pipeline expansion (SCPX) route. Although no significant changes or impacts from the Project are to be expected on the geology of the area, it is possible that geological processes and geological hazards could cause events that may have an impact on other areas of environmental significance or on the Project itself. The aim is to understand baseline conditions prior to construction.

The methodology used to achieve the above aims will be described and the following will be reviewed:

- Underlying geology
- Drift geology

- Geohazards, including seismicity and terrain hazards
- Economic geology
- Geomorphology and topography.

The key sensitivities will then be summarised.

7.2.2 Methodology

7.2.2.1 Data sources

The information included in this section has been collated from several sources. Owing to the similarities between the proposed route and the Western Route Export Pipeline (WREP), Baku–Tbilisi–Ceyhan (BTC) pipeline and South Caucasus Pipeline (SCP), some of these reference sources were originally produced in connection with the original surveying for WREP and BTC/SCP. The sources that have been used in producing this section are outlined below:

- Baseline survey of those areas where the proposed BTC/SCP route deviates significantly from the WREP, undertaken by AETC on behalf of BP, January–February 2001
- Rapid reconnaissance survey of the WREP undertaken by Environment Resources Management (ERM) on behalf of BP, August/September 2000
- Baseline data acquisition for BTC/SCP ESIAs undertaken by AETC on behalf of BTC Co. and SCP Partners, 2001
- ABS International (EQE), Shah Deniz Gas Export Project, Seismic Hazard Assessment and Engineering Recommendations, 2001
- Results of Shah Deniz midstream geotechnical investigations (Gibb), 2001
- Baseline survey of WREP undertaken by AETC on behalf of Azerbaijan International Operating Company (AIOC) as part of the Environmental Impact Assessment of the WREP Azerbaijan, 1997
- Supplementary details and clarifications provided by Dr R Mamadov in meeting with Dr Heike Pflasterer held in Baku for WREP project, February 1997
- Supplementary details provided by Prof. G. Yagubov in meeting with Dr Heike Pflasterer held in Baku for WREP project, February 1997
- Literature review on contamination along the WREP corridor by Dr R. Mamedov, Scientific Center ‘Nafta’, Institute of Geology, December 1996
- Review of Publications on Geomorphology and Relief Along the Western Pipeline Route, 1996
- Mamedov, G.Sh. and Yagubov, G. Sh., Review of Publications on Soil Cover Along the Western Pipeline Route, 1996
- Review of Publications on Geology along the Western Pipeline Route, 1996
- Literature review on soils and agrochemistry along the WREP corridor by Prof. G. Yagubov, Institute of Soils and Agrochemistry, December 1996
- Soils of Azerbaijan (Map), 1991
- Review of Publications on Geology along the Western Pipeline Route, 1996
- Report on Anthropogenic Impacts on the Seismic Regime, 1995
- USA Uniform Building Code, Volume 2. Structural Engineering Design, 1997
- Seismic Review Report, 2000
- United States Geological Survey (USGS) National Earthquake Information Centre, accessed May 2012
- ESO Earthquake Database, accessed May 2012

- Dynamic prediction and earthquake monitoring – one of possible approaches to decrease the risk for oil and gas pipeline, O.B. Babazade, N.O. Babazade, L. Griesser and B. Romanov, The 14th World Conference on Earthquake Engineering, 2008.

In addition to the above, further information was also made available by BP and through online searches, as detailed below:

- Azerbaijan Borrow Pits Status Report, undertaken on behalf of BP as part of the BTC/SCP project, construction phase, December 2004
- Mineral extraction in Azerbaijan (Map), Ministry of Ecology and Natural Resources Azerbaijan, 2011
- Topography of Azerbaijan (Map), Ministry of Ecology and Natural Resources Azerbaijan, 2011
- WolframAlpha, "Earthquakes in Azerbaijan", http://www.wolframalpha.com/input/?i=earthquakes+in+azerbaijan, accessed May 2012.

7.2.2.2 *Assessment of importance and sensitivity of geology*

An assessment has been made of the importance of geology along the proposed pipeline route and the potential sensitivity to change. As a result, the importance and sensitivity of geology has been classified into categories that range from very low to very high. Information on this process is given in Chapter 3 (Approach and Methodology).

7.2.2.3 *Technical difficulties or uncertainties*

Some of the information used here was acquired over ten years ago. However, geological conditions are unlikely to have altered significantly since this data was produced and, as such, a reasonable level of confidence can be placed in these sources of data.

7.2.3 Underlying (Solid) Geology

The area along the proposed pipeline route, from close to Hajigabul in the east to the Georgian border in the west, is located along the southern extension of the Greater Caucasus mountain range at a distance of approximately 60–70km. The formation of the Caucasus is associated with the Alpine-Himalayan orogenic belt, which originated because of the closure of the Tethys Ocean and the subsequent collision of the Eurasian continental plate with the African and Indian continental plates.

The regional structure is dominated by compressional deformation of sedimentary rock, which led to the formation of nappes verging towards the south-east. There was some volcanic activity during this long period of compressional tectonism. Thrust faulting in the Late Miocene period lifted Jurassic and Cretaceous rocks over the Pliocene deposits of the Greater Caucasus. Associated fault zones are located along the margins of this zone and have been a focal point for seismic events. Of particular importance are vertical faults orientated in a north-east–south-west direction, which also led to block faulting of the basement.

The area to the south and north of the Caucasus extension is dominated by Oligocene to Quaternary age sediments. These are relatively flat lying in the north (mainly Quaternary) while in the south they have been subjected to minor folding events, which have exposed Oligocene and Quaternary rocks at the surface (as shown in Table 7-1).

The whole area has been subject to much tectonic activity and the proposed pipeline route crosses an active seismic area where fault-related earthquakes up to intensity 8 on the Richter scale occur, principally between Hajigabul and Borsunlu. Relatively recent (Cretaceous, Tertiary and Quaternary) sedimentary rocks are divided into several tectonic units by a number of active fault zones.

Highly folded and faulted sedimentary rocks (sandstones, clays, marls, schists and limestones) dating back to the Jurassic are intruded by volcanics. The tectonic units and associated faulting found along the proposed pipeline are indicated in Figure 7-1.

Table 7-1: General Stratigraphic Column of Sedimentary Rocks along the Proposed Pipeline

Era	Period	Division
Cenozoic		Recent (QIV)
	Quaternary	Late (QIII)
		Middle (QII)
		Early (QI)
		Late (N2)
	Pliocene	Middle (N2)
	Neogene	Early (N2)
		Late (N1)
	Miocene	Middle (N1)
		Early (N1)
	Oligocene	Late (P3)
	Palaeogene	Early (P3)
	Eocene Palaeocene	(P2) (P1)
Mesozoic		Late (K2)
	Cretaceous	Early (K1)

The proposed pipeline corridor passes through several tectonic units, which are separated by major faults. These units are from east to west:

- Lower Kura Depression
- Kurdemir – Saatly Uplift Zone
- Yevlakh – Agdjabedi Basin
- Pre-Lesser Caucasian Side Range (Monocline)
- Shamkor Anticline
- South side of Yuri–Adjinour Trough
- Mega-Anticline of Lesser Caucasus.

The major fault zones that separate the tectonic units are:

- Yashma Flexure
- Agichay–Alyat Fault (Jurassic–Neogene)
- Western Caspian Fault (Jurassic–Neogene)
- Mingechevir–Lenkoran Fault
- Kura Fault (Jurassic–Palaeogene)
- Pre-Lesser Caucasian Fault (Jurassic–Palaeogene)
- Ganjachay–Alazan Fault
- Gazakh–Signakh Fault.

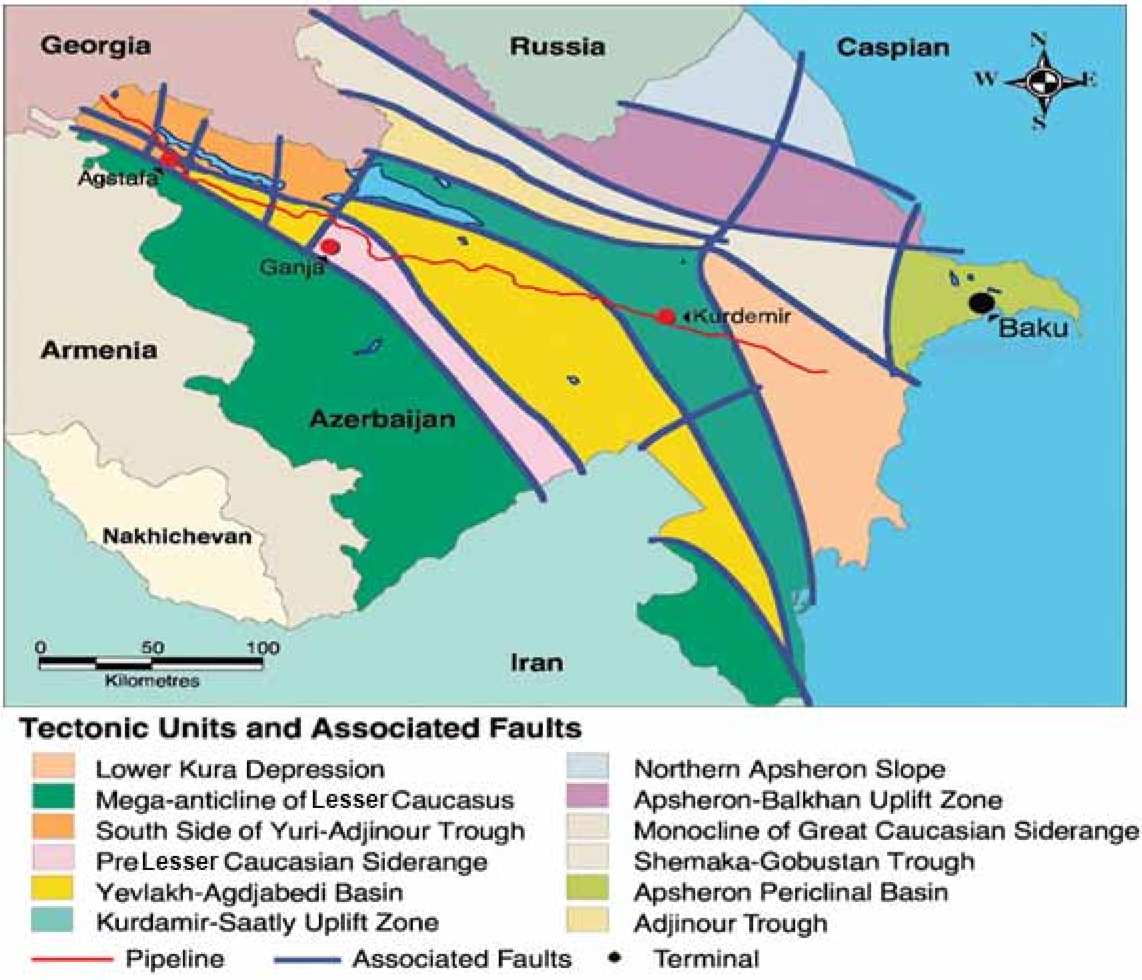


Figure 7-1: Tectonic Units and Associated Faults along the Proposed Pipeline

The geology of the proposed pipeline corridor can be divided into two distinct terrains. From east to west these are:

- Hajigabul to Borsunlu (KP0–217)
- Borsunlu to the Georgian border (KP217–390).

The geological setting of each of these areas is described in turn below.

7.2.3.1 Hajigabul to Borsunlu (KP0 to KP217)

In the Hajigabul to Borsunlu section (see Figure A7-1, Appendix A) the proposed pipeline crosses the Lower and Middle Kura Depression, which is a vast alluvial/proluvial plain. The sedimentary cover of the mesozoic basement reaches 5000m thickness and is composed of Palaeogene and Neogene aged deposits. The Quaternary sediments have a thickness of 800–1400m. A subsidence rate of up to 5600m is recorded for the Middle Kura zone and 1600m for the Lower Kura zone. Tectonics in this section are difficult to assess, although smaller tectonic structures such as the Naftalan and Khasanbulag Anticlines reveal fold structures. Deep-seated faults are located at a depth of 3–7km and have a north–south or north-west–south-east direction. They are not cutting through sediments of Pliocene to Quaternary age, but are a source for seismic events such as the Western Caspian Fault, which is situated at a depth of 3–3.5km. The amount of dislocation along these faults is uncertain and it is unclear whether some of the faults are still active. Furthermore, a magma chamber has been identified which is causing bulging of the Mesozoic basement.

7.2.3.2 Borsunlu to the Georgian border (KP217 to KP3890)

In the Borsunlu to the Georgian border section (see Figure A7-1, Appendix A) the proposed pipeline corridor is located within a narrow band of the Kura River alluvial plain, the continuation of the Middle Kura zone, situated between the Greater Caucasus in the north and the Lesser Caucasus in the south. Smooth, Quaternary anticlinal structures, with an altitude of 400–600m have developed due to the tectonics of the Lesser Caucasus. They expose rocks of Middle to Upper Jurassic, Upper Cretaceous and Neogene to Palaeogene age, which have a varying lithology (e.g. carbonates, intrusives and volcanics). The proposed pipeline corridor is located approximately parallel to the Pre-Lesser Caucasian Fault, which affects Jurassic to Palaeogene sediments and forms the southern border between the alluvial plain and the Lesser Caucasus. The northern boundary is formed by the Kura Fault, which cuts through Jurassic to Palaeogene formations. The tectonic setting is complicated with faulting of various orientations and magnitude. The Mesozoic basement is block faulted and the overlying geology, of Cretaceous to Palaeocene age, has also experienced intense fault formation (overthrusts, reverse faults, etc.) that are today hidden under the Quaternary cover. Remote sensing and geophysical data reveal transversal faults along the river valleys coming from the north-eastern slopes of the Lesser Caucasus. However, no information is available about the amount of displacement along these faults.

7.2.4 Drift Geology

Drift geology is the unconsolidated sediments above the underlying geology, at or near the earth’s surface, which undergo a certain amount of movement through glacial, fluvial, aerial or mass movements.

Borehole and trial pit logs from the Shah Deniz midstream geotechnical investigations (Gibb, 2001) have been examined. The assessment is based on the zone from 1 to 4m depth and indicated the following:

- Subsoil to the east of the Kura River crossing near Yevlakh is largely comprised of fine-grained silts and clays with subordinate sands
- West of Yevlakh, and especially west of Shamkir, the subsoil becomes more frequently sandy, gravelly and cobbly
- In the Ganja-Gazakh Plain and the Garayazi section, there are locations where a superficial layer of silty or clayey material several metres thick appears to be present, although not consistently
- It is notable that, east of Ganja, it was typically not possible to identify a clear massive sand/gravel aquifer unit within the depth of the borehole
- West of Ganja, an "unconfined" sand/gravel aquifer unit becomes more readily identifiable (especially in major river valleys), either with or without any protective superficial layer. However, even here, in a significant number of localities, a clearly identifiable aquifer unit was not identified within the depth of the borehole.

7.2.4.1 Grain size distribution

Grain size analyses from samples from the boreholes and trial pits of the Shah Deniz midstream geotechnical investigations (Gibb, 2001) have been examined.

The grain size analyses suggest that such gravelly deposits as encountered in boreholes and trial pits in the Yevlakh, Agstafa and Garayazi areas are generally rather poorly sorted, with d60/d10 ratios in the range 10 to >100. Occasionally, better-sorted coarse-grained gravels occur, with d60/d10 ratios in the range 2–10 and very high calculated values of hydraulic conductivity, especially within the valleys of the Tovuzchay and Shamkirchay.

Figure 7-2 and Figure 7-3 show grain size analyses for samples of gravels and silts/clays with rather typical estimated values of hydraulic conductivity (with the exception of BH-A61/B4, which comprises very coarse gravels in the Tovuzchay valley, yielding an extremely high value of conductivity).

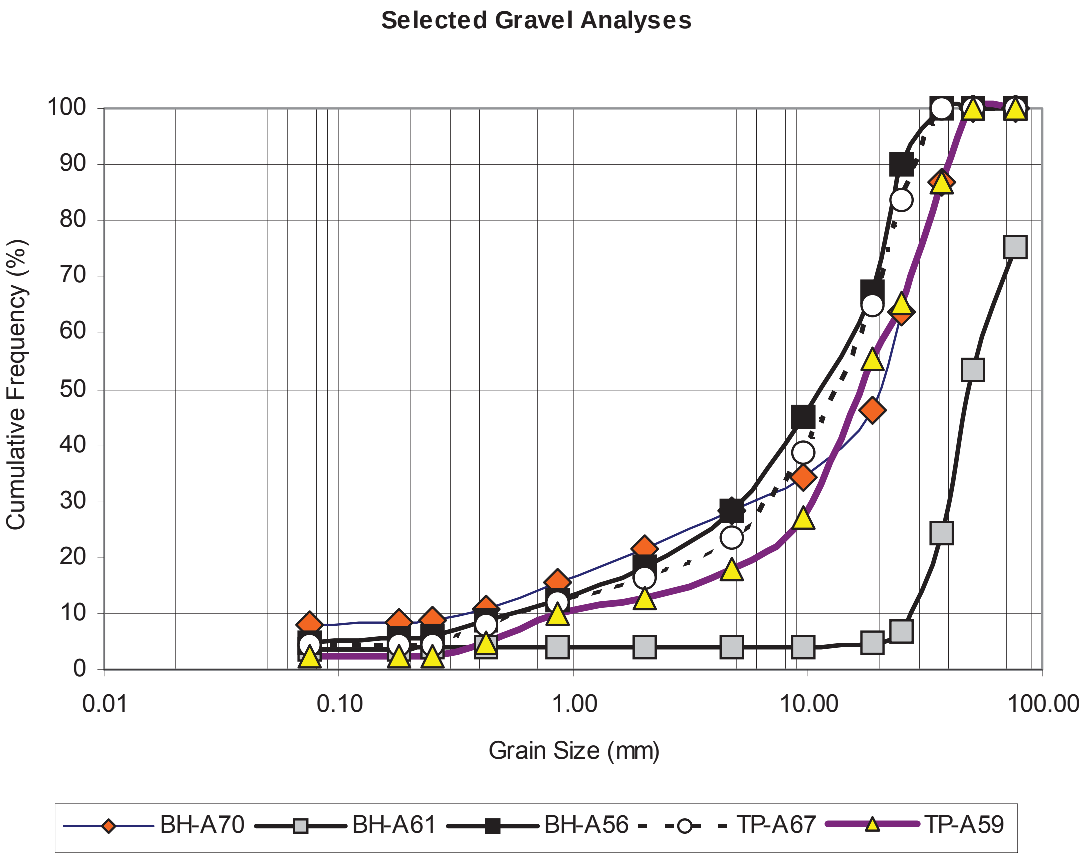


Figure 7-2: Grain Size Distribution Curves for Five Selected Samples of Gravel

Notes: (i) Borehole BH-A70, sample B2 (4–5m depth), Garayazi, nr. Kechveli, estimated K = 70m day^{-1}, (ii) Borehole BH-A61, sample B4 (6.5–8m depth), River Tovuzchay, estimated K > 1000m day^{-1}, (iii) Borehole BH-A56, sample B1 (0–0.75m depth), near the Zeyamchay, estimated K = 190m day^{-1}, (iv) Trial pit TP-A67, sample B1 (0.2–1m depth), near Hasansu, estimated K = 290m day^{-1}, (v) Trial pit TP-A59, sample B3 (1.1–3.1m depth), between Zeyamchay and Tovuzchay, estimated K = 390m day^{-1}.

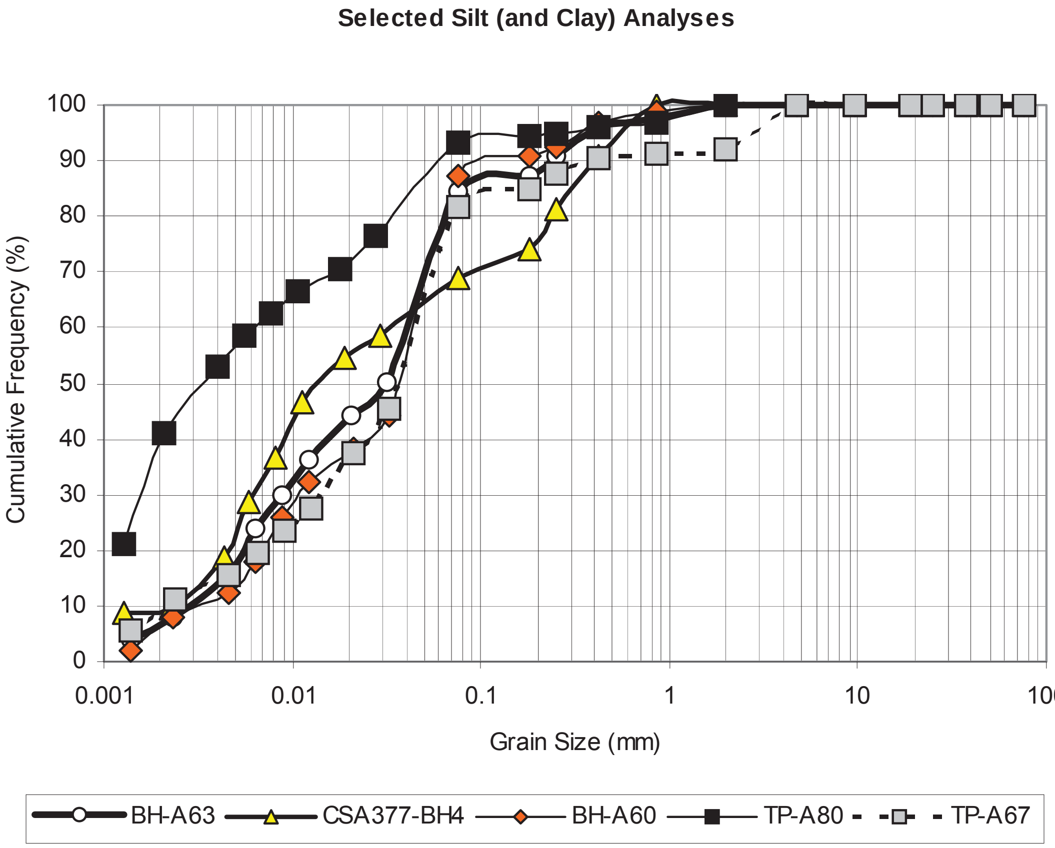


Figure 7-3: Grain Size Distribution Curves for Five Selected Samples of Silt/Clay

Notes: (i) Borehole BH-A63, sample UD3 (silt, 4–4.5m depth), SW of River Hasansu, estimated K = $5x10^{-8}$ m/s, (ii) Borehole CSA377-BH4, sample B1-2 (silt, 2.5–3m depth), NW of River Tovuzchay, estimated K = $4x10^{-8}$ m/s, (iii) Borehole BH-A60, sample UD1 (silt, 2.5–3m depth), near River Tovuzchay, estimated K = $7x10^{-8}$ m/s, (iv) Trial pit TP-A80, sample B1 (clay, 0.15–1.05m depth), near Boyuk Kasik, Garayazi, near Georgian border, estimated K = $8x10^{-9}$ m/s, (v) Trial pit TP-A67, sample B2 (silt, 1.3-2.2m depth), near Hasansu, estimated K = $3x10^{-8}$ m/s.

7.2.5 Geohazards

A geohazard can be defined as a geological state that represents or has the potential to develop further into a situation leading to damage or uncontrolled risk. Geohazards are widespread phenomena that are related to geological and environmental conditions and involve long-term and/or short-term geological processes. Geohazards can be relatively small features (e.g. minor rock slides), but they can also attain huge dimensions (e.g. submarine or surface landslide). In addition, human activities (for example, drilling through geohazards like overpressured zones) could result in significant risk. As such, improved understanding of geohazards and their preconditions, causes and implications is paramount in identifying and implementing appropriate mitigation measures.

Pipelines can often be exposed to a range of geohazards including the following, which require mitigation through design, including pipeline routing, design materials and construction techniques:

- Seismic activity
- Ground subsidence and settlement
- Erosion events

- Landslides.

Geohazards associated with the proposed SCPX route are discussed below.

7.2.5.1 Seismicity

Much of the seismic information included in this section was gathered during the production of the Seismic Review Report (August 2000) carried out for the BTC pipeline. The main objectives of the document were to summarise the seismic activity in the area through which the BTC pipeline is routed to identify specific risks to the BTC pipeline, facilities and aboveground installation (AGI), and to identify and describe possible mitigation measures for the design and construction of the BTC pipeline. As already mentioned, the proposed SCPX route is very similar to that of BTC and, as such, the findings of the seismic review report have been used here.

In addition to the above, the USGS website was accessed in May 2012 and all earthquakes that have been recorded within a predefined search area (see Figure 7-4) were documented. The search area encompassed the pipeline route and included all earthquake events recorded between 1973 and May 2012.

Azerbaijan, including the regions through which SCPX is routed, is subject to earthquakes, which have the potential to disrupt the pipeline by deforming or shearing the pipe due to ground faulting or flexing.

The region between the Black Sea and the Caspian Sea is part of the central Asian segment of the Alpine-Himalayan foldbelt and comprises the Greater Caucasus fold and thrust belt in the north, and the Lesser Caucasus-Pontides fold and thrust belt in the south. The mountain ranges of the Caucasus were formed by the collision of the African, Arabian and Indian tectonic plates with the Eurasian plate.

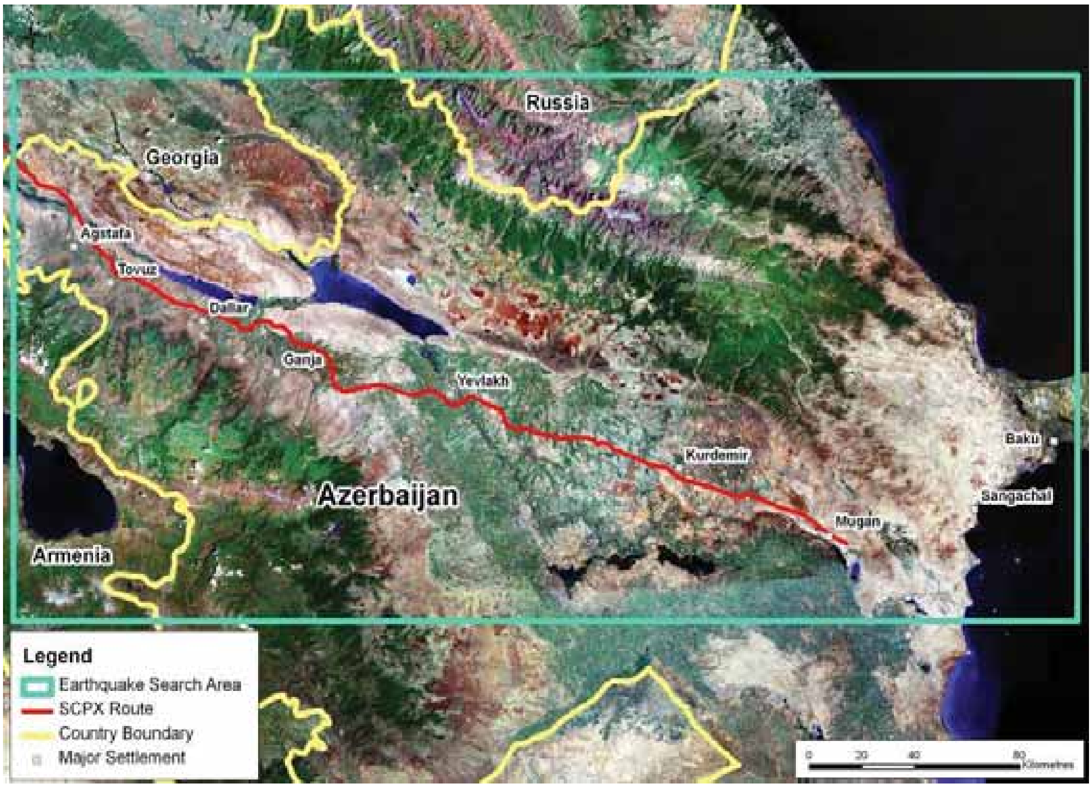


Figure 7-4: Search Area within which all Earthquake Events from 1973 to May 2012 were Reviewed

The Greater Caucasus Mountains are geologically very young, having formed during the Middle Pliocene. The Lesser Caucasus, found to the south, have been folded and thrusted towards the north just east of the Black Sea. Compressional uplift and thrusting separated a once-continuous basin into western and eastern parts, the eastern part of which became the Kura basin.

The eastern and western parts of the Greater Caucasus Mountains are found to differ in structure with respect to trends and seismicity. One of the main distinctions is the presence of intermediate depth earthquakes in the eastern Caucasus at depths of up to 100km. Earthquakes in the western region occur at shallower depths, typically 30km.

Continuing plate convergence means that Azerbaijan experiences high seismic activity. Over 600 seismic events of varying intensity have been recorded since 1600 (Aganirzoyev, 1987; USGS, 2012). Research and monitoring has been carried out to identify general background seismic characteristics, define possible factors that lead to destabilisation of the seismic regime and to determine the degree of seismic danger.

Earthquake severity

The three classes of seismic activity considered here are tectonic, volcanic and artificially induced. The tectonic variety is by far the most devastating and is caused by stress build-up due to movements of the plates that make up the earth's crust. The Caspian is located in a zone stretching from the Mediterranean to the Himalayas that is characterised by tectonic earthquakes.

Data about the severity of earthquakes in Azerbaijan are usually given in energy classes (K), whereas Europeans are used to moment of magnitude scale (MMS, expressed with the unit "M_w"). Both these systems are comparable and describe the energy at the source of an earthquake. Intensity figures based on the Richter scale cannot be directly compared, as they relate to surface effects of an earthquake. Many local earthquake reports use units of intensity measured on a scale of 1–12. Intensity is a relative measure of earthquake effect at any given location dependent on the size of the earthquake and the distance from the epicentre. Table 7-2 compares the units that describe the energy released at the epicentre (the focus) of the earthquake.

Table 7-2: Comparison of Energy Classes and Magnitudes of Earthquakes

Energy Class (K)	Moment of Magnitude Scale (M_W)	Intensity (Epicentre)	Description (Intensity)
9	3–3.4	I	Felt by few under especially favourable conditions
10	3.5–3.9	II	Felt by few at rest, especially on upper floors of buildings
11	4–4.9	III	Felt noticeably: houses and cars shake, exaggerated effect indoors compared with outdoors
12	5–5.4	V	Felt by all: windows broken, unstable objects overturned
13	5.5–6	VI	Felt by all: heavy furniture moved, instances of fallen plaster. Damage is slight
14–16	6.1–6.9	VII	Tangible damage to poorly constructed buildings, damage to buildings of good design and construction is negligible
This is beyond recordable	7–7.9	VIII–IX	Can cause serious damage over large areas

Energy Class (K)	Moment of Magnitude Scale (M_W)	Intensity (Epicentre)	Description (Intensity)
range of energy class (K)	8–8.9	X–XI	Can cause serious damage in areas several hundred kilometres across
	9–9.9	XII	Devastating in areas several thousand kilometres across

In Azerbaijan, the highest density of earthquakes occurs approximately 80–100km north of the proposed route in the foothills of the Greater Caucasus, near Shemaka, which in the past have recorded earthquakes up to a magnitude of $9M_w$. The most significant recent earthquake to have occurred in Azerbaijan was in May 2012, which was located in the foothills of the Greater Caucasus, approximately 85km north-east of where the SCPX route passes north of Ganja. The earthquake recorded $5.6M_w$.

Earthquake data from 1960 to 1990 was recorded from the Baku archipelago, near Absheron, indicating numerous earthquakes with energy class (K) up to 11 (up to 4Mw). Seismic events of energy class 12 (K) (5Mw) were recorded in the Lower Kura lowland. Data from 1990 to 1997 indicate the occurrence of events with energy classes (K) of 13 (5.5 Mw) in the coastal part of East Azerbaijan including the Baku archipelago and strong earthquakes in north-eastern Iran. Generally, a zone of earthquakes surrounds a large part of the Southern Caspian (as shown in Figure 7-5). However, most of the strongest earthquakes occur onshore and are associated with tectonic movement in the Caucasus mountain regions. Strong earthquakes with an epicentre further away from the pipeline route can still have strong intensities along the pipeline route, as shown in Table 7-3.

Table 7-3: Intensity of Earthquakes Occurring in Other Areas within the BTC Pipeline Corridor

Location	Year	Intensity on Surface above Epicentre (I)	Intensity Along Pipeline (I)	Distance of Epicentre from Pipeline
Shemaka	1902	8–9	5–6	*c*.35km
Dagestan	1948	7–8	6	*c*.250km
Saatli–Sabirabad	1959	8	8	*c*.25km
Tovuz Region	1962	7–8	7–8	0km
Caspian	1961	8	7	*c*.100km

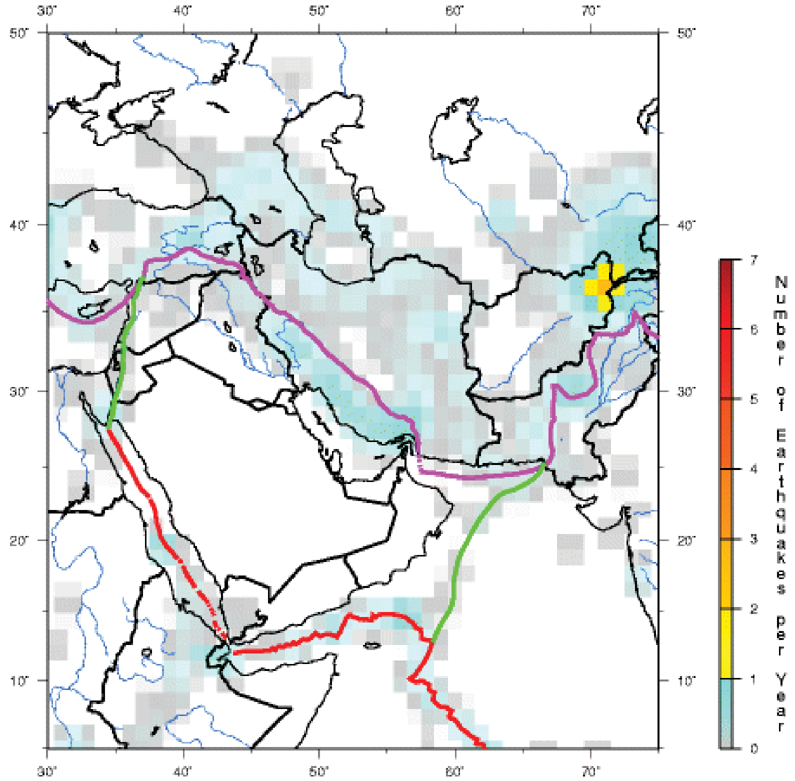


Figure 7-5: Number of Earthquakes per Year, Magnitude 5 and Greater. All Depths (USGS, 2012)

The probability of the occurrence of earthquakes along the Kura trough has been calculated by the Azerbaijan Institute of Geology (see Table 7-4). They also recorded intensities of earthquakes from 1965 to 1994, as shown in Table 7-5.

Table 7-5 has been supplemented with data from the period 1995–May 2012, obtained from the USGS website.

Table 7-4: Probability of Strong Earthquakes in the Kura Trough and the Shemaka–Ismaili Area (calculated per 1000km^2)

MMS (M_W)	Years to Occur
6.7–7.2 (Kura Trough)	10,000
6.7 (Kura Trough)	2000–3000
6.1 (Kura Trough)	800–1000
6.1–7 (Shemaka Area)	15–35

Table 7-5: Severity of Earthquakes Along the Pipeline Route for Different Periods Between 1965 and May 2012

Energy Class (K)	1965–1972	1973–1981	1982–1989	1990–1997	1998–2004	2005–May 2012	Total
9	40	106	45	23	1	3	218
10	17	30	34	17	10	17	125
11	4	9	6	16	23	25	83
12	1	5	-	3	2	1	12
13	-	2	-	-	-	1	3
Total	62	152	85	59	36	47	

Seismicity along pipeline route

Medium-density earthquake zones cover about one third of the length of the proposed SCPX route, with more than 200 epicentres identified within 30km of the route since 1962 (EQE, 2001). Larger earthquakes further removed from the route may still be significant.

The highest densities of earthquake epicentres occur along the proposed SCPX route in a zone from Hajigabul to 25km east of Kurdemir (KP0 to KP51) and for another 15km from Mingechevir (KP188) to Goranboy (KP203), as indicated in Figure 7-6 based on the WREP pipeline route.

Owing to the disproportionate density distribution of the epicentres, three seismic zones can be classified along the proposed SCPX route. These are described from east to west below.

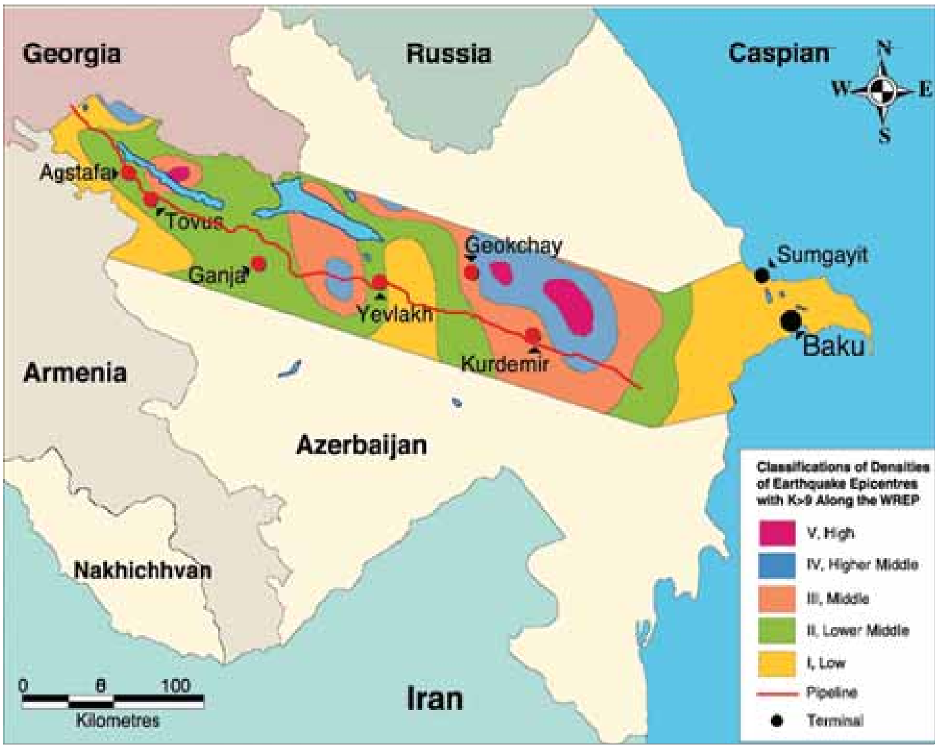


Figure 7-6: Classification of Densities of Earthquake Epicentres of K > 9 Along the Proposed SCPX Route

Hajigabul to Ujar (KP0–122)

Earthquakes of energy class (K) 9–11 are registered in the highly active seismic zone between Hajigabul and Ujar, the boundaries of which are delineated by the fault at Hajigabul and a major fault running parallel to the Kura River from approximately the Karasu River crossing as far as the Georgian border.

Ujar to Yevlakh (KP12–169)

The density of epicentres present in the zone between Ujar and Yevlakh corresponds to a lower to middle density, when compared with other regions, and the earthquakes mainly have energy class (K) values of 9 and 10.

Yevlakh to the Georgian border (KP189–390)

The zone between Yevlakh and the Georgian border is characterised by a more even distribution of epicentres, mainly with energy class values (K) of 9 and 10. However, this section is a zone of high tectonic and seismic activity and the risk of an earthquake affecting the pipeline, by either displacement or landslide, has been investigated during detailed surveys undertaken by seismic specialists prior to the construction of BTC/SCP.

Active fault zones
Within Azerbaijan there are several fault zones and tectonic units. A seismic survey commissioned by BP has identified several major faults traversed by the SCP/BTC pipeline route (EQE, 2001). The sources of earthquakes can quite often be traced to these major faults. The general orientation of active faults is from the north-west to the south-east.

Earthquake intensities (K) in active fault zones are generally considered to be in the range of 8. The highest earthquake intensities are found in areas where known active faults are present. Pipeline failure due to displacement along active fault zones during seismic events cannot be excluded, and the areas of highest activity are located at the eastern and western ends of the pipeline in Azerbaijan. Landslides caused by events of high intensity are possible in the steep, unconsolidated areas of the Lesser Caucasus lowlands. In addition, high-intensity events further away from the pipeline have the potential to indirectly affect the pipeline by causing damage to other structures (e.g. breaching of the Mingechevir water reservoir). Figure 7-7 shows the tectonic regime along the pipeline route.

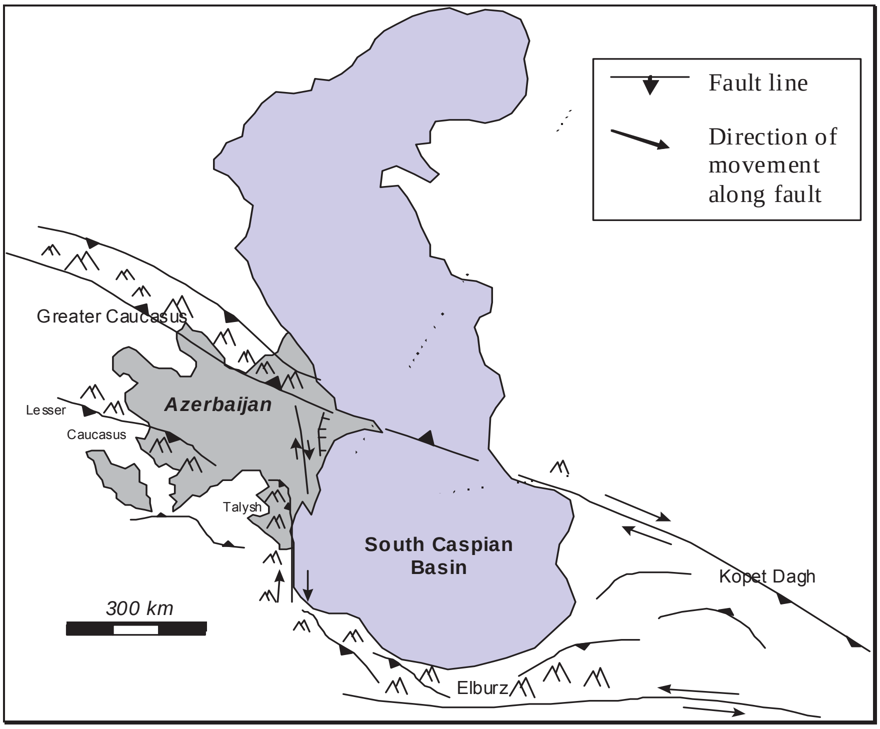


Figure 7-7: Tectonics of the Caspian Region (modified from Allen and Tull, 1997)

Fault identification
A thorough investigation into seismic hazards presented by faults was carried out by EQE International (2001) on behalf of BP Exploration (Shah Deniz) Ltd. The main scope of works was to identify active faults along the BTC pipeline route, characterise them for engineering design purposes and carry out ground-motion hazard assessments.

The Kura Valley, through which SCPX passes for much of its proposed route, is not prone to active tectonic faulting. At both the western and eastern ends of the route, the active geological structures of the Greater and Lesser Caucasus Mountains are encountered.

Where east–west faults are present, the fault type is generally of a compressive thrust nature, while north-east or north-west trending faults exhibit generally lateral strike-slip movements. Thrust faults are typified by one block being forced over the other, with the angle of dip of the fault plane being less than 45°. In strike-slip faulting, the two blocks move laterally past each other. A combination of these two fault types can occur, where blocks involved in thrust faults also move laterally. Thrust faulting and strike-slip faulting are both shown in Figure 7-8.

In many areas, slope instability hazards coincide with active faulting, which suggests that the faulting is at least in part responsible for the presence of slope instabilities.

In March 2011 Tectonic Geologic LLC (seismic and active fault specialist consultant) carried out an assessment on the active tectonic faults crossed by the BTC/SCP pipelines in Azerbaijan and Georgia. This reported that no active faults are present on the proposed SCPX route within Azerbaijan.

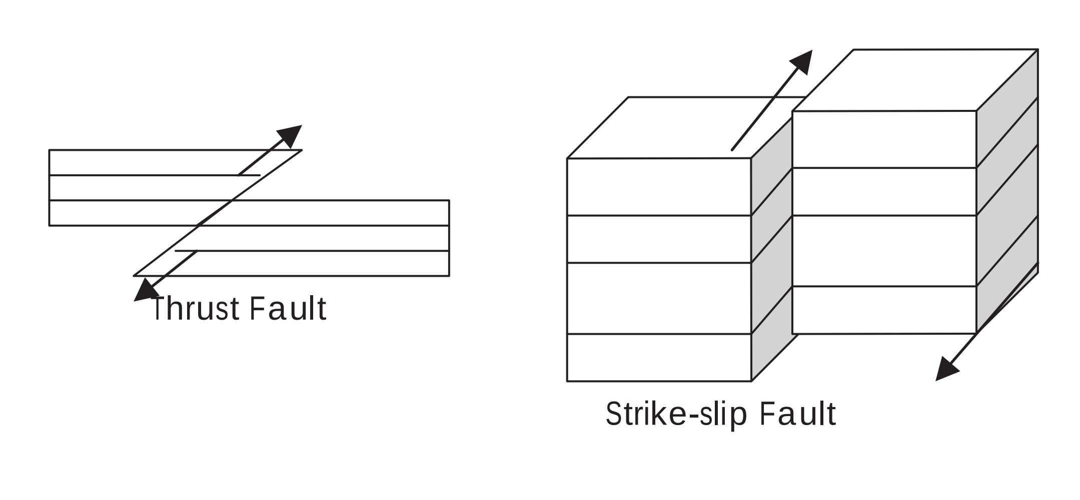


Figure 7-8: Thrust and Strike-Slip Faulting

Soil liquefaction
Tremors during an earthquake can cause the water pressure within sediments to increase to the point at which the soil particles can readily move with respect to each other. This phenomenon is known as liquefaction and may be triggered as a result of seismic activity, and has the potential to cause a pipeline rupture (Babazade et al., 2008). Preferential conditions for liquefaction occur in saturated soils when earthquake shaking or other rapid loading reduces the strength or stiffness of a soil. The area where this is most likely to occur is between the Kura West crossing (KP358) and the Georgian border.

During the course of the review of aerial photographs, an effort was made to identify geomorphic evidence of liquefaction. Soil liquefaction is a concern along the Kura Valley, as overbank sediments are prone to liquefaction and lateral spread during ground shaking. The aerial photographs did not show any evidence of liquefaction in Azerbaijan. The most logical explanation for this is that the poorly sorted deposits of gravel, sand and silt, with a high clay content, are not highly prone to liquefaction. However, analysis based on aerial photographs cannot be considered definitive, and geotechnical sampling and testing has been undertaken that will quantify liquefaction potential and soil susceptibility along the proposed route.

Significant historical earthquakes
The most significant historical earthquake to occur in the Eastern Caucasus region was recorded on 1 January 1668. The magnitude of the earthquake was measured on the uniform MMS to have a magnitude of 7.5M_w. This measurement provides the energy released by an earthquake and is therefore seen to be the most appropriate measure for representing the true force of the earthquake. The area of strongest seismic activity was

located 300km west of Baku in a relatively small area of the eastern Caucasus that has a history of relatively frequent earthquakes. Other major historical earthquakes were registered in both Georgia and Armenia.

The largest earthquake to occur within the SCPX region in recent years took place on 25 November 25 2000, close to the Caspian Sea (USGS, 2000). At least 27 people were killed (3 from the earthquake, 21 from heart attacks and 3 on 26 November from a natural gas explosion from a Soviet-era pipeline caused by the failure of a valve damaged by the main shock) and more than 400 were injured in the Baku area. Some structural damage occurred and utilities were disrupted in the Baku area. The magnitude of the earthquake was recorded as 6.3M_w, with the epicentre located very close to Baku. The effects were felt across Azerbaijan and in Turkmenistan, Russia, Georgia and northern Iran.

Since 1982 the most significant earthquake (>5M_w) to have occurred within 50km of the proposed pipeline route was recorded on 4 June 1999 in the Eastern Caucasus region (WolframAlpha, 2012). The approximate location of the epicentre was greater than 50km to the north of the proposed SCPX route. With a magnitude of 5.5M_w, the earthquake caused up to US$2.5 million damage in the Agdash area of Azerbaijan. The epicentre was registered at a depth of 33km. Fifteen people were injured and approximately fifty houses damaged in the immediate area. Three people were injured at Ujar (a town close to the proposed SCPX route) and several houses damaged at Agali, with the total damage for central Azerbaijan estimated at US$5 million. The effects of the earthquake were felt in parts of Armenia and Georgia and in the Ardabil region of Iran.

7.2.5.2 Terrain

Erosion and soil-related geohazards

Although the majority of the route passes through easily dug soils and rocks, it is possible that in certain areas there will be a requirement for ripping or hammer breaking prior to back-hoe excavation. In addition to this, badlands (highly dissected terrain) are encountered for approximately 30km west of Ganja. Here, a combination of highly erodible, silty clay soils and steep slopes and narrow ridges may lead to severe erosion problems alongside or adjacent to the proposed SCPX corridor. The re-instatement of silt-rich soils that are highly erodible is anticipated to be difficult. The proposed SCPX corridor may be subject to severe erosion events.

See Section 7.3.3.7 for further information regarding erosion susceptibility along the SCPX route.

Terrain-related hydrological geohazards

On the plains to the west of Kurdemir lateral movement of straight artificial channels (canalised rivers and deep drainage canals) also occurs, as they are gradually transformed into meandering channels.

Other hydrological issues include the presence of small soil collapse features, known as sinkholes, which occur frequently along surface drainage lines. Possible impacts resulting from these features include foundation collapse around the pipeline.

Landslides

Landslides in the Azerbaijan region generally occur as a result of rainstorms, earthquakes and various human activities. The greatest potential for landslides to occur would therefore be at the eastern end of the pipeline route, where earthquakes are more prevalent.

Debris flows

Debris flows tend to be rivers of rock, earth and other surface fragments saturated with water. They are caused when water accumulates rapidly in the ground, for example during heavy rainfall or rapid snowmelt, when the earth is changed into a flowing river of mud. Debris flows move rapidly down slopes or through channels. Debris flows can reach several kilometres from their origins, carrying trees, cars and other materials.

Flows are generally thick, viscous mixtures of water and sediment, with flow velocity being highly dependent on water content. Higher water content will result in a faster flow. Typical speeds are approximately 15km/hr^{-1} although speeds up to 20km/hr^{-1} are not uncommon in Azerbaijan. Other types of debris flow may be expected in regions of higher relief, where elevated levels of precipitation occur.

7.2.6 *Economic Geology*

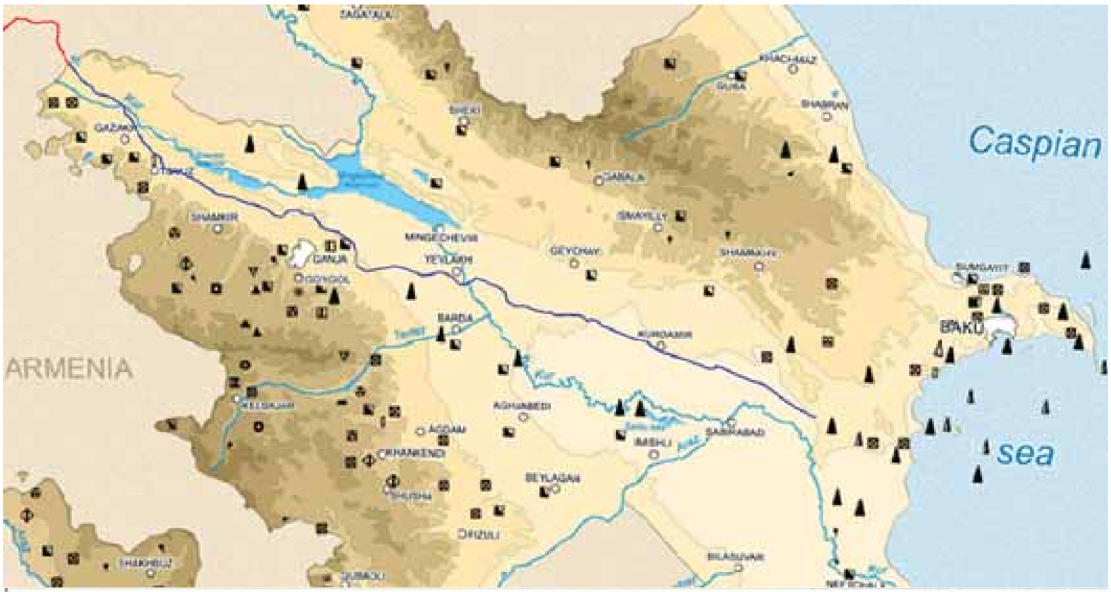
Third-party oil and gas exploration and production, which typically involves an initial surveying stage followed by the drilling and construction of production wells, has taken place along certain sections of the route and some areas still have active concessions. However, although the route passes close to disused oil exploration or production wells, current production facilities have been avoided.

There are several borrow pits located in the vicinity of the current pipeline route that previously provided aggregates for phases of the BTC/SCP project, and that may be used for the proposed SCPX Project. Table 7-6 describes six borrow pits used by the BTC/SCP project, as detailed in “Azerbaijan Borrow Pits Status December 2004”.

Table 7-6: Borrow Pits Used as Part of BTC/SCP Project

Location	Description
Kura East River, near Yevlakh	Small-scale sand extraction on the banks of the river, extracting sand via pumping from the riverbed
South of Yevlakh, near Barda, on Ter Ter River	Large-scale aggregate extraction and processing facility that has been in operation for over 20 years and is regionally important
Kura River, near Mingechevir	Medium-scale sand and gravel extraction on banks of the river, extracting sand and gravel from the riverbed via pumping
Shamkir River	Medium-scale sand and aggregate extraction, grading and washing facility within the Shamkir River bed. The site has been in existence for many years.
Shamkir District	Small site used by local municipality for sand extraction. Mounded uncultivated area surrounded by agricultural land
Chokhranli village, near Kurdemir	Small-scale aggregate extraction from a 5m-high hill that exists because of construction of Geokchay collector

In addition to the borrow pits mentioned above, third-party mineral and aggregate extraction occurs throughout Azerbaijan and is practised in areas relatively close to the proposed pipeline route (see Figure 7-9, Photograph 7-1 and Photograph 7-3). Figure 7-9 indicates that the closest areas of mineral extraction to the pipeline route are near Hajigabul, where oil and limestone is extracted, and Ganja, where gypsum is extracted.



Conventional signs

Oil	Oil and natural gas	Natural gas
Iron ore	Chromite ore	Molybdenum ore
Bauxite	Copper ore	Complex ore
Mercuric ore	Barit	Sulphury pyrites
White salt	Brackish salt	Dolomite
Gypsum	Limestone	Marble
Silica sand	Gill	Cement raw material
Mineral dyes	Pearlites	Agate
Mineral water sources	SCPX route	

Figure 7-9: Mineral Extraction Sites within Azerbaijan

Third-party sand and gravel extraction is known to occur close to where the proposed pipeline route crosses three rivers: Kura East, Shamkirchay and Tovuzchay (see Photograph 7-3). The Shamkirchay is the most heavily exploited of the three rivers and is likely to be of regional importance, whereas the limited extraction in the other two rivers means they are likely to be of local importance.

Photograph 7-1: Mining Operation in Lesser Caucasus Mountains close to Goygol, South-west of Ganja

Photograph 7-2: Excavated Sand Being Stockpiled Close to where SCPX Crosses the Kura West

Photograph 7-3: Aggregate Being Extracted from the Tovuzchay

7.2.7 Geomorphology and Topography

The topography and geomorphology along the majority of the proposed pipeline route is dominated by the presence of the Kura River valley floodplain, which remains close to sea level, as depicted in Figure 7-10. The Kura River valley is bordered by the Greater Caucasus mountains to the north and the Lesser Caucasus mountains to the south. The pipeline route begins to gain altitude between Ganja and the Georgian border, where it approaches the foothills of the Lesser Caucasus.

The proposed pipeline route can be characterised into three distinct sections, the Shirvan Plain, the Karabakh Plain and the Ganja-Gazakh Plain. This section will begin with a description of the Shirvan Plain, followed by a description of both the Karabakh and Ganja-Gazakh Plains.

7.2.7.1 Shirvan Plain

From the west of Hajigabul to the Kura Valley at Yevlakh (KP0–KP169) (see Figure A1-1, Appendix A, EBSR) the central part of the proposed pipeline route consists of the vast Shirvan Plain. In this area Quaternary alluvial deposits from the Greater and Lesser Caucasus form huge fans, cones and terraces (Novocaspian formations). The topography is flat and altitudes are low, varying from -12 to 10m above mean sea level (amsl). The sedimentary cover of the basement reaches more than 5000m thickness and is of Mesozoic and Cenozoic age. The Shirvan Plain is highly intersected by rivers sourced in the Great Caucasus and by irrigation canals.

The landscape of the Korchay region is comprised mainly of undulating plains with slight slopes and fairly low relief.

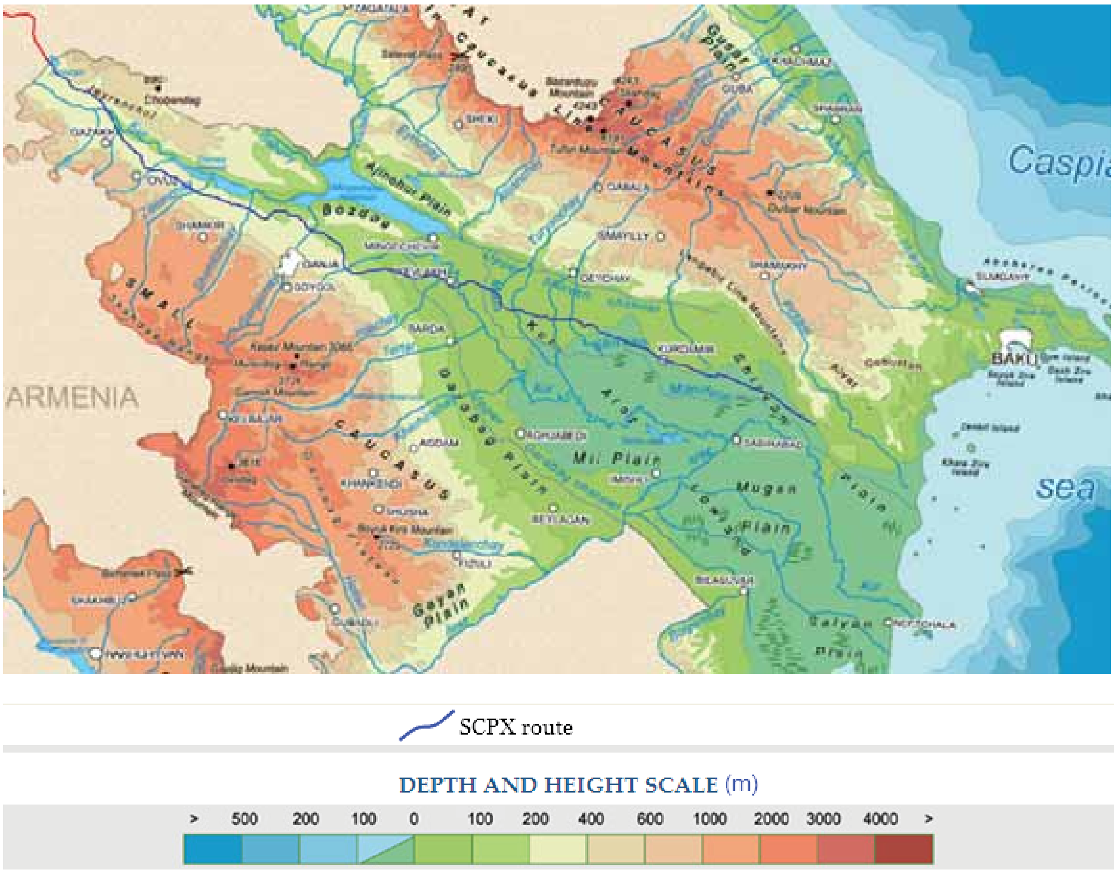


Figure 7-10: Topography of Azerbaijan

7.2.7.2 Karabakh Plain and Ganja-Gazakh Plain

The western section of the proposed pipeline route consists of the Karabakh Plain and the foothills of the Lesser Caucasus up to Poylu, where the proposed pipeline route crosses the Kura River (see Figure A1-1, Appendix A, EBSR). The cover of Palaeogene to Miocene sediments reaches a maximum thickness of 2000 to 3000m. The monoclinal deformation dips towards the Kura River in the north. This section is characterised by Quaternary alluvial and proluvial deposits, which are derived mainly from the Lesser Caucasus.

North of the Kura River the plain is fed by alluvium from the Greater Caucasus Mountains, the watershed being situated near Poylu at an altitude of 197m. The major braided rivers are located in this section, where altitudes range from 80 to 330m.

Close to Shamkir, to the east of the western crossing of the Kura River, the proposed pipeline route crosses undulating hills and valleys. The valleys sometimes comprise fairly wide alluvial plains. Owing to the moderate relief, drainage is generally good, with rivers draining the hills, and drainage ditches on more level cultivated areas of ground.

To the west of the Kura River, the route crosses the Lesser Ganja-Gazakh Plain and Lowlands. This low relief topography has good drainage in the form of drainage ditches and canals. Within this region an area of badlands has developed for approximately 30km to the west of Ganja.

The topography in the region of the Garayazi aquifer (KP358–390) is generally flat, being on the wetland flood plain of the Kura River.

7.2.8 *Sensitivities*

The key sensitivities relating to geology, geomorphology and geohazards along the proposed SCPX route are summarised below:

- The majority of the proposed route passes through soft and unconsolidated sediment that can be sensitive to erosion (see Section 7.3.3.7 for further information)
- Azerbaijan experiences relatively frequent earthquakes; the proposed pipeline is routed through an area that is less seismically active than other regions and does not cross any active faults
- Aggregate extraction is known to occur at rivers crossed by the proposed pipeline route; this has the potential to influence river morphology both up and downstream, which may affect pipeline crossings.

7.3 Soils and Ground Conditions

7.3.1 *Introduction*

This section describes the various soil types, as well as areas of soil contamination, that may be crossed by the proposed SCPX route. The aims are to:

- Provide information concerning the existing or 'baseline' soil types, fertility and structure at the proposed pipeline route, temporary construction camps and pipe storage areas and block valve locations so that the impact of the construction, operation and decommissioning of the proposed SCPX Project can be predicted and assessed
- Identify any areas of contamination that may put the workforce at risk
- Establish current baseline soil contamination conditions (Section 3.5 of Appendix 4 of the HGA) as a due diligence exercise to allow identification of any potential future impacts that may occur as a result of construction activities.

This section will begin by reviewing the methodology that was used to achieve the aims outlined above, including existing data sources and field survey methodologies. Subsequent to this, the section will review the soil that is present along the proposed route and at the proposed temporary construction camp and pipe storage areas and block valve and pigging station locations, including the following:

- Regions traversed
- Soil type classification
- Occurrence of gypsum rich soils
- Soil stability and susceptibility to erosion
- Soil fertility
- Potential for dust and silt generation.

Potential contamination sources and characteristics will be considered, followed by a detailed description of contamination identified as part of the baseline field surveys undertaken for the Project. The sensitivities in relation to soil and contamination will then be summarised.

7.3.2 *Methodology*

7.3.2.1 *Data sources*

In the preparation of this section a number of reference sources have been reviewed, in addition to undertaking additional SCPX specific surveys in the field. As the proposed SCPX pipeline follows the existing WREP, BTC and SCP pipeline routes for much of its route; existing baseline information on soils and contaminated land along the WREP and BTC/SCP routes has been used. Baseline information provided in the EIA for the WREP (1996) and the ESIAs for BTC and SCP (2002) was based on a combination of field survey work, literature review reports prepared by members of the Azerbaijani scientific community, and clarification meetings held with the authors of the reports, as detailed below:

- Contamination survey of Pipe Dumps and Camp Locations undertaken by RSK Environment Ltd on behalf of BP, September 2001
- Supplementary details and clarifications regarding contamination on the WREP ROW provided by Dr R. Mamadov in meeting with Dr Heike Pflasterer held in Baku, February 1997
- Baseline survey of areas along the BTC/SCP route that deviate significantly from the WREP undertaken by AETC on behalf of BP, January–February 2001
- Rapid reconnaissance survey of the WREP undertaken by Environment Resources Management (ERM) on behalf of BP, August/September 2000
- Baseline survey of WREP undertaken by AETC on behalf of Azerbaijan International Operating Company (AIOC) as part of the Environmental Impact Assessment of the WREP, 1997
- Supplementary details regarding contamination on the WREP ROW provided by Prof. G. Yagubov in meeting with Dr Heike Pflasterer held in Baku, February 1997
- Literature review on contamination along the WREP corridor by Dr R Mamedov, Scientific Center 'Nafta', Institute of Geology, December 1996
- Mamedov, G.Sh. and Yagubov, G. Sh., Review of Publications on Soil Cover Along the Western Pipeline Route, 1996
- Literature review on soils and agrochemistry along the WREP corridor by Prof. G. Yagubov, Institute of Soils and Agrochemistry, December 1996.

In addition to the above, further information was also made available by BP and also through on-line searches, as detailed below:

- BP Erosion Register for BTC/SCP ROW (Right of Way)
- Geotechnical investigation along the BTC/SCP ROW undertaken by GIBB Ltd, on behalf of BP Exploration (Shah Deniz) Ltd (BPSD), October 2001
- CB&I, SCPX Expansion Project Soil Erosion Survey Report (Document number SCPX03-MS00-PL-RP-00012), 2011
- BTC Pipeline topsoil survey undertaken by AETC on behalf of Consolidated International Contractor Company (CCIC), 2003
- Social complaints log for 2010 and 2011, used by BP Azerbaijan Operations to register local complaints relating to SCP/BTC ROW, which includes contamination related complaints
- UN Economic Commission for Europe, Environmental Performance Review: Azerbaijan, 2010
- IUSS Working Group WRB, World reference base for soil resources (2006) 2nd edition. World Soil Resources Reports No. 103, FAO, Rome, 2006
- CB&I Construction Camp Reconnaissance Reports, September 2012
- BP Environmental and Social Field Survey Report, March 2013.

7.3.2.2 Synthesis of desktop data

The data sources outlined in Section 7.3.2.1 were reviewed and a gap analysis undertaken to identify any additional information that would be needed to best define the soil and ground conditions baseline with regards to the proposed SCPX Project footprint.

An initial outcome of the review indicated that while most of the existing soils information in the literature listed above is still relevant to the SCPX baseline, areas of contaminated soils would almost undoubtedly have changed since the reports were produced. In particular, all areas of contamination on the WREP, BTC and SCP ROWs were cleared prior to construction, while new areas of contaminated land (particularly fly-tipping associated with communities in close proximity to the pipeline) are constantly developing.

The review also revealed that an area that was not studied in previous baseline soil surveys was soil fertility. This is an important indicator that could be affected by pipeline construction and which needs careful consideration.

It was therefore concluded that additional information would be required regarding soil fertility and areas of contamination along the proposed pipeline route and at temporary construction camp and pipe storage areas. The approach used for obtaining additional information regarding soil fertility is outlined in Section 7.3.2.3 and for soil contamination in Section 7.3.2.4.

While new data was collected to assist in establishing the environmental baseline, the existing data identified in Section 7.3.2.1 was considered relevant and robust enough to also be taken into account, with the exception of areas of existing contamination.

7.3.2.3 Soil survey

To obtain a high enough level of accuracy to determine baseline soil types present along the proposed pipeline route, soil samples were taken at 5km intervals. Soil sampling began at SCPX KP0, close to Hajigabul, and finished at SCPX KP387, close to the Georgian border. Samples were also taken at a number of the proposed temporary construction camp and pipe storage areas (referred to as Alternatives 1 in Chapter 4) listed in Table 7-7. Within Table 7-7 the locations not highlighted had both a contaminated land survey (see Section 7.3.2.4) and a soil fertility survey undertaken; those highlighted had only a contaminated land survey undertaken and not a soil fertility survey.

Table 7-7: Soil Fertility and/or Contaminated Land Rail spur, Offloading, Temporary Construction Camp and Pipe Storage Area Survey Locations

X Coordinate	Y Coordinate	Name
8825507	4448048	Mugan Pipe Storage Area, Rail Spur and Offloading Area
8825720	4448080	Mugan Rail Spur and Offloading
8826768	4449209	Mugan Camp Option 3*
8749019	4482369	Kurdemir Rail Spur and Offloading
8748791	4482475	Kurdemir Pipe Storage Area Option 1 (Mususlu)
8748452	4481402	Kurdemir Pipe Storage Area Option 2 (Mususlu)
8766800	4468950	Kurdemir Camp Option 5
8726170	4485930	Ujar Camp Option 5
8678984	4500765	Yevlakh Camp Option 1*
8681590	4495980	Yevlakh Pipe Storage Area
8681590	4495980	Yevlakh Rail Spur and Offloading
8645510	4505260	Gazanchi Pipe Storage Area Option A
8645730	4505470	Gazanchi Pipe Storage Area Option B
8645360	4505140	Gazanchi Rail Spur and Offloading
8586891	4527251	Dallar Pipe Storage Area
8586940	4526860	Dallar Rail Spur and Offloading
8576460	4532000	Dallar Pipe Storage Area, Option 1B (Bayramli)
8634201	4512152	Goranboy Camp and Pipe Storage 1*
8634769	4512252	Goranboy Camp and Pipe Storage 2*
8642400	4501620	Goranboy Camp Option 3
8613700	4523130	Samukh Camp Option 3
8551751	4546049	Tovuz Camp Option 5*

X Coordinate	Y Coordinate	Name
8534635	4555571	Agstafa Pipe Storage Option 1*
8534684	4555555	Agstafa Pipe Storage Option 2*
8534886	8534886	Agstafa Pipe Storage Option 3*
8534777	4555493	Agstafa Offloading Option 4*
8534413	4555579	Agstafa Pipe Storage Option 5
8546020	4554910	Agstafa Camp Option 3
8537340	4567100	Poylu Pipe Storage Area
8537130	4567120	Poylu Rail Spur and Offloading
8530420	4571120	Saloghlu Rail Spur and Offloading
8533190	4569600	Saloghlu Camp
8533190	4569600	Saloghlu Pipe Storage Area

* Temporary facilities that have subsequently been rejected and are no longer being considered

Note: Locations highlighted green had a contaminated land survey only; those not highlighted had both a soil fertility and contaminated land survey

Alternative 2 temporary construction camp and pipe storage areas were identified late in the ESIA process; as such, time was not available to allow for a detailed soil fertility survey at these locations. Baseline conditions at these areas are generally thought to be consistent with the original sampled locations.

The survey team consisted of a field survey team leader, an Azerbaijani soil specialist from the Institute for Soil Studies and Agricultural Chemistry, and a translator.

Each sample consisted of five sub-samples, one from each corner of a 10m x 10m square and one from the centre of the square sampling area, referred to as an “envelope” pattern. Each sub-sample was excavated to a depth of 300mm, which allowed for the investigation of topsoil depth and horizon profiles. For each composite sample, five sub-samples were combined and mixed thoroughly (homogenised) to create the composite sample before chemical analysis.

At each site the soil specialist made observations regarding the location, including the following:

- Land use
- Surface characteristics
- Soil colour
- Topsoil depth
- Hole depth.

The above information was noted on a pro forma, in addition to GPS readings and photographs. The information for each location can be found in Appendix C-3 of the ESBR.

The soil was tested against the following parameters:

- Nitrogen, phosphorous and potassium (NPK)
- Bulk density
- Particle size distribution
- Sodium absorption ratio, using calcium, magnesium and sodium concentrations.

Using the information obtained during the survey and results from the laboratory analysis, the soil at each sample location was classified by the soil specialist. The soil was classified using the World Reference Base (WRB) for soils.

Soil texture was classified using the Wentworth Scale, and the gradings for the different grain sizes identified during the current study are outlined in Table 7-8.

Table 7-8: Wentworth Grain Size Classification Ranges

Particle Description	Minimum Grain Size (mm)	Maximum Grain Size (mm)
Clay	0.001	0.004
Very fine silt	0.004	0.008
Fine silt	0.008	0.016
Medium silt	0.16	0.31
Coarse silt	0.31	0.62
Very fine sand	0.62	0.125
Fine sand	0.125	0.250

7.3.2.4 Survey of contamination

A walkover survey of a 100m-wide corridor along the whole of the SCPX ROW route, which encompassed the proposed block valve locations, was surveyed except:

- The SCP/BTC ROW, as this is regularly inspected by the pipeline security patrols that report contamination to the operations team who arrange for remediation/mitigation.

The Phase 1 survey was undertaken at the proposed temporary construction camp and pipe storage areas (see Table 7-7). At each site the Phase 1 survey was undertaken throughout the full extent of the proposed area footprint.

7.3.2.5 Phase 1

The Phase 1 survey involved a visual observation of the area being surveyed and looked for evidence of any surface contamination, including any of the following:

- Fly-tipping, including asbestos materials
- Hydrocarbon contamination
- Industrial contamination/storage of chemical or hazardous waste
- Agricultural contamination
- Naturally occurring contaminants.

The location of all observations was recorded with the use of a global positioning system (GPS) unit and noted on the Phase 1 survey pro forma. Photographs were also taken and noted on the pro forma.

7.3.2.6 Phase 2

The Phase 2 survey involved samples being taken at areas identified in Phase 1 as requiring further investigation, by collecting shallow soil/surface samples. Sampling was undertaken following the guidance in ISO Standard 10381-2: 2002 Guidance on Sampling Techniques.

Phase 2 sampling involved taking a surface soil sample using the following process:

- The soil was excavated with the use of a clean, non-galvanised spade. The excavation was no deeper or wider than the height and width of the spade head
- The soil sample was placed in a 600g/1kg snap-on-lid plastic container or a 250g/60g glass container, depending on the contaminants of concern. The container was supplied clean and filled to the top with soil to ensure as little air as possible was contained within
- The container was then labelled with the following information:

- o Unique sample reference
- o Date
- o Time
- o Surveyor initials.

The sample was then placed in a cool box before being transported back to the laboratory for analysis in Baku.

7.3.2.7 Sample analysis

The majority of sample analysis was undertaken by the Akva Miljo Caspian (AmC) laboratory in Baku. AmC holds the ISO 17025 laboratory-specific accreditation (DANAK accreditation no. 480) and its procedures are accredited by the Azerbaijan Republic State Committee for Standardisation, Metrology, and Patents (AZStandard).

Samples taken during the December 2011 surveys, which comprised all locations on the pipeline ROW between the Kura West River (KP358) and Georgian border (KP390) and temporary construction camps and pipe storage areas (see Table 7-7), were analysed by Azecolab laboratory in Baku. This was because of a change in SCPX's preferred laboratory, which has been further discussed in Section 7.3.2.8. Azecolab holds the ISO 17025 laboratory-specific accreditation (TURKAK accreditation AB-469-T) and is accredited by AZStandard.

Soil sampling
In order to ascertain soil fertility each sample was analysed against the following parameters: bulk density; sodium absorption ratio (SAR); calcium; magnesium; sodium; potassium; ammonium; nitrate; phosphorus; and particle size analysis.

All analyses complied with prescribed quality assurance and quality control criteria. A detailed description of the analytical methodology used for each sample can be found in the soil analysis results in Appendix C-3 of the ESBR.

Phase 2 sampling
Two locations were identified during the Phase 1 survey as requiring further investigation owing to hydrocarbon contamination. Surface samples were taken at each of the locations and analysed against the following parameters:

- Total petroleum hydrocarbon (TPH)
- Polycyclic aromatic hydrocarbon (PAH)
- Benzene
- Toluene
- Ethylbenzene
- Xylene
- Phenol
- Arsenic
- Cadmium
- Chromium
- Copper
- Mercury
- Nickel
- Lead
- Selenium
- Zinc

7.3.2.8 Assessment of importance and sensitivity of soils

An assessment has been made of the importance of soil along the proposed pipeline route and the potential sensitivity to change. As a result, the importance and sensitivity of soil has been classified into categories that range from very low to very high. Information on this process and the assessment table, defining the categories used, is given in Section 3.9.6.1.

7.3.2.9 Technical difficulties or uncertainties

Information contained here was accurate at the time of writing, to the best of our knowledge. However, the occurrence of contamination, which in the majority of cases is caused by third parties, will vary both spatially and in time, which will be taken into consideration when determining the need for further surveys, e.g. prior to construction.

As part of the risk assessment for the contamination survey one of the biggest risks identified was the possibility of being attacked by wild animals and working dogs. To reduce this risk to an acceptable level, it was considered necessary to remain within visual contact of the survey vehicle. Vehicular access to agricultural land was restricted in certain sections and it was not possible to remain within visual contact of the vehicle. Within such sections access was therefore limited. However, much of the agricultural land is continuously worked (e.g. ploughed, tilled and harvested) by farmers, meaning the presence of certain types of contamination (e.g. fly-tipping) is considered less likely.

As outlined in Section 7.3.2.7, two separate laboratories were used to undertake sample analysis. For the December 2011 surveys AmC was no longer available and had been replaced by Azecolab as SCPX's approved laboratory. Both laboratories used hold the ISO 17025 laboratory-specific accreditation and, as such, it is considered likely that their methodologies, and therefore the results, will be consistent. However, caution should be taken regarding any possible discrepancies that may exist between the results.

Topsoil depth along the proposed pipeline route is discussed in Sections 7.3.3.2 to 7.3.3.4. These sections review findings from the 2011 SCPX soil survey, a 2003 soil survey carried out along the BTC/SCP ROW by AETC on behalf of CCIC and a 2001 geotechnical survey carried out along the BTC/SCP ROW by GIBB Ltd. Throughout the route there are variations in recorded topsoil depth between the three surveys. This may reflect differences in sample locations and sampling frequency. The 2003 survey measured topsoil depth every 500m, the 2001 survey measured depth within 21 different sections that were predetermined based on differences in geomorphology, surface features and ground conditions, while the 2011 survey measured depth every 5km. It is possible that differences in sampling location resulted in different topsoil depths being encountered.

Subjectivity in topsoil depth measurement is another possible explanation for any differences between the findings of the three surveys. Topsoil is measured as the distance from the soil surface to the more densely packed subsoil. Often there is an abrupt change in soil properties (e.g. colour and texture) between the two layers, making the distinction relatively straightforward. However, soil properties may also change more gradually, meaning there may be scope for differences in opinion regarding topsoil depth. Soil types along the pipeline vary (see Section 7.3.3.5) and it is possible that topsoil depth in certain areas is more difficult to define. Discrepancies in topsoil depth between the 2003 and 2011 surveys were generally 2–4cm (e.g. maximum depth of 2cm in 2011 survey versus 6cm in the 2003 survey). This difference is relatively small and so is likely to reflect differences in judgement regarding where the topsoil ends and the subsoil begins.

Differences in recorded depths between the 2001 and the 2003 and 2011 surveys were more marked, varying by 10 to 40cm in similar areas. Despite the larger variation, this may also be explained by differences in judgement regarding the boundary between the topsoil and subsoil. Both the 2003 and 2011 surveys were soil specific surveys, whereas the 2001 survey was a geotechnical survey. However, the differences in recorded depths should be taken into consideration when considering baseline soil conditions along the proposed route.

It should be noted that the differences in recorded topsoil depth between the 2001 and the 2003 and 2011 surveys is not a result of the BTC and SCP projects. Both the 2001 and 2003 surveys were undertaken prior to BTC and SCP construction and the 2011 samples were taken in locations off the BTC/SCP ROW. As such, BTC and SCP construction could not have influenced the findings.

7.3.3 Soils and Ground Conditions

7.3.3.1 Introduction

The soil types present along the proposed route can be broadly divided into three distinct regions, beginning with the Shirvan Plain in the east, the Karabakh Plain in the centre and the Kura Plain in the west.

7.3.3.2 Shirvan Plain (KP0 to KP169)

The Shirvan Plain occupies the majority of the landscape east of the Kura River crossing at KP169, including the proposed temporary construction camps and pipe storage areas located at Mugan, Kurdemir and Ujar, the proposed block valves located at SCPX KP21 (BVR A6) and 95 (BVR A7) and pigging facility located at SCPX KP0. The landscape through which the proposed SCPX route runs can be characterised as a flat landscape, close to sea level, that is interrupted at different locations by stream channels (fluvial lands), sloping lands and disturbed lands (see Photograph 7-4).

Tillage in this region is deep and usually undertaken using mouldboard ploughs followed by harrowing. Agriculture has worn away the berm over parts of the existing WREP pipeline. In other areas fill material has settled to below the level of the soil surface, creating a kind of parabolic channel. This is most prominent in saline soils having a hard to very hard, blocky structure, and may result from inadequate preparation of fill material.

Slopes perpendicular to the proposed pipeline route occasionally traverse the plains. Soil erosion and deposition play a role in soil formation in these regions, so that gravel from upland areas might cover soils lower on the slopes. Where the landscape is rolling or hilly, sand is therefore likely to be a greater constituent of the soil, with pale colour and infertility being typical. Such soils have little resistance to erosion, and when severely eroded become classified as ‘badlands’.

Soils in the fluvial regions differ from their drier counterparts in that they are often associated with hilly, rolling, and undulating terrain: their occurrence is rarely abrupt, but results as a transition with other land forms. In fluvial regions the soils tend to convey water and lie entrenched below the level of the natural land surface.

Photograph 7-4: SCPX KP23, Located on the Shirvan Plain

Regions in the study area are used for a mix of rain-fed and irrigated farming of crops such as maize, cereals, hay and grapes (see Photograph 7-5). Their landscape is more diverse and higher in altitude than the warmer plains. Rivers, some of which are deeply incised, act to divide upland plains into discrete segments. Wet lowlands have more relief than dry lowlands and their soils resist salt accumulation. As with most plains' soils, the soils found on wetter plains develop a thin platy crust (3–4mm thick), which reduces infiltration. Tillage breaks up the crust, so that it is less of a feature on valley and plains soils than on sloping lands, where the potential for run-off and soil erosion is high.

Within the study area, there are areas of disturbed land associated with roadways, construction of different kinds and the existing WREP and BTC/SCP pipeline corridors. For example, there is evidence of highly cracked soils concentrated along the working width of the existing WREP and BTC/SCP pipeline corridors. In these areas soils have been so mixed as to lack observable diagnostic characteristics. As they contain subsoil mixed with soil from the surface, their general impact is to reduce soil fertility. This becomes extreme in areas that are compacted, prone to drought and on sloping ground where the topsoil may be washed away completely. The effect of disturbed lands is to reduce plant density, vigour and biomass. The existing pipeline corridor serves as an entry point for invasive weeds. Areas of disturbed soils, which have a soft consistency, attract burrowing animals such as rabbits and foxes.

Photograph 7-5: Field After Hay Harvest at SCPX KP99

Soil colour and texture

The soils found on the Shirvan Plain are depositional soils that are generally pale coloured (browns, grey-browns, khaki-browns and greys) with a texture that includes significant quantities of fine silts, very fine silts and clays (see Figure 7-11).

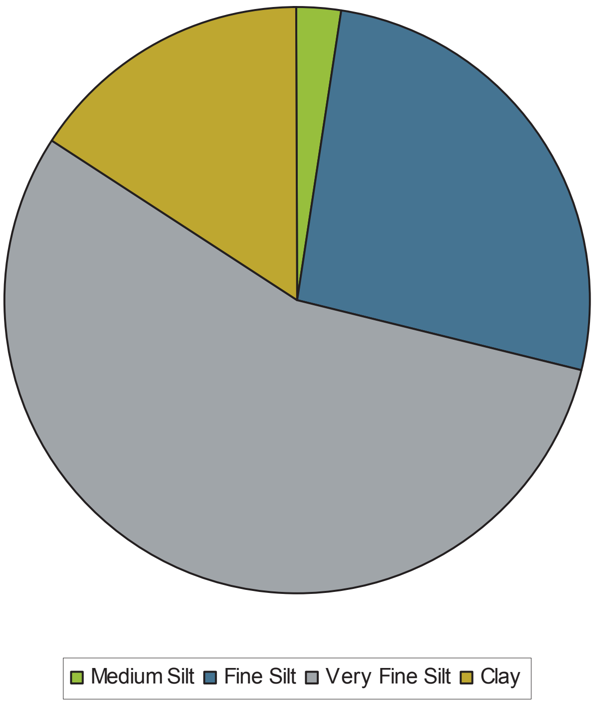


Figure 7-11: Distribution of Soil Sediment Types on the Shirvan Plain

Bulk density

The field survey results indicated that bulk density was found to be relatively consistent along the proposed route, ranging between 1.61g/cm^3 and 2.47g/cm^3. It is widely accepted that mineral soils with a bulk density exceeding 1.6g/cm^3 are considered to be compacted. Compacted soil can result in shallow plant rooting, poor plant growth and reduced vegetative cover. In addition, compaction can also lead to reduced water infiltration in the soil, which can cause increased run-off and erosion.

Soil salinity

Soil salinity was measured using the sodium absorption ratio (SAR). It is widely accepted that when SAR rises above a value of 13, the excess sodium can cause the soil to become hard and cloddy when dry, to crust badly and take water on very slowly. At SCPX KP155 and KP165 and at the proposed temporary pipe storage area at Mugan Camp Option 3* the soil SAR value was 77.5, 14.1 and 18.5 respectively and can all be classed as sodic. At all other sample locations within the Shirvan Plain the SAR were below 13, ranging from 0.09 to 8.4.

Although the SAR for the majority of soil samples was below 13, historical evidence and visual observations made during the current survey indicate the soil in this region has a high saline content. Unless irrigated, the soils tend to be highly cracked, with the rifts staying open for much of the year. Highly cracked soils in hot climates are known to accumulate salts (see Photograph 7-6). Salt pollution of soils is a problem throughout the irrigated area east of the Kura River at KP168, and poor irrigation practice is generally the cause of salination. Some soils are so severely affected by soil salinity as to have a salt flock structure or crust to their upper surface (see Photograph 7-7).

Photograph 7-6: Cracked Soil at SCPX KP139

Photograph 7-7: Salt Flock on Soil Surface at SCPX KP153

Topsoil depth

Maximum topsoil depth on the Shirvan Plain, recorded during the SCPX soil survey, was 4cm, although the depth only exceeded 2cm in three of the locations, between SCPX KP43 and SCPX KP54 (see Figure 7-12). Minimum topsoil depth was 0cm, which was recorded at one location: SCPX KP129. At all other locations topsoil depth was between 1 and 2cm. This is considered particularly shallow, and therefore a comparison with 2001 and 2003 topsoil survey data was undertaken.

Findings from the 2003 topsoil survey carried out by CCIC on the BTC/SCP ROW (see Section 7.3.2.1) showed topsoil depth along the Shirvan Plain to be similar to the findings described above. However, between SCPX KP94 and KP111, topsoil depth was found to be 5 or 6cm at the majority of sample points (see Figure 7-12). Topsoil depths recorded during the 2001 geotechnical survey were significantly different to both the 2003 and 2011 surveys, ranging from 10cm to 30cm (see Figure 7-13).

Possible explanations for differences in recorded topsoil depth between the three surveys have been discussed in Section 7.3.2.9.

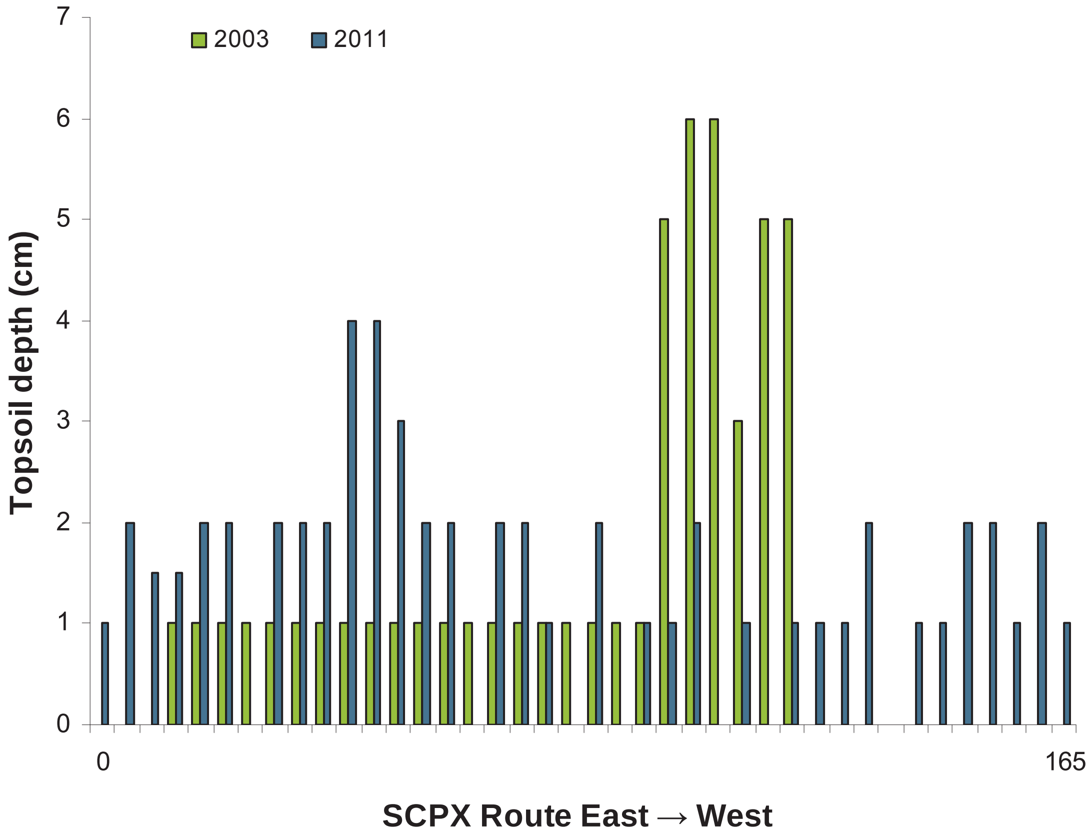


Figure 7-12: Topsoil Depths along the Shirvan Plain Section of the Proposed Pipeline ROW Recorded during 2003 and 2011 Soil Surveys

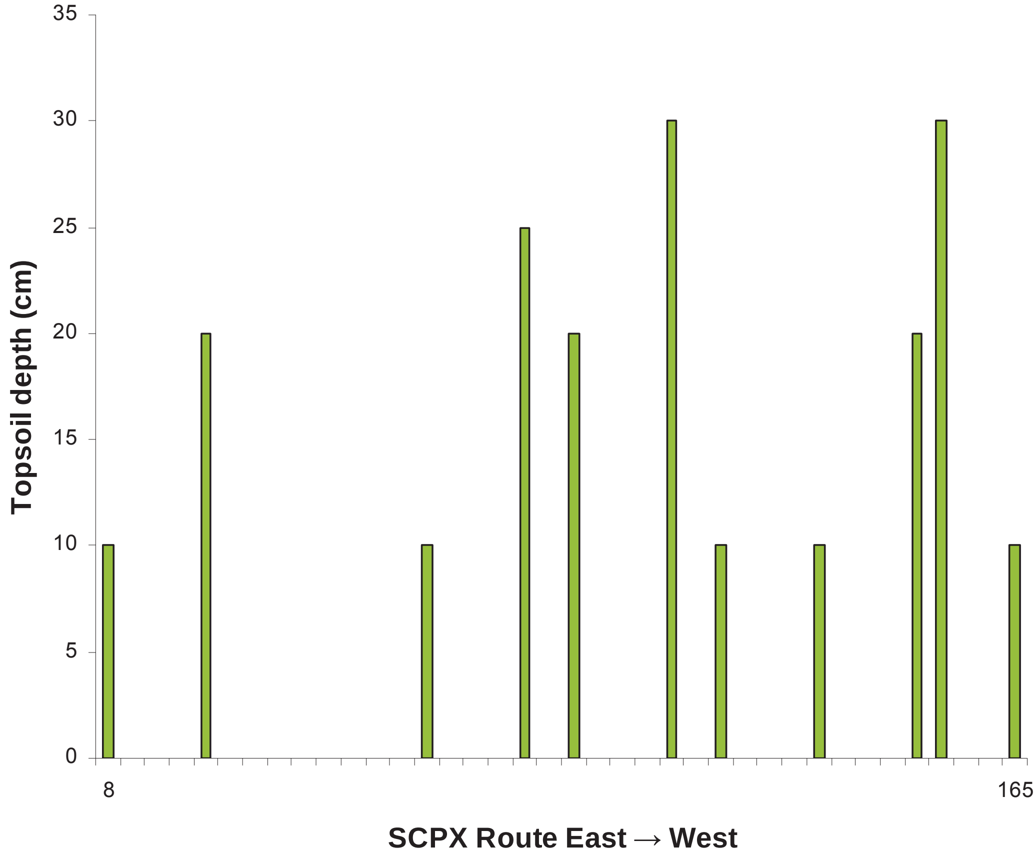


Figure 7-13: Topsoil Depths along the Shirvan Plain Section of the Proposed Pipeline ROW Recorded during 2001 Geotechnical Survey

7.3.3.3 Karabakh Plain (KP169 to KP202)

The proposed pipeline route crosses the northern part of the Karabakh Plain from east of Yevlakh to the Goran railway station near the village of Goranboy (KP169–202). This section of the route also encompasses the proposed temporary construction camp and pipe storage area option at Yevlakh and the proposed block valve location at SCPX KP172 (BVR A8). The vegetation encountered is mixed, varying from natural, uncultivated regions, to semi-natural and agricultural lands (see Photograph 7-8 and Photograph 7-9). Grazing is widespread, with a few cultivated areas that have been used predominantly for the cultivation of vines and maize. A general trend was noted of grazed areas on valley sides, with cultivation and irrigation in the valley bottoms.

Photograph 7-8: Semi-natural Vegetation at SCPX KP185

Photograph 7-9: Hayfield at SCPX KP195

Soil colour and texture

The soils found on the Karabakh Plain are depositional soils that generally have a colour mixture of browns and grey-browns. The soil in this region was found to have a composition that includes significant quantities of fine silts and very fine silts.

Bulk density

Bulk density along the proposed pipeline route in the Karabakh Plain is very similar to that of the Shirvan Plain, ranging from 1.42g/cm^3 to 2.28g/cm^3. The soil can therefore be considered to be relatively compact, the effects of which have been outlined above.

Soil salinity
During the current study, the SAR value at SCPX KP190 was found to be 22.5, which is considered sodic. The SAR value at the remaining sample locations ranged between 0.18 and 7.8. Visual observation as part of the current study, and also historical information, indicate that soil salinity in this region is variable.

Topsoil depth
Between SCPX KP170 and SCPX KP185 topsoil depth on the Karabakh Plain was relatively constant at 2cm, and west of this, until SCPX KP200, the depth was observed to be 1cm (see Figure 7-14). Topsoil depth at the proposed temporary construction camp at Yevlakh was recorded as 0cm.

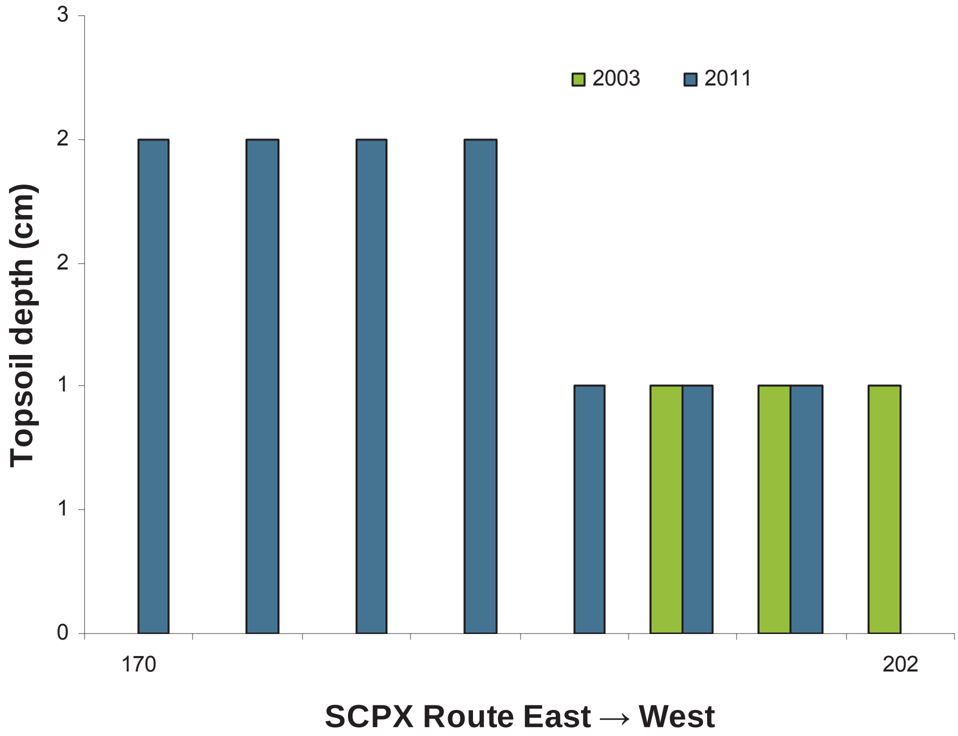


Figure 7-14: Topsoil Depths along the Karabakh Plain Section of the Proposed Pipeline ROW Recorded during 2003 and 2011 Soil Surveys

Findings from the 2003 topsoil survey carried out by CCIC on the BTC/SCP ROW showed topsoil depth along the Karabakh Plain to be similar to the findings described above (see Figure 7-14). All locations sampled during the 2003 survey recorded a topsoil depth of 1cm. Topsoil depths recorded during the 2001 geotechnical survey were significantly different to both the 2003 and 2011 surveys, ranging from 15cm to 50cm (see Figure 7-15). Possible explanations for differences in recorded topsoil depth between the three surveys have been discussed in Section 7.3.2.9.

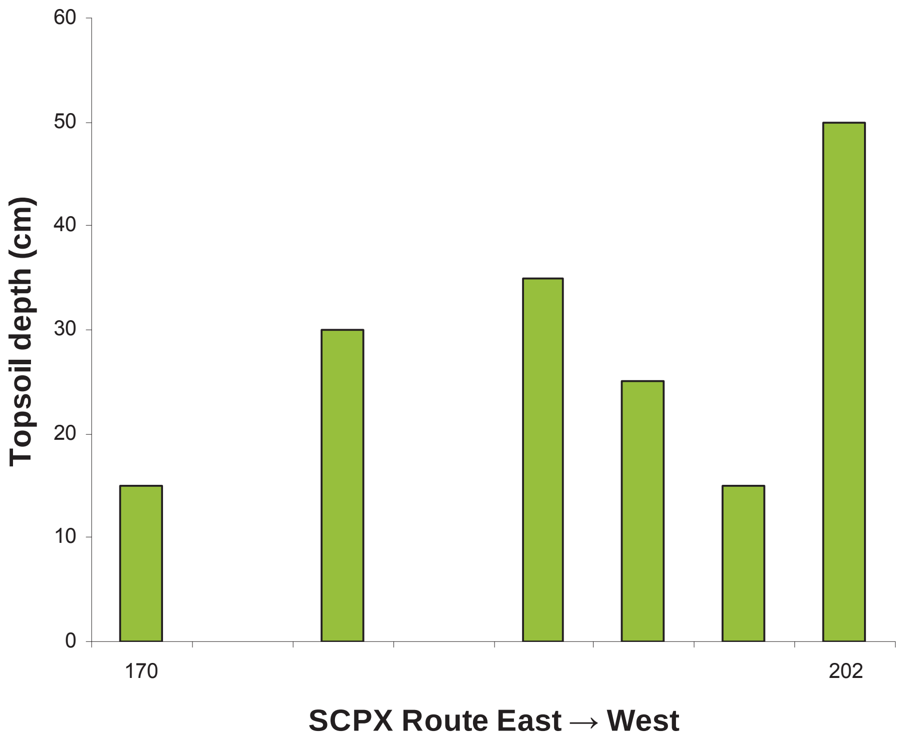


Figure 7-15: Topsoil Depths along the Karabakh Plain Section of the Proposed Pipeline ROW Recorded during 2001 Geotechnical Survey

7.3.3.4 Ganja-Gazakh Plain (KP202 to KP390)

This area covers the western part of the Kura River Plain and the foothills of the Lesser Caucasus. It stretches from the Goran railway station up to the Georgian border (KP202-390), which encompasses the proposed block valve locations at SCPX KP243 (BVR A9) and 334 (BVR A10) and also the proposed temporary construction camp and pipe storage areas located at Gazanchi, Dallar, Samukh, Tovuz, Agstafa, Poylu and Saloghlu.

Soil colour and texture
Seasonally cracking soils are present in some areas with fairly low levels of moistness. This means that they are pale-coloured, often brown with a tendency towards shades of grey. The soil in this region was found to have a composition that ranged from very fine sand to very fine silt (see Figure 7-16). These soils tend to become sticky when wet and vehicles can be difficult to manage during irrigation or the rainy season. Tillage requires careful attention to soil moisture content: too wet and ploughs become difficult to pull; too dry and they become hard. Well managed, these soils will retain their fertility and provide good yields.

Where hills (or undulating or rolling lands) associate with plain-like valleys in close proximity, the soils are typically pale-coloured, shallow and on sloping lands, where soil erosion is a factor in soil development. Because the soils are thin, they may be easily damaged by construction and compaction. Their principal uses include watershed, habitat and limited grazing; they are unsuited to most forms of horticulture.

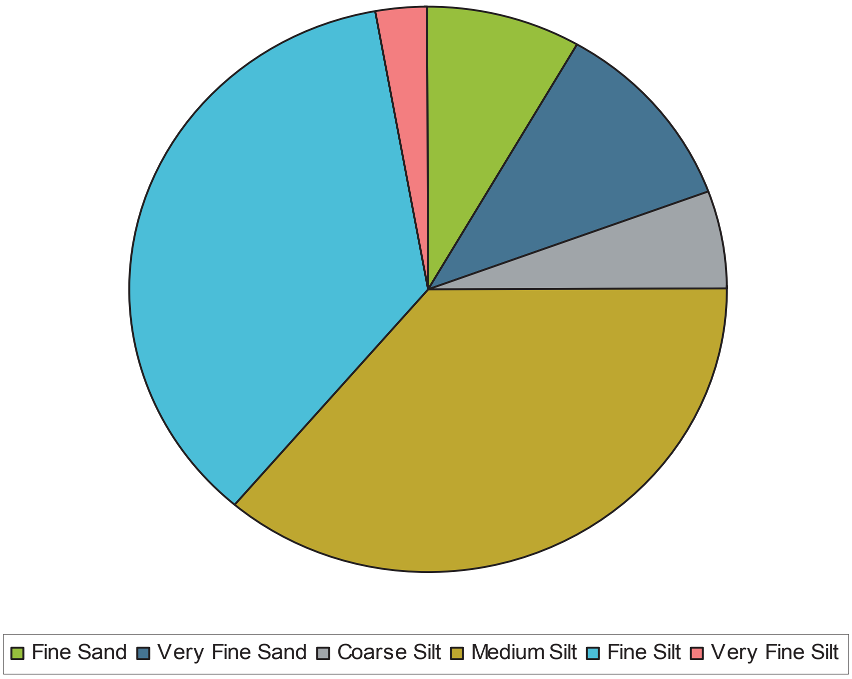


Figure 7-16: Distribution of Soil Sediment Types on the Proposed Route in the Ganja-Gazakh Plain Region

Undulating, rolling or hilly lands often precede or follow fluvial lands in the landscape sequence (see Photograph 7-10). If undulating, their soils may resemble those of the plains. If occurring down slope of rolling or hilly terrain, however, their surface may become covered by gravels transported from the higher land. They have a low suitability for farming because of soil drought enhanced by internal drainage. Rolling and hilly lands usually contain soils similar to those described in the preceding paragraph. They are often skeletal, meaning that gravel makes up an important part of their composition.

In the cool, upland environments typical soils are depositional soils with little soil horizon development and can support deep ploughing (see Photograph 7-11). Most soils in this category are irrigated for hay or maize production during the summer, followed by rain-fed cereal production during the winter. Fields are small and although tillage will be by tractor-drawn mouldboard ploughs, much of the subsequent labour is by hand.

Photograph 7-10: Undulating Landscape at SCPX KP311

Photograph 7-11: Ploughed Soil at SCPX KP296

Bulk density

Bulk density within the Ganja-Gazakh Plain is very similar to that of the Shirvan and Karabakh Plains, ranging from 1.03g/cm^3 to 2.47g/cm^3. The soil can therefore be considered relatively compact, the effects of which have been outlined above.

Soil salinity

Soils within the Ganja-Gazakh Plain are locally saline. The SAR value at SCPX KP210 was found to be 18.9, meaning it can be classed as sodic, while the SAR value at all other locations was below 13. Between SCPX KP205 and SCPX KP220 and also SCPX KP250 and SCPX KP276 the SAR value appeared to be relatively elevated. Outside of these locations the SAR value remained below 0.43. However, because of the local variability in soil salinity it is difficult to gain an accurate understanding based on results from the current study.

Topsoil depth

Topsoil depth recorded on the Ganja-Gazakh Plain during the 2011 soil survey varied between 1 and 3cm (see Figure 7-17). The proportion of arable land on the pipeline route generally increases from east to west, with the greatest concentration being in the west of the Ganja-Gazakh Plain. Arable land would generally be considered to have a deeper topsoil than non-arable land and as such a greater average depth would have been expected for the Ganja-Gazakh Plain than was observed. However, much of the arable land in the study area is used to grow forage crops, such as cereals, hay and silage, which, relative to other crops, do not necessarily require or indicate the presence of deeper topsoil.

Findings from the 2003 topsoil survey carried out by CCIC on the BTC/SCP ROW showed topsoil depth along the initial section of the Plain, between SCPX KP202 and SCPX KP263, to correspond with the findings described above (see Figure 7-17). However, between SCPX KP263 and the Georgian border (SCPX KP390) the average depth of the topsoil was found to be greater, with depths ranging from 2 to 10cm. Within this section close to 38% of locations were found to have a topsoil depth of 2 or 3cm, over 45% were found to be 4 or 5cm, and approximately 14% had a depth of 6–8cm. Two locations were found to be 9cm and 10cm respectively. Over 60% of the 2003 sample locations therefore had a topsoil depth greater than any of the depths observed during the 2011 survey.

Topsoil depths recorded during the 2001 geotechnical survey were significantly different to both the 2003 and 2011 surveys, ranging from 15cm to 40cm (see Figure 7-18).

Possible explanations for differences in recorded topsoil depth between the three surveys have been discussed in Section 7.3.2.9.

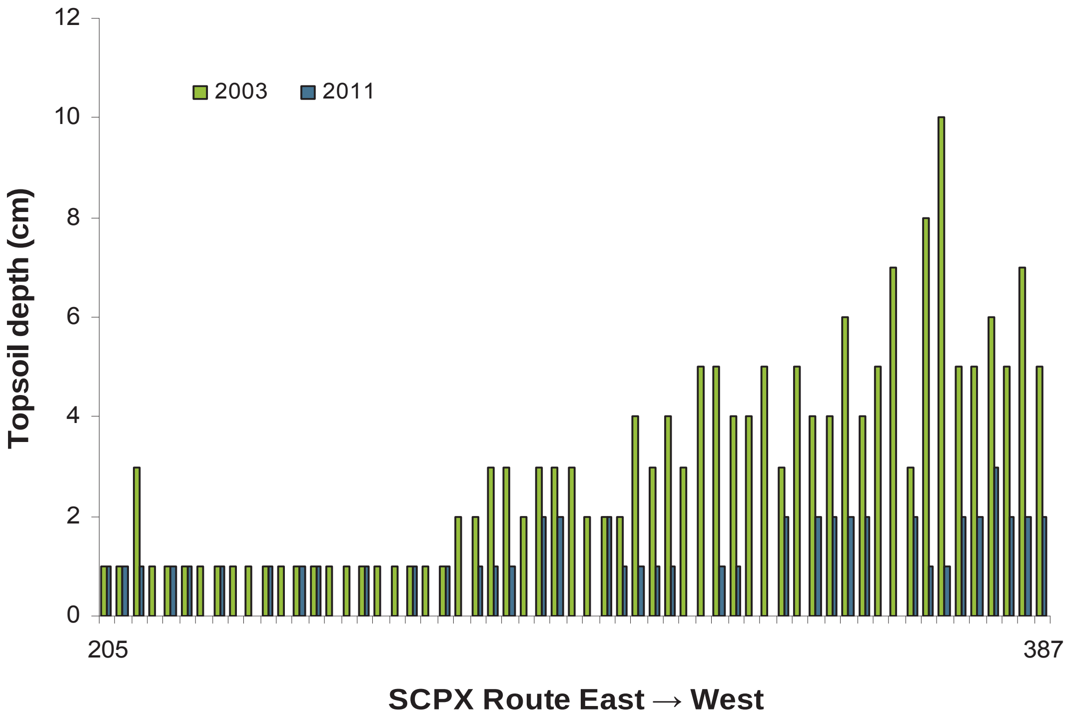


Figure 7-17: Topsoil Depths along the Ganja-Gazakh Plain Section of the Proposed Pipeline ROW Recorded during 2003 and 2011 Soil Surveys

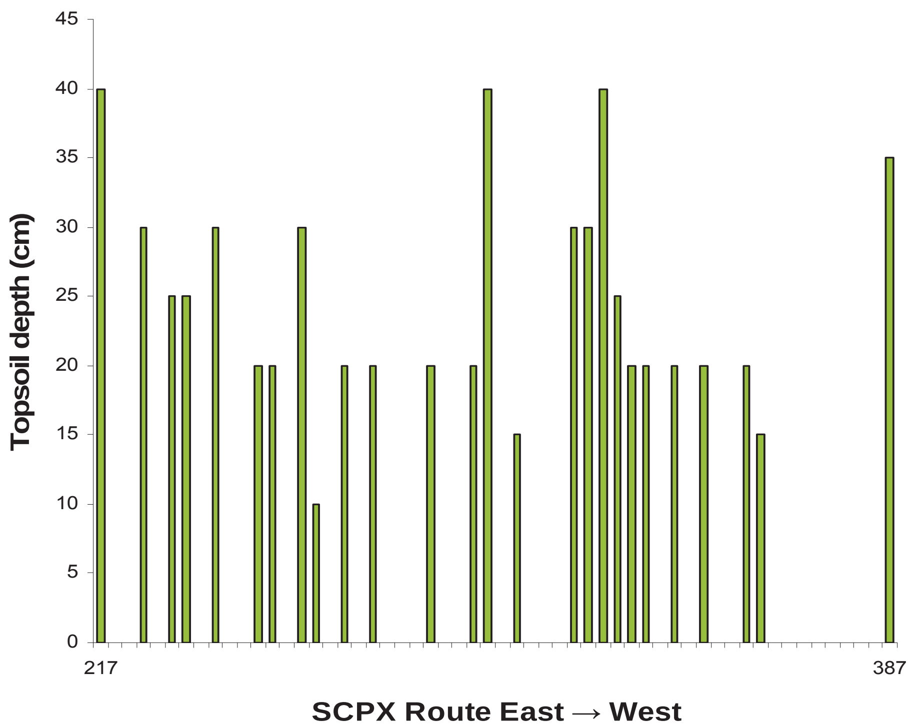


Figure 7-18: Topsoil Depths along the Ganja-Gakakh Plain Section of the Proposed Pipeline ROW Recorded during 2001 Geotechnical Survey

Data from SCPX Georgia ESIA environmental baseline surveys has also been reviewed to facilitate a greater understanding of topsoil depth in western Azerbaijan (SCPX Georgia ESIA Environmental and Social Baseline Report, 2012). The proposed SCPX ROW crosses the Azerbaijan border into Georgia at approximately SCPX KP390. In May and June 2011 field surveys were undertaken to assess the baseline soil types on the proposed pipeline ROW within Georgia. Owing to the close proximity and similarity in terrain, baseline topsoil depth from the Georgian side of the border can be used as an indicator of general topsoil depth within western Azerbaijan.

Topsoil depth on the Georgian SCPX ROW, adjacent to the Azerbaijan border, was recorded as being between 0 and 12 cm. This range is concurrent with depths observed during both the 2003 and 2011 Azerbaijan topsoil surveys, although is significantly lower than the range observed during the 2001 survey. Owing to the observed variations, caution should be exercised when considering topsoil depth and generalisation of large areas should be avoided.

7.3.3.5 Soil class

Along the length of the proposed SCPX route, and at the proposed temporary camp and pipe storage areas and block valve locations, a total of six soil types were identified and are listed below then described in further detail:

- Calcic gypsisols
- Gleyic calcisols
- Gleyic fluvisols
- Histic gleysols
- Kastanozems
- Mollic fluvisols.

Calcic gypsisols

Based on findings from the current survey very little of the proposed pipeline route is overlain with calcic gypsisols, which were only identified in the first two sample locations on the proposed SCPX route, from SCPX KP0 to SCPX KP6, which includes the area where the pigging facility would be located. Calcic gypsisols were also identified at the following proposed temporary construction camp and pipe storage locations:

- Mugan Camp Option 3*
- Goranboy Camp and Pipe Storage 1*
- Dallar Pipe Storage
- Tovuz Camp Option 5*
- Agstafa Pipe Storage and Offloading Options*.

Calcic gypsisols have the following attributes:

- Substantial secondary accumulation of gypsum ($CaSO_4.2H_2O$)
- The environment in which they are found is predominantly level to hilly land and depression areas (e.g. former inland lakes) in regions with an arid climate
- The natural vegetation is sparse and dominated by xerophytic shrubs and trees and/or ephemeral grasses
- A light-coloured surface horizon and an accumulation of calcium sulphate
- Secondary calcium carbonate ($CaCO_3$) that has accumulated in a diffuse form
- Can be used for the production of small grains, cotton, alfalfa, etc.
- Large areas with calcic gypsisols are in use for extensive grazing

- Irrigated agriculture on calcic gypsisols is plagued by rapid dissolution of soil gypsum, resulting in irregular subsidence of the land surface, caving in canal walls, and corrosion of concrete structures.

Gleyic calcisols

Gleyic calcisols were primarily observed where the proposed route traverses the Shirvan plain. They dominate the route between SCPX KP8 and SCPX KP89, although they continue to have a presence until SCPX KP183. Gleyic calcisols were also identified at the block valve location at SCPX KP21 and the following proposed temporary camp and pipe storage areas:

- Mugan Camp Option 3* and Mugan Pipe Storage Area
- Kurdemir Pipe Storage Area Option 1 (Mususlu) and Kurdemir Rail Spur and Offloading
- Yevlakh Camp Option 1.

Gleyic calcisols have the following attributes:

- Accommodate soils in which there is substantial secondary accumulation of lime
- Natural vegetation is sparse and dominated by xerophytic shrubs and trees and/or ephemeral grasses
- Typically have a pale brown surface horizon and substantial secondary accumulation of lime occurs within 100 cm of the soil surface
- Reach their full productive capacity only where carefully irrigated
- Vegetable crops can be grown successfully on irrigated gleyic calcisols when fertilised with nitrogen, phosphorus and trace elements.

Gleyic fluvisols

Gleyic fluvisols appear intermittently along the proposed route, where it traverses both the Shirvan and Karabakh plains, between SCPX KP13 and SCPX KP190. Gleyic fluvisols occur at the block valve location at SCPX KP172 and were identified close to the following river crossings:

- Geokchay
- Turianchay
- Kura East
- Karabakh Canal.

Gleyic fluvisols have the following attributes:

- Exist is alluvial plains, river fans, valleys and tidal marshes on all continents and in all climate zones
- Under natural conditions are flooded periodically
- Can develop a gleyic colour pattern.

Mollic fluvisols

Mollic fluvisols appear on the proposed route in two sections between SCPX KP314 and SCPX KP334 and SCPX KP344 and SCPX KP356.5. These two sections include the following river crossings:

- Asrikchay
- Tovuzchay
- Hasansu

- Kura West.

Mollic fluvisols have the following attributes:

- Exist is alluvial plains, river fans, valleys and tidal marshes on all continents and in all climate zones
- Under natural conditions are flooded periodically
- A thick, well-structured, dark-coloured surface horizon with a high base saturation and a moderate to high content of organic matter.

Histic gleysols
Based on findings from the current survey, very little of the proposed pipeline route is overlain with histic gleysols, which were identified at five of the sample locations between and SCPX KP94 and SCPX KP155, encompassing the block valve location at SCPX KP95.

Histic gleysols have the following attributes:

- Wetland soils that, unless drained, are saturated with groundwater for long enough periods to develop a characteristic gleyic colour pattern
- Primarily located in depression areas and low landscape positions with shallow groundwater
- Main obstacle to utilisation of gleysols is the necessity to install a drainage system to lower the groundwater table
- Adequately drained gleysols can be used for arable cropping, dairy farming and horticulture
- Soil structure will be destroyed for a long time if soils are cultivated when too wet
- A surface or a subsurface horizon occurring at shallow depth, which consists of poorly aerated organic material.

Kastanozems
On the proposed route between SCPX KP195 and SCPX KP311 kastanozems were the only soil type identified during the current study. Kastanozems were also identified between SCPX KP332 and SCPX KP342. Kastanozems are therefore the dominant soil type in the Ganja-Gazakh Plain section of the proposed pipe route.

Kastanozems have the following attributes:

- Primarily accommodate dry grassland soils
- Exist in dry and continental regions with relatively cold winters and hot summers; flat to undulating grasslands dominated by ephemeral short grasses
- The profile of kastanozems comprise a brown mollic horizon of medium depth, in some cases with secondary gypsum
- Periodic lack of soil moisture is the main obstacle to high yields
- Irrigation is nearly always necessary for high yields
- Care must be taken to avoid secondary salinisation of the surface soil
- Phosphate fertilisers might be necessary for good yields
- Small grains and irrigated food and vegetable crops are the principal crops grown. Wind and water erosion is a problem on kastanozems, especially on fallow lands
- Extensive grazing is another important land use on kastanozems.

7.3.3.6 Occurrence of gypsum-rich soils

Hydrated calcium sulphate, gypsum, is often present within soils just below or at the surface. Gypsum is quite soluble and when in solution may have an influence over the steel and concrete used in pipeline construction, by influencing the ionic matrix of the materials. The presence of gypsum will therefore lead to an increased risk of corrosion, which may result in ground collapse beneath foundations and pipes. Within Azerbaijan gypsum is generally only known to occur within the Gobustan region, where gypsum crusts have been recorded in association with very saline soils, especially along silty wadis. However, this region is not crossed by the proposed SCPX route.

7.3.3.7 Soil stability and susceptibility to erosion

This section is based on the SCPX Project Soil Erosion Report that was produced by CB&I in October 2011. The report is based on a desktop review of the proposed route against the erosion control strategies used for the WREP and SCP/BTC pipelines, and fieldwork undertaken in June 2011.

Erosion is a natural process that wears away the land surface and is generally expressed as tonnes of material moved per hectare per year (t/ha). Rates of natural erosion are often relatively low because a state of ‘dynamic equilibrium’ is reached in which the rate of removal is balanced by the rate at which new material is added through soil-forming processes. Where the land surface is disturbed, particularly when vegetation is removed, erosion rates increase.

There are certain areas along the proposed SCPX route (termed ‘badlands’) where the soils are unstable and highly susceptible to erosion and desiccation. Water and wind erosion of soils in these areas has led to the creation of gully and ravine complexes in areas where even moderate relief is encountered.

The CB&I report has classed the soil along the proposed SCPX route using erosion classes outlined in the Erosion Control Manual for Onshore Pipelines. The definition of the erosion classes used has been summarised in Table 7-9.

Table 7-9: Definition of Erosion Classes

Erosion Class	Verbal Assessment	Erosion Rate (tonnes/ha)	Visual Assessment
1	Very slight	<2	No evidence of compaction or crusting of the soil. No wash marks or scour features. No splash pedestals or exposed roots or channels
2	Slight	>2–5	Some crusting of soil surface. Localised wash but no or minor scouring. Rills (channels < 1m^2 in cross-sectional area and < 30cm deep) every 50–100m. Small splash pedestals where stones or exposed roots protect underlying soil
3	Moderate	>5–10	Wash marks. Discontinuous rills spaced every 20–50m. Splash pedestals and exposed roots mark level of former surface. Slight risk of pollution problems downstream
4	High	>10–50	Connected and continuous network of rills every 5–10 m or gullies (> 1m^2 in cross-sectional area and > 30cm deep) spaced every 50–100m. Washing out of seeds and young plants. Reseeding may be required. Danger of pollution and sedimentation problems downstream
5	Severe	>50–100	Continuous network of rills every 2–5m or gullies every 20m. Access to site becomes difficult. Revegetation work impaired and remedial measures required. Damage to roads by erosion and sedimentation. Siltation of water bodies

Erosion Class	Verbal Assessment	Erosion Rate (tonnes/ha)	Visual Assessment
6	Very severe	>100–500	Continuous network of channels with gullies every 5–10m. Surrounding soil heavily crusted. Integrity of the pipeline threatened by exposure. Severe siltation, pollution and eutrophication problems
7	Catastrophic	>500	Extensive network of rills and gullies; large gullies (> 10m^2 in cross-sectional area) every 20m. Most of original surface washed away exposing pipeline. Severe damage from erosion and sedimentation on-site and downstream.

The soil erosion assessment was made using the Universal Soil Loss Equation, which predicts the mean annual soil loss (in t/ha) using the following values:

- Rainfall erosivity factor
- Soil erodibility factor
- Slope steepness factor
- Slope length factor
- Crop management factor
- Erosion control practice factor.

Information on the above factors was collected as part of both the desktop literature review and the field survey undertaken in June 2011. The erosion class and rate that were calculated for the proposed SCPX route, using the above factors, have been presented in Table 7-10. Areas where soils of erosion class 4 and above are encountered have a high sensitivity, and have been highlighted within the table.

Table 7-10: Erosion Classification on SCPX Route

SCPX KP	Estimated Erosion Rate (t/ha)	Erosion Class
0–36.5	2.300	2
36.5–40	2.530	2
40–41	1.380	2
41–89	1.534	2
89–96	1.840	2
96–139.5	2.300	2
139.5–159.5	0.562	1
159.5–172	1.050	1
172–177	0.937	1
177–188	1.022	1
188–190	1.534	1
190–195.5	7.838	3
195.5–222.5	2.300	2
222.5–222.7	8.435	3
222.7–256	2.300	2
256–260.5	8.201	3
260.5–264	25.918	4
264	0.000	
264–303	2.300	2
303	0.000	
303–322.5	2.684	2
322.5	14.953	4
322.5–344.5	2.300	2
344.5	154.851	6
344.5	117.576	6

SCPX KP	Estimated Erosion Rate (t/ha)	Erosion Class
344.5–357.5	2.300	2
357.5	16.747	4
357.5–390	3.408	2

Along the majority of the proposed pipeline route the soil erosion class is either 1 or 2, although four sections were revealed to have a class of 4 or above. An erosion class of 3 was identified in three sections, totalling an approximate length of nine kilometres. In all four sections where an erosion class of 4 or above was identified the SCPX route crosses at least one river. The rivers crossed in each of these sections (highlighted in Table 7-10) are outlined below:

- Sarisu (KP261)
- Asrikchay (KP323)
- Hasansu (KP345)
- Kura West (KP358).

When erodible soils are close to rivers there is a risk of water pollution by sediments moving downstream. In these four sections of the route, erosion is likely to present the biggest challenge with regards to successful reinstatement.

7.3.3.8 *Soil fertility*

Nitrogen, phosphorous and potassium are the elements required in the greatest quantity when considering soil fertility. This section will discuss concentrations of each of these elements within the soils found along the proposed pipeline route.

Nitrogen

The majority of nitrogen in the soil is present in the form of organic nitrogen in large complex molecules that are unavailable to higher plants. Inorganic nitrogen, in the form of ammonium (NH_4) and nitrate (NO_3), are those most readily available to higher plants and the most useful to review when considering soil fertility and will therefore be discussed in the following sections.

Ammonium to nitrate ratio

The concentration of different forms of available inorganic nitrogen is an important variable affecting soil fertility and a mixture of both ammonium (NH_4) and nitrate (NO_3) is considered preferable for optimal plant growth and root proliferation. The optimal NH_4:NO_3 ratio will vary depending on different plant species, internal physiological conditions and external conditions.

Concentrations of NH_4 along the proposed pipeline route vary between 0.82 mg/kg and 10.2 mg/kg, while concentrations of NO_3 show a lot more variation, peaking at 44.5 mg/kg and descending to 0.13 mg/kg. NH_4 is protected from leaching because it is positively charged, while NO_3 moves with the soil water and will leach out of the root zone during heavy rain or move to the soil surface during dry conditions. This explains why NO_3 shows greater variation in concentration.

Between SCPX KP0 and SCPX KP160 along the proposed route, an area that approximately corresponds to the Shirvan plain, NO_3 shows the greatest amount of variation and is predominantly present in greater concentrations than NH_4. Between SCPX KP145 and SCPX KP301 NO_3 shows less variation and levels are very similar to NH_4, while beyond SCPX KP281, NO_3 again shows greater variation, ranging from 1.1 to 24 mg/kg.

Total nitrogen

Results from the current study indicate that total inorganic nitrogen levels along the majority of the proposed pipeline route are relatively low. Between SCPX KP0 and SCPX KP150 nitrogen concentrations show most variation, due to the changes in NO_3 concentration described above. However, in only 11 out of the 29 samples in this area do concentrations exceed 20 mg/kg, and at only two locations, SCPX KP28 and SCPX KP134, do concentrations exceed 35 mg/kg, at 46.6 and 46.1 mg/kg respectively. The lowest value in this section of the route is 6.8 mg/kg at SCPX KP124.

Between SCPX KP160 and SCPX KP364, total inorganic nitrogen concentration, at each location sampled, was below 15 mg/kg. The concentration ranged between 2.73 mg/kg at the proposed Kurdemir Pipe Storage area and 13.4 mg/kg at SCPX KP200. Beyond SCPX KP306.2 the nitrogen concentration exceeded 15 mg/kg at four of the locations sampled, with the highest concentration, 30.9 mg/kg, at SCPX KP332.

Phosphorous

Phosphorous concentrations along the proposed pipeline route are relatively low and only exceed 10 mg/kg at six of the sample locations along the proposed pipeline route and at two of the proposed camp locations (Alternative 1). The highest concentration was found at SCPX KP271 at 38.64 mg/kg, while the lowest was 0.392 mg/kg at SCPX KP210. In seven out of the eight locations where phosphorous levels exceeded 10 mg/kg, the samples were taken from agricultural land, which may explain the relatively elevated levels.

Potassium

Potassium concentrations within soil samples taken from the proposed pipeline route and temporary camp and pipe storage areas ranged from 83 mg/kg at SCPX KP2560 to 964 mg/kg at SCPX KP323. Only seven of the soil samples had concentrations exceeding 600 mg/kg, while the majority of the soil samples had a concentration between 200 and 400 mg/kg. Potassium concentrations along the entire pipeline route are therefore relatively low, although they are within levels that would be expected for the soil types that were encountered.

Summary

Nitrogen, phosphorous and potassium levels in the soil along the proposed pipeline route were relatively low, although they were within levels typical for the soil types identified in the area. While soil fertility is dependent on more than nitrogen, phosphorous and potassium levels, they are able to provide a good indication. Based on the information outlined above, soil fertility along the pipeline route can generally be considered to be low.

7.3.3.9 Potential for dust and silt generation

As outlined in Sections 7.3.3.2 to 7.3.3.4, the soil texture along the proposed pipeline route is predominantly medium to very fine silt. The soil texture is generally finer in the eastern half of the route, the Shirvan Plain, gradually becoming very slightly coarser towards the Georgian border. The fine structure of the soils underlying the route means they are prone to dust generation during dry conditions, with even light traffic having the potential to generate significant amounts of dust. Silt generation is likely along the majority of the route since desiccation of the soil tends to increase the likelihood of silt and fine sand being incorporated into surface water flow.

There is an increased potential for dust and silt generation in areas where there are roadways and unvegetated surfaces, particularly during dry and windy conditions. Along the proposed pipeline route, unvegetated areas are most common in the Shirvan Plain (see Section 7.3.3.2) and in areas of the BTC/SCP and/or WREP ROW that have not been fully reinstated.

7.3.4 Contamination

7.3.4.1 Potential contamination sources and characteristics

Hydrocarbons

In the Shirvan Plain section (KP0 to KP169) the pipeline crosses, or is routed close to, three exploration drilling fields where drilling activities have been undertaken in the past: Small

Harami (north of Hajigabul), Padar and Karadjarle. Contamination within oil fields is usually restricted to the immediate vicinity of the drill site.

In the Karabakh Plain area (KP169 to KP202) the proposed pipeline route crosses the Amirarx oil prospecting area where oil contamination due to bombing of a well during the conflict with Armenia has been reported (Mamedov, 1996). Elsewhere, contamination within these oil fields is usually restricted to the immediate vicinity of the drill site.

In the Ganja-Gazakh Plain area (KP202 to KP390) the pipeline traverses the Borsunlu, Dalimammedli, Giragkasaman, Dallar-Tovuz, Khatunli and Agstafa oilfields, some of which are in operation. There is only local contamination around the drill sites within these fields. One disused oil well near Borsunlu (KP215), which is sited on the proposed SCPX ROW, was identified during BTC/SCP construction as actively leaking oil and water. This disused oil well was also identified during the Phase 1 survey in June 2011.

Municipal waste and contamination

For the majority of its length, the pipeline corridor is within proximity of human settlements, ranging from relatively large cities such as Ganja, through to small villages and hamlets. Information from the national water company indicates that in 2010 approximately 8.3% of the rural population and 54.2% of the urban population was connected to sewerage systems. However, municipal wastewater does not receive any treatment and contamination of surface and groundwater by untreated wastewater, particularly during high precipitation, is a persistent problem.

Within Azerbaijan, municipal solid waste management is primarily focused on Greater Baku and the Absheron peninsula in general. Along the pipeline corridor larger towns, such as Tovuz and Yevlakh, have their own designated waste disposal sites. However, local waste collection services are unable to provide a regular and reliable service. As a result the practice of illegal fly-tipping is relatively common. This was observed during the 2001 baseline contamination survey that was undertaken as part of the BTC/SCP ESIA, which identified numerous instances of fly-tipping. Waste materials identified during this survey included asbestos-containing materials (ACMs), glass, metals, plastic and rags. Municipal waste was also identified during the SCPX Phase 1 survey undertaken in May, June and December 2011.

Agriculture

From approximately KP43, working west on the proposed SCPX route, the landscape is predominantly agricultural. A large proportion of the land is intensively cultivated arable land, used primarily for cereal and cotton production. Towards the Georgian border the type of crops varies and includes potatoes, tomatoes, maize and sunflowers. There is a possibility that the soil in heavily cultivated lands is contaminated with high levels of herbicides and/or pesticides. Trade in unused and obsolete pesticides is known to occur in Azerbaijan, and mismanagement of pesticides, in terms of over application and poor handling, has been described as having a heavy environmental burden in the country. There is a high potential for soil in agricultural areas of the pipeline corridor to be contaminated with agricultural chemicals.

Within the Shirvan Plain section of the proposed pipeline route, the area from Hajigabul to the Kura River east of Yevlakh (KP0–KP169) is a flat land area that has been used extensively for agriculture. The intense farming practices in the area have had a profound effect on the soil characteristics. The land is intensively cultivated arable farmland used mainly for cotton and cereals, with smaller areas of rice and pasture. The soils have become depleted and crops are patchy and sparse in places. There is a possibility that the soils in this area may be contaminated with high levels of pesticides and/or herbicides.

Agriculture in the Ganja-Gazakh Plain is similar in type and intensity to the Shirvan and Karabakh Plains, with the addition of vineyards and orchards towards the west in the foothills of the Lesser Caucasus. There is therefore a possibility that the soils may be contaminated with high levels of pesticides and/or herbicides.

Military

In the Karabakh Plain area the proposed pipeline route crosses the Amirarx oil prospecting area which, as mentioned, was reportedly damaged by bombing during the conflict with Armenia, resulting in local crude oil contamination and the possibility of live ordnance still being found. Unexploded ordnance has been identified between KP168 and KP171.

In the Ganja-Gazakh Plain, there is a military training area north of the western Kura crossing at Poylu (KP358), extending westwards to Jandar Lake and the Georgian Border (KP390). Unexploded ordnance is known to exist in this area also, as a legacy of previous military conflicts and military training exercises.

Radiation

The exploration and production of oil creates a number of potential sources of contamination. Radiation from radionuclides may be released by hydrocarbon operations such as exploration drilling wells, oil collection points and oil storage tanks.

The Ministry of Ecology and Natural Resources (MENR) have several stations throughout the country that monitor background radiation levels. Data exists for several of the major towns along the proposed route including Hajigabul, Kurdemir, Yevlakh, Ganja, Tovuz and Gazakh. Throughout the year background radiation within these locations varies between 6 and 17 μRhr-1 (microradians/hour). Typical background exposure for humans has been estimated to be 31 μRhr-1 (United States Nuclear Regulatory Commission, 2012), which is above the levels recorded at all monitoring stations closest to the proposed pipeline corridor.

Industrial contamination

In the Shirvan Plain section of the proposed pipeline corridor, Hajigabul and Ujar are small industrial bases where industries such as printing, brick making and cotton processing take place. They are also oil storage bases. The proposed pipeline corridor is located 1km to the north of Hajigabul and 5km to the south of Ujar.

The Karabakh Plain area traversed by the proposed pipeline route has the potential for contamination mainly due to the industrialisation at Yevlakh. The industry at Yevlakh includes concrete and ferro concrete production, asphalt production, wool processing and oil storage facilities. The proposed pipeline corridor is located 1km to the south-west of Yevlakh.

Industry, military activity and oil exploration in the Ganja-Gazakh Plain have the potential to cause contamination within the proposed pipeline corridor. The town of Ganja has a high level of industrial activity including concrete production, aluminium oxide production machinery manufacturing (see Photograph 7-12), non-ferrous metal plant, instrument engineering plant, wood processing, furniture manufacture and oil storage facilities. The towns of Tovuz, Kazakh and Agstafa also have oil bases and light industry such as wine distilleries and bread baking. The limited use of up-to-date technology and best management practices for controlling emissions, to air, water and ground, leads to the potential for contamination in such areas. The proposed pipeline corridor is located approximately 8km north of the outskirts of Ganja.

Photograph 7-12: Oxide Aluminium Plant Close to Ganja, Approximately 10km from the Proposed Pipeline Route

7.3.4.2 Contamination on the SCPX route – field survey

SCPX route

Table 7-11 outlines areas of observed contamination along the proposed SCPX route that were identified during fieldwork carried out in May, June and December 2011. Twenty-seven areas of contamination were identified, each of which has been illustrated (see Figure A7-1, Appendix A). The nature of contamination most frequently observed was uncontrolled waste disposal (fly-tipping).

The survey encompassed the proposed pigging station at KP0 and BVRs A6, A7, A8, A9 and A10 at KP21, KP95, KP172, KP243 and KP334 respectively. No contamination was identified at the proposed pigging station or any of the proposed BVRs during this survey.

Pro formas detailing all areas of observed contamination are provided in Appendix C-2 of the EBSR.

Table 7-11: Observed Contamination along the Proposed SCPX Route

Nearest SCPX KP	Unique ID No.	Contaminant	Description
7	SCPXCon01	Asbestos	Fly-tipped AC (asbestos cement) in very poor condition*
8	SCPXCon02	Hydrocarbon	Immediately adjacent to the BTC KP65 marker. It had rained very heavily the previous night and the contamination had washed to the surface. Discussed further in 'Hydrocarbon' section below
23	SCPXCon03	-	Depression in the ground, although no direct evidence of contamination observed
98	SCPXCon04	Asbestos	Small piece of AC observed, no evidence as to

Nearest SCPX KP	Unique ID No.	Contaminant	Description
			where it originated and no other pieces identified
104	SCPXCon05	Metals, mixed waste	Small pile of general waste at side of track, glass and some metal
102	SCPXCon06	Hydrocarbons, metals, mixed waste	Ground discoloured giving slight odour of oil, some waste also present (glass and metal) – likely to be an isolated incident from fly-tipping. Also other waste (glass and plastic) in the vicinity scattered about
140	SCPXCon07	Mixed waste	Fly-tipped waste, mainly glass and plastic, nothing hazardous
149	SCPXCon08	Asbestos, mixed waste	Fly-tipped AC in poor condition, also glass, empty paint tins, bottles, glass and metal – unevenly distributed over an area not restricted to the coordinate location
150	SCPXCon09	Mixed waste	Non-hazardous waste off same track as above
151	SCPXCon10	Asbestos, metals, mixed waste	Rubbish dumped next to trackside: glass, plastic and metal. Profiled AC sheets also present, in very bad condition
187	SCPXCon11	Asbestos, metals, mixed waste	A significant amount of fly-tipping running parallel to canal, opposite BTC KP243, AC observed in poor condition and also general waste. Seems to be an established fly-tipping area
189	SCPXCon12	Asbestos, mixed waste	Well-used fly-tipping area, AC and general waste. Outside of survey zone, but close to proposed route and PSA2
198	SCPXCon13	Asbestos, mixed waste	Fly-tipping area, general waste and poor condition AC, near SCP 253 marker
199	SCPXCon14	Asbestos, mixed waste	AC debris and general waste, adjacent to and in the canal, near SCP 254 marker
215	SCPXCon15	Asbestos	AC debris in small pieces scattered over an area not restricted to the co-ordinate location no sign of source, next to road side
215	SCPXCon16	Hydrocarbon, asbestos	Hydrocarbon contamination on surface, next to disused concrete structure, asbestos insulating board and AC debris also present, adjacent to BTC 271 marker. Old oil well site
231	SCPXCon17	Mixed waste	Fly-tipping, general waste, nothing hazardous
236	SCPXCon18	Asbestos	Small pieces of AC debris scattered along trackside
243	SCPXCon19	Asbestos	AC pipe used to link water channel where track crosses
246	SCPXCon20	Asbestos, mixed waste	Small amounts of AC dumped with other waste
271	SCPXCon21	Asbestos	AC debris on small man-made soil pile
271	SCPXCon22	Asbestos	AC debris and AC pipe crossing underneath track
276	SCPXCon23	Asbestos, mixed waste	Fly-tipping all the way along track side, AC and general waste observed
281	SCPXCon24	Asbestos, mixed waste	Fly-tipping area – poor condition AC and general waste
281	SCPXCon25	Metals	Old car chassis has been fly-tipped
300	SCPXCon26	Asbestos, mixed waste	Fly-tipped AC and general waste
326	SCPXCon27	Metals	Abandoned car shell (no engine)

* "Very poor condition" implies the material is badly damaged with asbestos fibres visible on the surface.

Temporary construction camps and pipe storage areas
Table 7-12 outlines the contamination that was identified at proposed temporary camp and pipe storage areas (Alternative 1 locations) during the December 2011 surveys.

Pro formas detailing all areas of observed contamination are provided in Appendix C-2 of the ESBR.

The nature of contamination most frequently observed was uncontrolled waste disposal (fly-tipping). The proposed site at Dallar was found to contain the most significant quantities of contamination, including:

- Asbestos contaminated land
- Redundant underground storage tank
- Significant quantities of municipal waste.

Table 7-12: Contamination Observed at Proposed Rail Spur, Offloading, Temporary Camp and Pipe Storage Locations

Location	Contaminant	Description
Mugan Pipe Storage	Asbestos	A small section of redundant AC pipe was observed.
	Municipal waste	Small quantities of mixed municipal waste were observed throughout the site, the greatest quantities of which were adjacent to the access track that runs next to the site.
Mugan Rail Spur and Offloading	Municipal waste	Fly tipped waste including needles, clothes and plastics were observed in moderate quantities. The waste was concentrated around the rail spurs.
	Medical Waste	Discarded needles were observed at the site, which were predominantly concentrated around the rail spur.
	Other	Chicken feed was deposited across the rail spur. Historic maps of the area indicate that a factory previously existed on the site. Historical contamination may exist as a result of this.
	Asbestos	Asbestos board was observed to be scattered throughout the eastern area of the site.
Mugan Camp Option 3*	Municipal waste	Very small quantities of municipal waste were observed throughout the site.
Kurdemir Rail Spur and Offloading Area and Kurdemir Camp Option 3*	Asbestos	Two small pieced of AC debris were observed in Area 2
	Municipal waste	Very small quantities of municipal waste were observed throughout all areas. This was predominantly located adjacent to tracks that run next to the areas.
Kurdemir Pipe Storage Area Option 1 (Mususlu)	Municipal waste	General waste including nappies and tins were observed
	Medical waste	Needles, introvenus drips, glass and a number of unidentified waste sacks were observed in the northern part of the site.
Kurdemir Pipe Storage Area Option 2 (Mususlu)	-	None noted during walkover surveys.
Kurdemir Camp Option 5	-	None noted during walkover surveys.
Ujar Camp Option 5	Municipal waste	Household waste was observed at the site
	Asbestos	AC debris waste was observed at the site
Yevlakh Camp Option 1*	Asbestos	AC debris and large redundant asbestos cement pipes were observed in several locations.
	Municipal waste	Municipal waste was observed throughout the site.
	Other	Two small isolated and odourless patches of discoloured soil were observed. The source of the discolouration was not evident and are considered likely to be the result of isolated third party incidents.

Location	Contaminant	Description
Yevlakh Pipe Storage Area	Asbestos	Absestos board debris was observed in Pipe storage area A at edge of rail spur.
Yevlakh Rail Spur and Offloading	-	None noted during walkover surveys.
Gazanchi Pipe Storage Area Option A	Asbestos	Small quantities of asbestos board were scattered throughout the site.
Gazanchi Pipe Storage Area Option B	Asbestos	Small quantities of asbestos board were scattered throughout the site.
Gazanchi Rail Spur and Offloading	Asbestos	Small quantities of asbestos board were scattered throughout the site.
Dallar Pipe Storage Area	Asbestos	Quantities of AC debris were observed in several areas of the site. .A large concrete structure is present in the centre of the area, with large piles of soil/rubble adjacent. AC debris was observed to be mixed into the rubble. A large proportion of the area was comprised of made ground, which was also observed to contain AC debris.
	Other	An isolated oil stain was observed on the made ground; there was no apparent source for this and is considered likely to be an isolated incident.
	Municipal waste	Small quantities of municipal waste were observed in several areas of the site.
Dallar Rail Spur and Offloading	Asbestos	AC debris was throughout the site, and was also mixed in with a large pile of municipal waste in the eastern section of Area 4.
	Municipal	Large quantities of municipal waste were observed in the eastern section of the site.
	Other	Two large redundant metal containers/tanks were observed in the centre of the site. A square container/tank containing a bituminous product was observed in the centre of the site. Also in the centre of the site a large underground storage tank is present, which was partially filled with a bituminous product.
Dallar Pipe Storage Area, Option 1B (Bayramli)	-	None noted during walkover surveys.
Goranboy Camp and Pipe Storage 1*	Asbestos	Large quantities of AC debris
	Municipal waste	Small quantities of municipal waste were observed adjacent to the road that runs parallel to the site. Large quantities of municipal waste were observed to the north of the site, outside the proposed area.
Goranboy Camp Option 3	Medical waste	Small quantities of medical waste, including syringes, were observed at the site
	Municipal waste	Municipal waste, including glass, plastics and razors, were observed throughout the site
Samukh Camp Option 3		No contamination was observed during the site visit
Tovuz Camp Option 5*	Asbestos	In the western corner of the site AC debris was observed.
	Municipal waste	Small quantities of municipal waste were observed along the roads that surround the proposed site.
Agstafa Pipe Storage and Offloading Areas*	Asbestos	Within Area 2 small quantities of asbestos cement were observed
	Municipal	Very small quantities of municipal waste were observed throughout the site.
Agstafa Camp Option 3	-	No contamination was observed during the site visit
Poylu Pipe Storage Area	-	No contamination was observed during the site visit
Poylu Rail Spur and Offloading	-	No contamination was observed during the site visit

Location	Contaminant	Description
Saloghlu Rail Spur and Offloading	UXO	Due to the presence of UXOs, a site walkover was not undertaken
Saloghlu Camp	UXO	Due to the presence of UXOs, a site walkover was not undertaken
Saloghlu Pipe Storage Area	UXO	Due to the presence of UXOs, a site walkover was not undertaken

* Temporary facilities that have subsequently been rejected and are no longer being considered

Baseline data regarding contamination at the ‘Alternative 2’ temporary construction camps, pipe storage areas and rail spurs was provided by both the Alternative 2 Construction Camp Reconnaissance Reports (CB&I, September 2012) and Environmental and Social Field Survey Report (BP, 2013).

Hydrocarbons

At KP8 hydrocarbon contamination was identified during the Phase 1 survey following very heavy rain the previous night and the rainwater appeared to have washed the contamination to the surface (see Photograph 7-13). The contamination was predominantly located on the BTC/SCP ROW, although it was also present in areas adjacent to the ROW, including within 100m of the proposed SCPX centreline.

The source of the contamination at KP8 is not clear. The oil was distributed in patches over a relatively large area. There was no aboveground installations observed in the vicinity of the contamination and at the time of the survey there were no temporary features observed that could explain the presence of the oil. Additionally, no records exist of any accidents or spills in the area that could explain the contamination. It is possible that the contamination was caused by a third party incident. This is supported by a BP investigation (2011-EVENT-3883797) undertaken in May 2011 that concluded the oil migrated towards the pipeline from a nearby ditch following heavy rain. However, to understand the source and age of the contamination at KP8 fully, further investigation would be required.

Photograph 7-13: Hydrocarbon Contamination Identified at KP8

The hydrocarbon contamination observed at KP215 was previously identified in the baseline contaminated land survey for BTC/SCP. This stated there was a disused oil well near Borsunlu, at KP215, that was actively leaking oil and water into three lagoons, which was confirmed by the current survey. The disused well is located within 100m of the proposed SCPX centreline.

The contamination identified at both KP8 and KP215 were highlighted for further investigation (Phase 2), and surface soil samples were collected for laboratory analysis.

Table 7-13 summarises the analysis results for each site. The full results are presented in Appendix C-3 of the ESBR.

Table 7-13: Sample Analysis Results for KP8 and KP215

Parameter	Unit	KP8	KP215
TPH	mg/kg	188	12809
PAH	µg/kg	251	15950
Benzene	mg/kg	3.5	0.1
Toluene	mg/kg	3.1	1.3
Ethylbenzene	mg/kg	1.8	0.5
Xylene	mg/kg	4.2	0.8
Phenol	µg/kg	<1.0	27
Arsenic	mg/kg	11.4	7.4
Cadmium	mg/kg	0.24	0.69
Chromium	mg/kg	30.3	21.2
Copper	mg/kg	42.4	41.5
Mercury	mg/kg	0.026	0.017
Nickel	mg/kg	54.7	44
Lead	mg/kg	12.1	22
Selenium	mg/kg	<0.25	<0.25
Zinc	mg/kg	66	61.3

Heavy metal and phenol concentrations at both sites are below the UK Environment Agency soil guideline values (SGVs) for commercial/industrial use. The concentrations of individual polycyclic aromatic hydrocarbon (PAH) compounds at both sites are below the typically adopted general assessment criteria (GAC) limits for commercial/industrial use. However, for total petroleum hydrocarbon (TPH) the concentrations at both sites are above widely accepted maximum target levels.

Analysis of the chemical fractions within the TPH shows that at both sites mineral oils (C_{16}–C_{35}) make up the majority of the sample. At KP8 mineral oils represented over 50% of the TPH sample, while at KP217 it was over 90% of the sample. A high proportion of mineral oils, which are relatively viscous, may suggest the oil has been in situ for a relatively long period of time, and the more volatile compounds, including benzene, toluene, ethylbenzene and xylene have had time to dissipate. However, a higher proportion of mineral oil is not necessarily indicative of the age of contamination and should not be used as definitive evidence.

As mentioned above, the contamination at KP215 can be attributed to an abandoned oil well, which had previously been identified in the BTC/SCP ESIA. The oil well is known to have been inactive for several years and contamination is likely to have existed at the site since this time, which is consistent with high mineral oil content.

Fly-tipping and asbestos
Surface contamination through the fly-tipping of waste was observed in a number of locations along the proposed SCPX route. This was predominantly mixed municipal waste including materials such as glass, plastic, metals, clothes and rags. In tandem with fly-tipped

general waste, and also separately, ACMs were identified at several locations, e.g. at KP187. This was primarily asbestos cement (AC), although asbestos insulating board (AIB) was identified at one of the locations, KP215. Fly-tipping was always located within close proximity to tracks and roads.

7.3.5 Sensitivities

Key issues relating to both soil and contamination, associated with construction and operation of the proposed SCPX pipeline, have been outlined below.

7.3.5.1 Soil

- Many of the soils encountered along the proposed pipeline route exhibit high levels of salinity, which can contribute to accelerated corrosion of both steel and concrete
- The texture of the soils along the majority of the proposed pipeline route is very small, primarily fine silts and clays, which are considered more prone to erosion
- Four areas of the pipeline route, SCPX KP260–264 (around the Sarisu crossing), SCPX 321-327 (narrow erodible ridges on approaches to Asrikchay and Tovuzchay), SCPX KP344-347 (approaches to the Hasansu) and SCPX KP358 (around the positive banks of the Kura West crossing), are noted as having a particularly high erosion potential
- Topsoil depth is very thin (less than 5cm) in many places along the route
- The small particle size of the soils means they are more prone to compaction, have poor traffic-ability when wet and are prone to dust generation during dry conditions
- Within the Karabakh and Ganja-Gazakh Plains the proposed pipeline route is predominantly routed through agricultural land that is used for cereal production.

7.3.5.2 Contamination

- Contamination was identified at various locations along the proposed SCPX route and at the proposed temporary construction camps and pipe storage areas
- The identified contamination was primarily low levels of municipal waste and asbestos cement, although other types of contamination were identified
- The majority of contamination identified appeared to be the result of ongoing fly-tipping by third parties. Therefore, it is likely to be an ongoing issue regardless of any remediation efforts
- Hydrocarbon contamination was noted on the SCPX route at KP8 (unknown source) and at KP215 (old, leaking oil well)
- There is no clear source for the hydrocarbon contamination identified at KP7, although it is likely to be the result of an isolated third-party incident
- There may be a health and safety risk to workers and the local population during both construction and operation. The risk to construction workers is likely to be greatest due to the potential for actively disturbing the contamination (e.g. ACMs)
- Pre-existing contamination along the proposed pipeline route being incorrectly attributed to SCPX construction activities or subsequent operation
- Unexploded ordnance is known to exist within vicinity of Saloghlu Rail Spur and Offloading Area, Saloghlu Camp and Saloghlu Pipe Storage Area
- The potential for the presence of unexploded ordnance (UXO) has been identified in two areas along the ROW. The first area, to the west of the Kura West crossing (KP358–KP390), has already been cleared and declared safe; the second, around the Kura East crossing (KP167–KP172) will be cleared in the near future. There is, however, the potential for additional areas of UXO to be identified should the project footprint change.

7.4 Landscape and Visual Receptors

7.4.1 *Introduction*

This section presents a description of the baseline landscape conditions and visual receptors along the proposed SCPX route. It is based primarily on data collected from field surveys along the SCPX route in May and June 2011 and the results of BP landscape monitoring of the existing BTC pipeline and SCP in 2011, supplemented by information from other previous reports.

The section begins by reviewing the data sources and field survey methodology used to gain an understanding of the baseline landscape conditions. Subsequent to this the section provides a general description of the landscape in terms of its character, quality and sensitivity to change. It also identifies the main groups of visual receptors and their sensitivity to change. It should be noted, however, that the pipeline will be buried, so landscape and visual impacts are temporary and linked to the construction and post-construction restoration phases of the pipeline and its associated temporary construction camp and pipe storage areas, with the except of the block valve sites (BVR A5–A10) and the pigging station at KP0).

7.4.2 *Methodology*

7.4.2.1 *Data sources*

The information included here has been collated from a number of sources, including previous reports for the WREP and BTC/SCP, owing to the generally close proximity of the proposed SCPX route to these pipelines.

The existing sources that have been used in producing this section are outlined below:

- Baseline survey of those areas where the proposed route of the BTC/SCP pipeline deviated significantly from the WREP undertaken by AETC on behalf of BP, January–February 2001
- Rapid reconnaissance survey of the WREP undertaken by Environmental Resources Management (ERM) on behalf of BP, August/September 2000
- Baseline data acquisition for BTC/SCP ESIAs undertaken by AETC on behalf of BTC Co. and SCP Partners, 2001.

In addition to the above, this section has also drawn upon information generated by the ongoing BTC/SCP landscape monitoring programme, which began in 2005 and is updated biannually.

7.4.2.2 *Overview of SCPX landscape survey*

The baseline landscape and visual assessment survey has been undertaken with regard to the following best practice (UK) guidelines and international standards:

- Environmental and Social Policy and Performance Requirements, European Bank for Reconstruction and Development (PR1, PR6 and PR8 as appropriate)
- Guidelines for Landscape and Visual Impact Assessment (Second Edition), Landscape Institute and the Institute of Environmental Management and Assessment, 2002.

However, these standards and guidelines have been applied in the context of the existing BTC/SCP landscape monitoring procedure for the BTC/SCP pipelines. The BTC/SCP landscape monitoring procedure was set up to provide a visible demonstration of the restoration of the landscape following construction of these pipelines and to:

- Provide a tool that allowed the success of the reinstatement and bio-restoration to be measured
- Monitor the need for, and implementation of, corrective actions
- Keep managers informed regarding the success of existing mitigation measures or the need to implement new ones.

Monitoring of the BTC and SCP right of way (ROW) has been taking place since 2005 and consists of taking a time-series photographic record at locations along the pipeline route that are representative of the range of landscape types crossed by the existing pipelines. The difference between this and UK guidelines and international standards for landscape and visual assessment is that the latter envisage that surveys are undertaken from the point of view of the potential receptor, such as the nearest settlement or road.

For the SCPX survey, photographs were taken along the pipeline route as the BTC/SCP methodology has the advantage that it facilitates closer monitoring of landscape restoration than would be possible if the photograph was taken from a receptor, as these are often distant from the proposed pipeline route. However, in addition, views from any receptors have been described during the survey. The methodology adopted therefore represents a combination of the two approaches, designed to both ensure that potential landscape and visual impacts from receptors are assessed and a baseline for post-construction assessment of landscape restoration established.

7.4.2.3 Survey locations

Survey locations were chosen where the proposed SCPX route deviates significantly from the BTC/SCP route (i.e. where it is more than 100m from the existing pipeline). Fourteen locations on the proposed SCPX route were selected for monitoring. The monitoring locations are numbered from AZLM1 to AZLM14 and are shown on Figure A4-1 in Appendix A of the ESBR. The survey locations were recorded using a high-accuracy GPS with sub 1m accuracy to facilitate post-construction monitoring. The locations of any new vantage points identified in the field were recorded using the GPS unit.

Where the proposed SCPX route runs within 100m of the existing BTC/SCP route, the existing monitoring locations have been used to inform the assessment of baseline conditions, see Section 7.4.2.2.

The pigging station and block valve (BVR) stations (as described in Chapter 5 and shown on Figure A7-1 in Appendix A) were not surveyed but landscape type and character have been identified here on the basis of existing BTC/SCP information as they are located close to the existing pipelines. This is adequate given the small area and low height of these sites and the fact that the BVRs will be collocated with existing SCP BVRs.

The proposed temporary construction camp and pipe storage areas were not included in the landscape and visual survey as they were not defined at the time of that survey. However, information on these sites was gathered from photographs taken during separate site visits undertaken as part of a preliminary environmental and social appraisal of camp and storage area location options. The locations of the proposed temporary camp and pipe storage areas are shown on Figure A7-1 in Appendix A.

7.4.2.4 Survey methods

Four high-definition photographs were taken at each of the survey locations along the proposed SCPX pipeline route (AZLM1 to AZLM14, as shown on Figure A4-1 in Appendix A, ESBR), facing north, east, south and west, using a standard camera lens with a focal length between 18–55mm, in accordance with the standards established for monitoring of the existing pipelines. Figures A4.2–A4.15 in Appendix A of the ESBR show the photographs taken at each of the monitoring locations.

The surveys were conducted in spring and early summer, as recommended in the procedure for monitoring the existing pipelines.

At each location, a pro forma was completed, including information on land-use and crop type, existing development (e.g. pylons, pipelines, industry), landscape character, receptors that can view the proposed pipeline route and the likely view of the SCPX from these receptors. Copies of the completed pro formas for each location are in Appendix D of the ESBR.

7.4.2.5 Assessment of likely importance and sensitivity of baseline landscape character and visual receptors

The assessment of the likely importance and sensitivity of the landscape and visual receptors is based on the Guidelines for Landscape and Visual Impact Assessment (Second Edition), published by the Landscape Institute and the Institute of Environmental Management and Assessment (2002).

Landscape assessment is based on an evaluation of the existing (baseline) landscape character, condition and quality. When completing the description of the baseline conditions for the proposed SCPX Project the following elements have been identified and considered:

- Land form and land use
- The presence of specific landscape elements, whether natural or man-made
- The presence of items that detract from the landscape, such as modern intrusive built developments
- The overall scale of the landscape
- The overall coherence and integrity of the landscape and/or the extent of fragmentation
- The sensitivity of the landscape to change, which is a function of landscape quality and value.

The visual assessment has involved an evaluation of the baseline visual context, the identification of visual receptors, and an assessment of their sensitivity to change. Sensitivity is a function of the location and existing visual context of the receptor or viewpoint, the expectations and occupation or activity of the receptor, and the importance of the view.

On the basis of the above assessments the likely importance of the landscapes crossed and their potential sensitivity to change, and the likely importance and sensitivity of the visual receptors affected, has been classified into categories ranging from very low to very high. More information on this process is given in Chapter 3 and also the categories are defined in Appendix B of the ESBR.

By their nature these judgements are subjective, to varying degrees, based on the evidence available and the spatial scale at which they are applied. The assessments made are therefore qualified, where appropriate.

7.4.2.6 Technical difficulties or uncertainties

Between SCPX KP364 and KP366 there is a section of the proposed SCPX route, approximately 1.5km in length, that runs 200m from the existing BTC/SCP pipelines. This location was not surveyed owing to the potential presence of unexploded ordnance (UXO), which prevented the surveyors from gaining access to the area. However, existing BTC/SCP monitoring data is considered sufficient to inform the assessment of baseline conditions in this area.

7.4.3 Landscape Context

The proposed route of the SCPX is largely located in the lowlands associated with the River Kura. The Kura lowlands, along with the lowlands associated with the Araz River, are the dominant landscape features in the centre of Azerbaijan, from the north-west to the south-east, where the rivers flow into the Caspian Sea. They can be seen clearly outlined on large-scale topographical maps, bordered by the Caucasus mountains to the north and west, and the Talysh mountains to the south.

7.4.4 Landscape and Visual Baseline

7.4.4.1 Introduction

The proposed SCPX route between KP0 and KP390 can be broadly divided into two landscape sections: the Shirvan and Karabakh Plains between KP0 to KP202; and the Ganja-Gazakh Plain between KP202 and KP390. The landscape has been presented in satellite imagery maps (see Figure A4-1 in Appendix A, ESBR) and also using photographs that were taken at each of the monitoring points during the current baseline survey (see Figures A4.2–A4.15 in Appendix A, ESBR).

7.4.4.2 Shirvan and Karabakh Plains

Between KP0 and KP202 (Mugan to Ganja), the proposed SCPX route is characterised by a generally flat landscape dissected by an inter-connecting network of drainage and irrigation channels. The most prominent landscape features in this section are the Greater Caucasus mountains to the north, the Lesser Caucasus mountains to the south (visible from the main highway on clear days), and the Kura River valley. Owing to the general lack of woodland or other tall features, and the flat landscape, visibility typically extends for several kilometres to the horizon in most places, although features low to the ground are obscured by small-scale changes in topography.

There are settlements scattered along the main east–west highway from Baku to Tbilisi (which the proposed pipeline follows for most of this section), ranging from large settlements such as Kurdemir and Yevlakh, to more numerous small villages and roadside services. Many of the villages have locally non-native trees (predominantly hybrid *Populus* spp. (poplars)) planted along the outskirts and minor roads. These tree belts and lines often limit views from houses and businesses towards the pipeline, see Photograph 7-14.

Photograph 7-14: View North from the Proposed SCPX Route at KP117 towards a Small Village Marked by a Line of Trees on the Horizon

The land use in this section of the route comprises both uncultivated scrub and grassland used for sheep herding and arable cultivation. The network of irrigation ditches and drainage canals form prominent landscape features at a local scale. Most of them are maintained by regular dredging, with the excavated material piled on top of the banks to form earth embankments up to 2m high along the larger ditches and rivers.

The Kura River valley is a broad, largely flat floodplain. The Kura River itself is crossed by the proposed route near to the town of Yevlakh at KP168. The landscape of this section comprises arable fields (primarily barley and other cereal crops). However, there are fragments of remnant tugay forest in the Kura floodplain (although none are crossed by the proposed SCPX route), several oxbow lakes and floodplain *Tamarix* (tamarisk) scrub.

Existing man-made features (including power lines on the main highway and into villages; villages and towns; aboveground water pipelines and buried pipelines and services) further detract from the already low landscape quality of this section of the SCPX route. In addition, many of the existing third-party pipelines in this area have either not been reinstated or have subsequently been exposed. Owing to the arid nature of the environment and the fragility of the soils, they often remain un-vegetated, detracting from the landscape character at the local scale.

In addition to houses and businesses in the vicinity of the route, the other visual receptors comprise passing traffic on the roads, livestock herders and agricultural workers.

The pigging station at KP0 (see Photograph 7-15) and BVRs A6, A7 and A8 (see Photograph 7-16, Photograph 7-17 and Photograph 7-18 respectively) are located within this section of the pipeline route at KP21, KP95 and KP172 respectively.

Photograph 7-15: View North from the Proposed Pigging Station Location at SCPX KP0

Photograph 7-16: View of the Proposed BVR Location at SCPX KP21 (BVR A6)

Photograph 7-17: View of the Proposed BVR Location at SCPX KP95 (BVR A7)

Photograph 7-18: View of the Proposed BVR Location at SCPX KP172 (BVR A8)

7.4.4.3 Ganja-Gazakh Plain

Between SCPX KP202 and the Georgian border, an area that corresponds with the Ganja-Gazakh Plain, the land is differentiated by an increasingly more undulating topography, with several deeply cut river valleys such as the Asrikchay at KP322, the Tovuzchay at KP323, and the Hasansu at KP345, the approaches to which comprise steep erodible ridges (see Section 7.3.5.1).

The proposed pipeline route crosses mostly agricultural land around the city of Ganja and west to the town of Shamkir (between KP210 and KP286). The topography here is generally flat to rolling and dominated by cultivation for cereal crops. This section is sparsely populated with few houses or settlements and very few surfaced roads (although there are numerous field tracks and unsurfaced roads leading to small settlements). BVR A9 at KP243 is located within this area (see Photograph 7-19).

Photograph 7-19: View of the Proposed BVR Location at SCPX KP243 (BVR A9)

West of the town of Shamkir, between KP286 and KP358, the topography becomes increasingly undulating owing to a number of small rivers draining into the Mingechevir and Shamkir reservoirs to the north. Visibility distances in this section are between 1–10km due to the undulating topography. BVR A10 at KP334 is located within this area (see Photograph 7-20). The landscape quality along the proposed SCPX route is greater in this section as it is less intensively farmed. Much of the steeper ground is uncultivated, semi-natural land supporting ecologically valuable and species-rich vegetation and predominantly used for sheep grazing. In this section there are also fewer man-made features detracting from the landscape character than there are in the flat lowlands and fewer, smaller settlements (see Photograph 7-21).

Photograph 7-20: View of the Proposed BVR Location at SCPX KP334 (BVR A10)

Photograph 7-21: Undulating Landscape Looking South from the SCPX Route at KP342, with Semi-natural Vegetation and no Visual Detractors

Although this section of the proposed pipeline route has a greater landscape value, it also has few potential human receptors. The main receptors are shepherds as settlements tend to consist of small villages with limited views of the surrounding landscape, owing to their position and because views are obscured by trees and houses.

West of the Kura River, between KP358 and KP390, the land becomes generally quite flat again and is both cultivated for crops and used as open grazing land. Existing features affecting the landscape character in this section include roads, power lines and pipelines (both above and below ground).

7.4.4.4 Condition of existing BTC and SCP right of way

To observe the progress of restoration of the landscape along the existing BTC and SCP ROW in Azerbaijan, 90 vantage points have been monitored by BP biannually from 2005. As of May 2011, monitoring had ceased at 13 of the vantage points, because the areas were considered fully restored. Generally, there is a positive improvement at all selected landscape vantage points, with many exhibiting extremely high restoration levels (see Figure 7-19). BTC KP0–147 is showing the least positive restoration, with many locations being less than 50% restored to original value, while in the central and western sections restoration is considered to be between 65% and 95%.

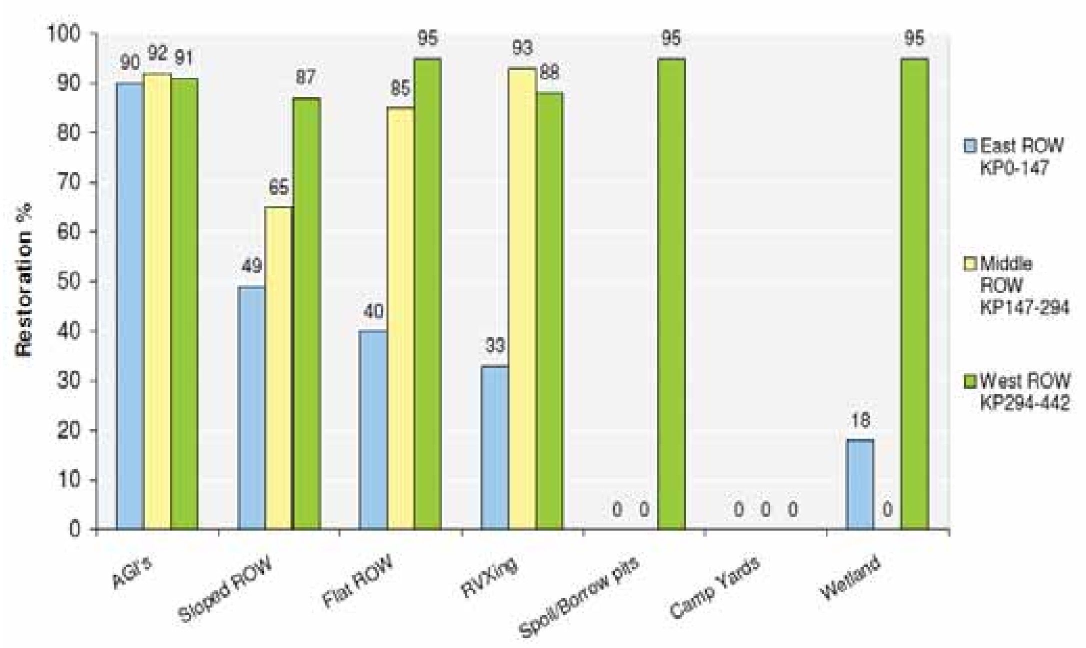


Figure 7-19: Results of Ongoing Monitoring of BTC/SCP ROW from the 2011 Landscape Monitoring Survey

7.4.4.5 Temporary construction camp and pipe storage areas

Mugan Camp Option 3* and Mugan Pipe Storage Area

The proposed temporary construction camp at Mugan is a greenfield site located on the Shirvan Plain, an area considered of low landscape importance and sensitivity, as described in Section 7.4.4.2. It is located approximately 1km north-east of the nearest community, i.e. at a considerable distance from sensitive visual receptors. The nearby pipe storage area at Mugan is adjacent to a railway line approximately 20m outside of the community boundary, although is approximately 80m from the nearest house. Photograph 7-22 is a view of the camp and Photograph 7-23 is a view of the pipe storage area.

Photograph 7-22: View of Mugan Camp Option 3

Photograph 7-23: View of Mugan Pipe Storage Area

Mugan Rail Spur and Offloading

The proposed rail spur at Mugan (see Figure A7-1, Appendix A) is located on a brownfield site within the Shirvan plain (see Section 7.4.4.2), so it is within an area considered of low landscape importance. Residential buildings are located approximately 200m southwest of the proposed site. Photograph 7-24 shows a view of the site.

Photograph 7-24: View facing southwest from northeast corner of Mugan Rail Spur site

Kurdemir Option 4*

The proposed temporary construction camp and pipe storage area at Kurdemir (Alternative 2) is located on agricultural land within the Shirvan plain (see Section 7.4.4.2), so it is within an area considered of low landscape importance. It is located approximately 0.75km north of the nearest community and south of the east-west (Baku to Georgia) highway, i.e. at a considerable distance from sensitive visual receptors. Photograph 7-25 shows a view of the site.

Photograph 7-25: View from East Boundary of Kurdemir Camp Option 4

Kurdemir Pipe Storage Area Option 1 (Mususlu) and Kurdemir Rail Spur and Offloading Area

The proposed temporary pipe storage area and rail spur and offloading area at Kurdemir (Alternative 1 and 2)(see Figure A7-1 in Appendix A) is located on a greenfield site within the Shirvan Plain (see Section 7.4.4.2) so is within an area considered of low landscape importance. It is over 500m from the nearest houses so there are no nearby visual receptors. The nearby proposed pipe offloading area at Kurdemir (Alternative 1 and 2) (see Figure A7-1 in Appendix A) is also within the Shirvan Plain and is, additionally, located on a previously developed site, with extant demolition rubble, so is considered of very low landscape importance. It is close (50m) to houses, including one house between the two proposed rail spur options and new houses to north of western area. but these are located on the opposite side of the existing railway line, so the residents of these already view the railway. Photograph 7-26 is a view of the temporary camp and pipe storage area and Photograph 7-27 is a view of the pipe offloading area.

Photograph 7-26: View of Proposed Kurdemir Pipe Storage Area Option 1 (Mususlu)

Photograph 7-27: View from Proposed Kurdemir Rail Spur and Offloading Area towards Railway and Settlement

Kurdemir Pipe Storage Area Option 2 (Mususlu)

The site for the proposed Kurdemir Pipe Storage Area Option 2 (Mususlu) (see Figure A7-1, Appendix A) is currently agricultural, and was observed during the walkover survey to be used for wheat production. It is situated within the Shirvan plain (see Section 7.4.4.2) and is considered to be of low landscape importance. The site is approximately 50m away from the nearest houses. Photograph 7-28 is a view of the proposed site.

Photograph 7-28: Southern end of site, wheat production

Kurdemir Camp Option 5

The site for the proposed Kurdemir Camp Option 5 (see Figure A7-1, Appendix A) is currently agricultural, and is used for grazing. It is situated within the Shirvan plain (see Section 7.4.4.2) and is considered to be of low landscape importance. Photograph 7-29 is a view of the proposed site.

Photograph 7-29: View facing east, of the proposed Kurdemir Camp Option 5 site

Ujar Camp Option 5

The proposed temporary construction camp (Alternative 2) at Ujar (see Figure A7-1 in Appendix A) is located on land that is likely to have been used in the past for cotton growth. It is situated within the Shirvan plain (see Section 7.4.4.2) and is considered to be of low landscape importance. It is close to the village of Garaberk and there are houses located to the north and west that will view the site, although views from the west may be filtered by existing trees. Photograph 7-30 shows a view of the site.

Photograph 7-30: View North from South-West Corner of Ujar Camp Option 5

Yevlakh Camp Option 1*

The proposed temporary construction camp at Yevlakh (Alternative 1) is located within the Karabakh Plain, as described in Section 7.4.4.2, on the western edge of an existing industrial area and was used as a temporary construction camp site during BTC/SCP pipeline construction. It is therefore considered to be of very low landscape importance. The camp is located approximately 100m from two houses located in a neighbouring field. The residents of these, if they are occupied, may therefore be able to view the site. Photograph 7-31 shows a view of the site.

Photograph 7-31: View of Yevlakh Camp Option 1

Yevlakh Pipe Storage Area and Yevlakh Rail Spur and Offloading

Both the proposed temporary pipe storage area and proposed rails spur at Yevlakh are located within the Karabakh Plain, as described in Section 7.4.4.2, and are considered to be of very low landscape importance. Both sites are approximately 50m away from the nearest house. Photograph 7-32 shows a view of the rail spur.

Photograph 7-32: View west along rail spur

Gazanchi Rail Spur and Offloading

The proposed site at Gazanchi (see Figure A7-1, Appendix A) is situated on disturbed brownfield land. The site is situated within the Ganja-Gazakh plain (see Section 7.4.4.3), which is considered of low landscape importance. The site is approximately 100m from the nearest dwelling. Photograph 7-33 shows a view of the site.

Photograph 7-33: View facing west across Gazanchi Rail Spur and Offloading

Gazanchi Pipe Storage Area Option A and Gazanchi Pipe Storage Option B

Option A at Gazanchi (see Figure A7-1, Appendix A) is located on disturbed shrubland, Option B lies on disturbed, mainly unvegetated and currently unfarmed land, both of which are situated within the Ganja-Gazakh plain (see Section 7.4.4.3), which is considered of low landscape importance. Option B is approximately 50m from the nearest dwelling, which is a large farmhouse that houses approximately 20 – 30 individuals. Photograph 7-34 and Photograph 7-35 show a view of each site.

Photograph 7-34: View north from Option A, Gazanchi village is in the background

Photograph 7-35: View of near-by farmhouse taken from the southwest corner of Option B (looking north)

Goranboy Camp Option 3

The proposed temporary construction camp at Goranboy (Alternative 2) (see Figure A7-1 in Appendix A) is situated within the part of the Ganja-Gazakh plain (see Section 7.4.4.3) that is considered of low landscape importance. The site is bordered by trees along the south-west boundary (see Photograph 7-36) and a tree belt along the eastern boundary. There are also scattered trees along the southern boundary. There are only scattered buildings in the area, none of which are close to the site. The nearest community (Borsunlu) is 1.5km to the north-west.

Photograph 7-36: View North from South-West Corner of Goranboy Camp Option 3

Camp and Pipe Storage Areas Goranboy 1 and Goranboy 2*

The proposed temporary construction camp and pipe storage areas at Goranboy (Alternative 1) (see Figure A7-1 in Appendix A) is located on a greenfield site within the Ganja-Gazakh Plain in the section between KP210 and KP286 that is considered, in Section 7.4.4.3, to be of low landscape importance. It is located approximately 500m from the nearest houses. Photograph 7-37 is a photograph of the site.

Photograph 7-37: View of Camp and Pipe Storage Areas Goranboy 1 and Goranboy 2

Zazali rail spur *
The Zazali rail spur storage site (Alternative 1) is located on industrial land adjacent to the existing railway and a factory. It is located within the Ganja-Gazakh Plain in the section between KP210 and KP286 and is considered, in Section 7.4.4.3, of low landscape importance. However, at the local level it is considered to be of very low landscape value. Photograph 7-38 is a photograph of the site. The site is located approximately 200m from a small community.

Photograph 7-38: View of Zazali Rail Spur Storage Area

Dallar Pipe Storage and Dallar Rail Spur and Offloading
The proposed Dallar pipe storage and rail spur site (Alternative 1) (see Figure A7-1 in Appendix A) is located within the part of the Ganja-Gazakh Plain, between KP286 and 358, and is considered of generally medium landscape value, see Sections 7.4.4.3 and 7.4.5. However, at the local level, the site is located on previously developed industrial land, which

is considered to be of very low landscape importance. The site is close (50m) to the nearest houses. Photograph 7-39 is a photograph of the site.

Photograph 7-39: View of Proposed Dallar Pipe Storage and Dallar Rail Spur and Offloading Area (to Left of the Road)

Dallar Pipe Storage Area, Option 1B (Bayramli)

The proposed temporary pipe storage area (Alternative 2) at Bayramli (see Figure A7-1 in Appendix A) is predominantly grazing land and is situated within the part of the Ganja-Gazakh plain (see Section 7.4.4.3) considered to be of low landscape importance. The proposed site is within close proximity of the village of Bayramli. Photograph 7-40 shows a view of the proposed site, with Bayramli village in the background.

Photograph 7-40: View of proposed pipe storage area, with Bayramli village in the background

Samukh Camp Option 3

The proposed temporary construction camp area (Alternative 2) at Samukh (see Figure A7-1 in Appendix A) is situated within the part of the Ganja-Gazakh plain (see Section 7.4.4.3) considered to be of low landscape importance. The area immediately north-west of the site, and adjacent to the main road is currently being prepared for residential development. There is also a memorial on the north-west corner of the land area and a few other buildings along the northern boundary that will view the site. However, the nearest community is 1km to the south-west of the site. Photograph 7-41 is a photograph of the site. There is a belt of shrubs along the south-west boundary.

Photograph 7-41: View North-East from South-West Corner of Proposed Samukh Camp Option 3

Tovuz Camp Option 5*

The area of the temporary construction camp at Tovuz (Alternative 1) is enclosed within an old reservoir and surrounded by the reservoir's banks. The site is within the part of the Ganja-Gazakh Plain, between KP286 and 358, that is considered to be of generally medium landscape value, see Sections 7.4.4.3 and 7.4.5. The nearest houses are 150m distant, on the opposite side of the bank walls. Their residents may have partial views of the site over the banks and the site may also be visible from a track to the community next to one of the site's boundaries. Photograph 7-42 is a photograph of the site.

Photograph 7-42: View of Proposed Tovuz Camp Option 5

Agstafa Pipe Storage Areas* Options 1, 2, 3 and 5 and Agstafa Offloading Area 4*
The Alternative 1 pipe storage and offloading areas at Agstafa are situated adjacent to each other in the part of the Ganja-Gazakh Plain, between KP286 and 358, considered to be of generally medium landscape value, see Sections 7.4.4.3 and 7.4.5. However, the sites are on previously developed land near an old factory so, at the local level, are located on land considered of very low landscape importance. The nearest community is approximately 1km distant. Photograph 7-43 is a characteristic view of the area.

Photograph 7-43: View of Agstafa Pipe Storage Areas and Offloading Area

Agstafa Camp Option 3
The proposed Alternative 2 temporary construction camp area at Agstafa (see Figure A7-1 in Appendix A) is in the part of the Ganja-Gazakh Plain, between KP286 and 358, considered to be of generally medium landscape value, see Sections 7.4.4.3 and 7.4.5. See Photograph 7-44 for a view of the area. However, the site itself is flat and with no natural features of interest so is regarded as of low landscape value when compared to the more undulating hilly areas that are present elsewhere on this section of the pipeline route. The area is sparsely populated, but there is a satellite receiving station and buildings to the north that will view the site from a distance.

Photograph 7-44: View North from South East Corner of Proposed Agstafa Camp Option 3

Poylu Pipe Storage Area

The proposed temporary pipe storage area at Poylu (see Figure A7-1 in Appendix A) is in the part of the Ganja-Gazakh Plain, between KP286 and 358, considered to be of generally medium landscape value, see Sections 7.4.4.3 and 7.4.5. The temporary pipe storage area is situated on pasture land. See Photograph 7-45 for a view of the area.

Photograph 7-45: View of proposed pipe storage area at Poylu

Poylu Rail Spur and Offloading

The proposed rail spur at Poylu (see Figure A7-1 in Appendix A) is in the part of the Ganja-Gazakh Plain, between KP286 and 358, considered to be of generally medium landscape value, see Sections 7.4.4.3 and 7.4.5. The rail spur and offloading area is situated on brownfield land. See Photograph 7-46 for a view of the rail spur and current gypsum supplier who occupies the site. Residential buildings are situated approximately 100m from the rail spur on the opposite side of the main railway line.

Photograph 7-46: View along the Poylu rail spur, looking towards the Kura River

Saloghlu Pipe Storage Area

The proposed temporary pipe storage area (Alternative 2) at Saloghlu (see Figure A7-1 in Appendix A) is situated within the part of the Ganja-Gazakh plain (see Section 7.4.4.3) considered to be of low landscape importance. The site is approximately 50m away from the nearest house. Photograph 7-47 shows a view of the proposed pipe storage area.

Photograph 7-47: View southeast of Saloghlu Pipe Storage Area

Saloghlu Camp

The proposed temporary pipe storage area (Alternative 2) at Saloghlu (see Figure A7-1 in Appendix A) is situated within the part of the Ganja-Gazakh plain (see Section 7.4.4.3) considered to be of low landscape importance. Photograph 7-48 shows a view of the proposed camp area.

Photograph 7-48: View of proposed Saloghlu Camp area

Saloghlu Rail Spur and Offloading

The proposed temporary pipe storage area (Alternative 2) at Saloghlu (see Figure A7-1 in Appendix A) is situated within the part of the Ganja-Gazakh plain (see Section 7.4.4.3) considered to be of low landscape importance. The site is approximately 50m away from the nearest house Photograph 7-49 shows a view of the proposed rail spur area.

Photograph 7-49: View across Saloghlu Rail Spur and Offloading site

7.4.5 Landscape and Visual Importance and Sensitivity

The landscape of the proposed pipeline route is generally considered to be of low importance and low sensitivity to the type of potential changes that could occur as part of the Project.

The lowlands between KP0 and KP210 (Hajigabul to Ganja) are considered to be of particularly low importance and sensitivity to the type of change that may occur during pipeline construction. This is because of the generally low quality of the existing landscape, which is a result of the flat topography; the lack of attractive natural features, such as natural trees and woodland; and the presence of a large number of often unattractive man-made features, such as power lines, settlements surrounded by planted locally non-native trees (which differ in colour to the generally earth-coloured natural vegetation and landscape) and above-ground pipelines. These above-ground man-made features and others, such as irrigation channels with earth embankments, can be visible from several kilometres away due to the naturally flat terrain.

The main human receptors in this landscape are likely to be people in settlements, agricultural workers (shepherds and field-workers) and road users. However, views from settlements towards the pipeline are likely to be restricted by the houses and tree belts that often surround villages.

The human receptors most likely to see the proposed pipeline will be shepherds (particularly those on horseback who have greater long-range views) and farm workers. However, the transient and work-orientated nature of their engagement with the landscape makes these receptors generally less sensitive to change.

The section likely to be more sensitive to potential landscape change is the undulating land between KP286 and KP358. This section has a higher (medium) landscape quality/importance and a greater sensitivity to change, so particular care will need to be taken regarding reinstatement. However, this section also has the fewest potential sensitive human receptors due to the lack of settlements. The human receptors most likely to see the proposed pipeline will be shepherds on the ridges and farm workers.

The landscape between KP210 and KP286, around Ganja to Shamkir, and between KP358 and KP390, from the Kura West crossing to the Georgian border, is considered of low quality/importance and sensitivity owing to the high degree of cultivation.

The landscape surrounding the pigging station and BVRs is of low landscape importance with the exception of BVR A10, which is located in an area of medium importance.

The landscape character of the temporary construction camp and pipe storage areas are considered of low or very low importance with the exception of the site at Tovuz, which is located in an area that is considered to be of generally greater (medium) landscape value.

The proposed temporary pipe storage site at Mugan, the pipe offloading area at Kurdemir, the temporary construction camp at Yevlakh and the Dallar pipe storage and rail spur site are located close to sensitive receptors (local residents). Samukh Camp Option 3 area may be close to houses if the area to the north-west of the site is developed for houses before the start of SCPX construction.

7.4.6 Sensitivities

As noted in Section 7.4.1, the pipeline will be buried, so landscape and visual impacts are temporary and linked to the construction and post-construction restoration phases of the pipeline and its associated temporary construction camp and pipe storage areas, with the except of the block valve sites (BVR A5–A10) and the pigging station at KP0).

The key issues that relate to landscape and visual receptors along the proposed pipeline route are summarised below:

- The landscape of the proposed pipeline route is generally considered to be of low importance and low sensitivity to the type of potential landscape change that could occur as part of the Project
- The majority of the land through which the proposed route passes is flat, with very few trees, hedges or fences to obscure visibility, and as such visibility can extend for several kilometres, although views from houses are often limited by tree planting. This has two implications: large above-ground features may be visible from long distances, but the visual impact of ground-level features (such as the existing BTC/SCP pipeline corridor and associated block valves) is low, except at close range, due to the lack of vantage points overlooking the landscape
- The section that is potentially more sensitive to potential landscape change is the undulating land between KP286 and KP358. This section is considered to have a higher landscape quality/importance and a greater sensitivity to change. However, it also has the fewest potential sensitive human receptors, due to the lack of settlements. This section includes the approaches to the Tovuzchay, Asrikchay and Hasansu rivers, which have steep erodible ridges
- The pigging station and BVR sites are, with the exception of BVR A10, located in areas considered to be of low landscape importance. BVR A10 is located in an area considered to be of medium landscape importance
- The temporary construction camp and pipe storage areas are located in areas considered of low or very low landscape importance. Fourteen of the areas, however, are close to sensitive human receptors as they are near to existing local houses.

7.5 Surface Water

7.5.1 Introduction

This section describes the baseline surface water environments that are crossed by the proposed South Caucasus Pipeline expansion (SCPX) route in Azerbaijan. The aim is to understand the baseline conditions at the different water systems, including major and minor river systems, canals and wetlands that will be crossed by the pipeline.

The section begins by reviewing the methodology used, including data sources and field survey methodologies, to understand the surface water baseline conditions. Subsequent to this the most significant watercourses and water bodies encountered by the proposed pipeline route will be considered before the following topics are discussed:

- Hydrological differences from east to west
- Surface water run-off and flooding
- River hydraulics
- River channel instability
- River water quality
- Environmental change.

The key sensitivities relating to baseline surface water quality in relation to the proposed pipeline will then be summarised.

7.5.2 Methodology

7.5.2.1 Data sources

In the preparation of this section a number of reference sources have been reviewed, in addition to undertaking additional SCPX specific surveys in the field. As the proposed SCPX follows the existing WREP and BTC pipeline and SCP for much of its route, existing baseline information on surface water along the WREP and BTC/SCP routes has been used. Baseline information provided in the EIA for the WREP (1996) and the ESIAs for BTC and SCP (2002) was based on a combination of field survey work, literature review reports prepared by members of the Azerbaijani scientific community, and clarification meetings held with the authors of the reports, as detailed below:

- A desktop study and literature review prepared by Professor Eyubov, 1996
- Detailed maps contained within the Agroclimate Atlas of Azerbaijan, Professor Eyubov (1993)
- Literature Reviews by Azerbaijani scientists, including those of Professor Kashkay of the Institute of Geography at the Academy of Sciences in Baku and Professor Firdowsi Aliyev of the State Committee of Geology and Mineral Resources for the Azerbaijan Republic, produced in 1996, 1998 and 2000, and the State Committee of Geology (2001)
- Line-walk re-route information generated by AETC and ERM staff in 2000-2001
- Reconnaissance field data collected by D. M. Lawler on behalf of AIOC in November and December 1996
- Western Route Export Pipeline in Azerbaijan (WREPA) EIA, produced by AETC in April 1997
- Hydrology, report to AIOC on Western Route Export Pipeline in Azerbaijan, R. M. Kashkay, 1996.
- Reports on Azerbaijan rivers, hazards, geomorphology and engineering and groundwater produced from 1998 to 2001, e.g. Fookes and Bettess (2000) and Banks (2001), made available by BP
- Published scientific papers on the hydrology of the Caucasus region (cited in References).

In addition to the above, more recent information was identified and used where possible to inform the baseline, as detailed below:

- BTC/SCP River crossing data for 2010, which considered the success of reinstatement and erosion control measures at certain crossings
- UNECE (2007), Our Waters: joining hands across the borders. The First Assessment of Transboundary Rivers, Lakes and Ground Waters. http://www.unece.org/env/water/publications/pub76.htm, accessed May 2012
- An SCPX-specific line walk and field reconnaissance was also undertaken by design engineers during 2011 to assess the SCPX river crossing points. Analysis of the results from this survey were still in progress at the time of writing the report, although any available information has been used where possible
- CB&I (2011) Major Watercourse Crossings Review – Assessment of Change from 42 to 56" OD Pipeline (document number CB-MX00ZZ-PL-REP-1001-000)
- Ministry of Ecology and Natural Resources Azerbaijan, *Rivers, Lakes and Reservoirs of Azerbaijan Republic*, http://www.eco.gov.az/en/hid-chay-gol-suanbar.php, accessed September 2011
- Republic of Azerbaijan Amelioration and Irrigation Open Joint Stock Company (2010) Water Users Association Development Support Project, available from the World Bank[1].

7.5.2.2 *Field survey of water quality*

Two rounds of water sampling were undertaken, one during high flow rate in spring (May 2011) and the other during the low flow rate in summer (September 2011), to account for any seasonal variability. As part of the surface water surveys the following water bodies were sampled. The water bodies have been listed in geographic order, working from east to west and the approximate SCPX KP is given in brackets.

Agsu canal (54)
Geokchay (115)
Turianchay (137)
Kura River East crossing (167)
Karabakh canal (189)
Goranchay (202)
Kurekchay (221)
Korchay (237)
Ganjachay (240)
Sarisu (261)
Goshgarachay (261)
Karasu (266)
Shamkirchay (277)
Zeyamchay (303)
Asrikchay (323)
Tovuzchay (324)
Hasansu (345)
Kura River West crossing (358)
Kurudere (369)

The Kurudere crossing was sampled separately, in December 2011. Prior to this, access to the area immediately adjacent to the river was prohibited due to the presence of unexploded ordnance (UXO). December can be classed as a period of low flow and therefore the data from the Kurudere will be reviewed as such.

River crossing locations were identified using a Trimble GPS unit that was pre-programmed with the crossing coordinates. Water samples were abstracted using a stainless steel bucket and transferred to an appropriately labelled water sample container. Temperature, turbidity, pH, conductivity and dissolved oxygen were measured and recorded directly in the field using a portable aquaprobe. The water samples were stored in a cool box and transferred back to the lab on a daily basis with a chain of custody form completed by the field surveyor.

[1] http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000333038_20110201001906&searchMenuPK=64187283&theSitePK=523679, accessed September 2011

Sample analysis

The majority of sample analysis was undertaken by the AmC laboratory in Baku. AmC holds the ISO 17025 laboratory-specific accreditation (DANAK accreditation no 480), and its procedures are accredited by AZStandard.

The sample taken from the Kurudere, during December, was analysed by Azecolab laboratory in Baku. Azecolab holds the ISO 17025 laboratory-specific accreditation (TURKAK accreditation AB-469-T) and is accredited by AZStandard. All analyses complied with prescribed quality assurance and quality control criteria.

To ascertain water quality each sample was analysed against the following parameters:

- pH
- Conductivity
- Dissolved oxygen (DO)
- Temperature
- Turbidity
- Total coliforms
- *E. coli*
- Total suspended solids (TSS)
- Biological oxygen demand (BOD)
- Chemical oxygen demand (COD)
- Chloride
- Aluminium
- Arsenic
- Barium
- Calcium
- Cadmium
- Chromium
- Copper
- Iron
- Mercury
- Manganese
- Lead
- Nickel
- Sulphate
- Selenium
- Zinc
- Total hydrocarbons (THC)
- Benzene
- Toluene
- Ethylbenzene
- Xylene
- Polycyclic aromatic hydrocarbons (PAH)

The above parameters were selected because they will provide the necessary information to be able to accurately determine baseline water quality at each of the watercourse crossings, when taking project activities and their potential impacts into consideration. While there are a number of additional parameters that could be chosen, they would not contribute to the understanding of relevant baseline conditions.

7.5.2.3 Assessment of importance and sensitivity of surface water

An assessment has been made of the importance of the surface water resources along the proposed pipeline route and their potential sensitivity to change. As a result, the importance and sensitivity of the surface water resources has been classified into categories that range from very low to very high. Information on this process is given in Chapter 3 and the assessment table, defining the categories used, is also included in Appendix B of the ESBR.

7.5.2.4 Technical difficulties or uncertainties

Much of the desktop information was produced over ten years ago for the BTC and SCP ESIAs. However, reviews have confirmed that much of this information is still likely to reflect current conditions.

The following limitations of the desktop hydrological and hydrogeological datasets and reports used as part of the BTC and SCP ESIAs should be noted, because they have significant implications for the confidence that can be placed in the data and hydrological baseline established:

- The hydrometric network in Azerbaijan was severely curtailed after 1991/92, so few datasets exist for the past 20 years. As such, quantification of current conditions is highly challenging. Early hydrological data, though useful, will not reflect subsequent climate variations, basin land-use changes, channel cross-sectional geometry shifts, canalisation projects, local river channel interference (e.g. gravel mining), new surface-water and groundwater abstractions and water resource development schemes

- Generally, with respect to the desktop information, little information is readily available on the hydrological and monitoring techniques adopted, including sampling conditions, constraints, timing and frequency, analytical methods, precision limits and data collection problems. As such, it is difficult to place confidence limits on the published datasets
- Flow measurement sites (river gauging stations) tend to be located in, or near the foot of, the Caucasus Mountains, mainly because this is considered to be the limit of significant run-off generation in these rivers. Consequently, they are sometimes considerable distances upstream (or occasionally downstream) of the SCPX (and BTC and SCP) routes. Some caution is warranted, therefore, in extrapolating data from the point of flow measurement to the pipeline crossing itself. Some rivers, as in many semi-arid environments, lose discharge in a downstream direction, because transmission, irrigation and abstraction losses outweigh run-off generation in the lower reaches
- The available data tends to be in the form of averages (means) and, though useful, provides limited information with respect to hydrological extremes (e.g. flood and drought magnitude and intensity).

As outlined in 'Sample analysis' above, two separate laboratories were used to undertake sample analysis. For the December 2011 surveys AmC was no longer available and had been replaced by Azecolab as BP's approved laboratory. Both laboratories used hold the ISO 17025 laboratory-specific accreditation and, as such, it is considered likely that their methodologies, and therefore the results, will maintain consistency. However, caution should be taken regarding any possible discrepancies that may exist between the results.

7.5.3 Surface Water Bodies and Watercourses

The key hydrological features the proposed SCPX route crosses or approaches include:

- Main stem of the Kura River system, which runs close by, and parallel to, the pipeline in the western half of the route, and is crossed twice
- Large Kura tributary rivers draining the Greater and Lesser Caucasus mountains
- Mingechevir Reservoir and dam
- Shamkir Reservoir and reserve
- Garayazi Wetland near the Georgian border
- Jandar Lake, which straddles the Azeri-Georgian border
- Canal and pipe networks supplying drinking or irrigation water to villages and fields.

Line-walk data and the crossings list provided by the pipeline design team indicates that the route crosses 18 significant watercourses between SCPX KP0 and the Azerbaijan/Georgian border (see Figure A1-1, Appendix A, EBSR). In addition to the significant river systems the route crosses, there are a number of minor streams, and a variety of man-made watercourses (canals, drainage ditches and irrigation systems) that are in various states of repair.

7.5.3.1 Kura River

The proposed SCPX route is dominated by the large Kura River system. The route crosses the Kura River twice. The lower, easterly crossing (Kura East) is near Yevlakh to the south-east of Mingechevir Reservoir (URS/Dames & Moore, 2000). The westerly crossing (Kura West) is at Polyu near the Georgian border, upstream of the important Shamkir and Mingechevir Reservoirs.

The Kura is the largest river system of the Caucasian region, originating in Turkey, and then passing into Georgia before flowing into Azerbaijan near Polyu. Once in Azerbaijan, the Kura flows into Shamkir Reservoir (see Photograph 7-50) and Mingechevir Reservoir, before crossing the Kura lowlands in the east and discharging into the Caspian. Its drainage basin area at Kurzan, near Polyu, is over 15,000km^2, and its mean annual discharge is 264m^3 s^{-1} (Table 7-14). Like its tributaries, the Kura has a strongly seasonal regime, with the main flow period concentrated between March and June, with a peak around the end of April (see Figure 7-20). This relates to the seasonal melting of snowpacks high up in the mountain run-off source areas of the Kura drainage basin in Turkey, Georgia and Azerbaijan.

However, the impact of water storage in the Mingechevir and Shamkir Reservoirs on the Kura flow regime is substantial. It is apparent from Figure 7-20 that, despite similar average annual flows upstream and downstream of the reservoirs, the natural highly peaked annual hydrograph of the Kura at Kurzan, upstream of the reservoirs, is strongly reduced at the outflow at Yevlakh. This is common in reservoir basins (e.g. Brandt, 2000). In contrast, low-flows in winter and summer are increased below the reservoirs (Figure 7-20). By smoothing out the strong seasonality in the Kura discharges, much more stable flows are achieved below the reservoir for irrigation purposes. Much river sediment is trapped in Mingechevir Reservoir (Selivanov, 1996), and ERM (2000) have flagged up possible implications for dam failure due to loss of storage capacity and loading of the dam structure.

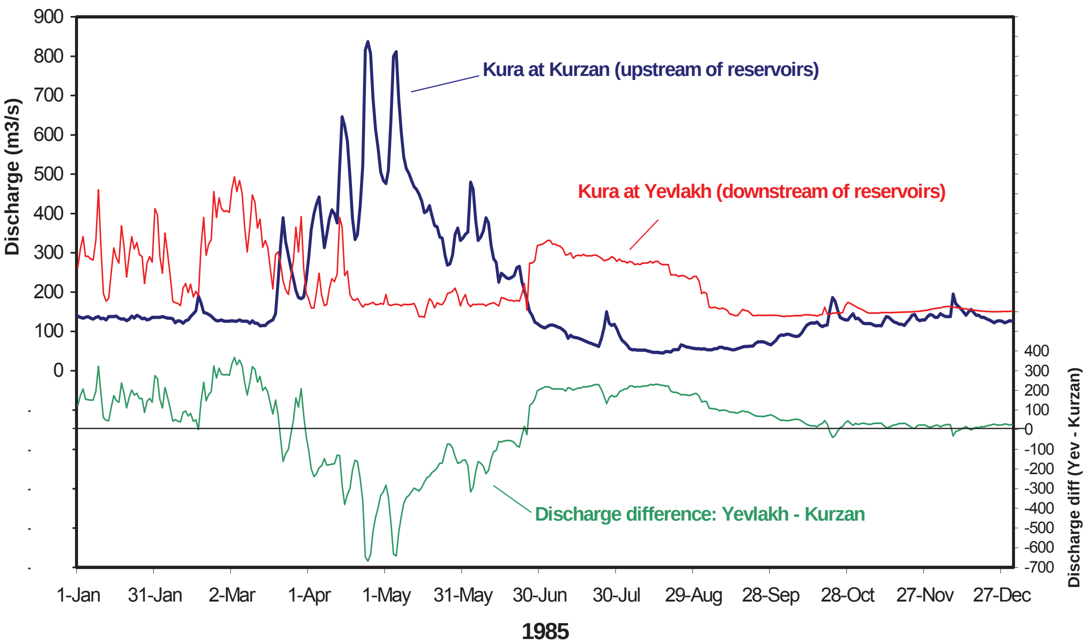


Figure 7-20: Impact of Substantial Flow Regulation by the Mingechevir Reservoir on Discharge Peaks and Seasonality of the Kura River: Mean Daily Flow Hydrographs for 1985 for Kurzan (Upstream of Mingechevir and Shamkir Reservoir) Compared to Yevlakh (Downstream of Mingechevir and Shamkir Reservoir)

Table 7-14: Hydrological and Hydraulic Information for the Main Rivers Crossed by the Proposed Pipeline Route (Figures in Brackets are Estimates) (Kashkay, 1996)

River	Station	Average Slope (m/m)	Minimum Slope (m/m)	River Discharge ($m^3 s^{-1}$)			Stream power(W/m)	Estimated Mean Velocity ($m s^{-1}$)	Downstream Receptor	Receptor Distance From Crossing (km)	Estimated Average travel Time (Hours)	Estimated Travel Time in High Flow** (hours)
				Mean Annual	Maximum	Minimum						
Kura system in Azerbaijan												
Kura (u/s of Shamkir)	Kurzan	0.0034	0.000014	264	969	44.4	9.3	1.71	Shamkir Reservoir	7	1.1	1.0
Kura (d/s of Mingechevir)	Yevlakh	0.000831	N/A	313	1350	20	9.87	1.65		200	33.7	27.8
Rivers of the Great Caucasus southern slopes												
Turianchay	Savalan	0.0205	0.00009	17.3	148	0.15	3497	0.28	Kura River	25	24.8	3.5
Geokchay	Geokchay	0.0175	0.00050	14.1	91	4.72	2433	0.55	Kura River	32.5	16.4	4.5
Agsu	Agsu	0.0247	0.00170	1.96	(246)	(0.048)	477	0.4	Karasu canal	10	6.9	1.4
Rivers of the Lesser Caucasus north-east slopes												
Agstafa	Krivoy Most	0.0210	0.00680	10.7	158	0.02	2216	N/A	N/A	N/A	N/A	N/A
Akhindjachay	Agdam	0.0236	0.01270	2.94	(47.6)	0.05	684	N/A	N/A	N/A	N/A	N/A
Tovuzchay	Oysuzlu	0.0343	0.01410	0.91	31.4	0.01	308	0.3	Kura River	8.5	7.9	1.2
Zeyamchay	Yanihli	0.0210	0.01410	5.66	179	(0.090)	1172	1	Kura River	8	2.2	1.1
Shamkirchay	Barsum	0.0330	0.01400	8.56	(127)	0.95	2785	1.3	Kura River	10	2.1	1.4
Kushkarachay	Saritapa	0.0300	0.01390	1.35	(2.44)	0.49	399	0.63	Kura River	11	4.9	1.5
Ganjachay	Zurnabad	0.0277	0.01200	4.61	(95.5)	0.39	1259	0.8	Mingechevir	10	3.5	1.4
Kurekchay	Dozular	0.0245	0.00470	4.2	(168)	0.72	1015	0.66	Mingechevir	40	16.8	5.6
Goranchay	Agjakend	0.0380	0.00830	2.4	(45.2)	0.3	899	0.87	Mingechevir	27.5	8.8	3.8

** Assuming velocities in high-flow periods of 2m s^{-1} (7.2km hr^{-1})

Photograph 7-50: Shamkir Reservoir

7.5.3.2 Kura tributaries

Moving west from SCPX KP0 all of the rivers crossed by the proposed pipeline are tributaries of the Kura. The longest of the tributaries crossed by the pipeline route is the Turianchay (180km), while the shortest is the Tovuzchay (42km).

In the eastern half of the proposed pipeline route, where the rivers originate in the Greater Caucasus, river flow is in a south-westerly direction and the pipeline crosses four left bank tributaries of the Kura (see Table 7-14 for list of rivers). The rivers that originate from the Lesser Caucasus, in the west of the route, flow in a north-easterly direction. After crossing the Kura River East near Yevlakh the pipeline crosses seven sizeable, high-energy and laterally mobile right-bank tributaries of the Kura moving within incised narrow gorges or floodplains (see Table 7-14 for list of rivers).

7.5.3.3 Garayazi Wetland

The proposed route will pass close (approximately 5–10km) to the valuable Garayazi Wetland area between Polyu and the Georgian border (KP358–KP390). The wetland is situated within the Garayazi State Nature Reserve and exists because of the Garayazi aquifer (see Section 7.6.3.3). In this area at the western end of the corridor, there is an 80% probability of receiving between 50 and 100mm precipitation during the summer months. This relative security of summer rainfall supplies helps to ensure the viability of the wetland.

A site visit on 30 November 1996, and subsequent visits by BTC and SCP team members between 1996 and 2011, confirmed that the groundwater table was at, or very near, the ground surface in the Garayazi Wetland, and standing water was visible. The wetland, however, is highly fragmented and heavily encroached upon by viticulture, drainage channels, pastureland and the main Baku–Tbilisi railway line.

Simple measurements of turbidity, pH and electrical conductivity on 30 November 1996 confirmed that Garayazi Wetland pool water was clear (turbidity 2.36 nephelometric turbidity units, NTU), alkaline (pH 7.82) and not highly mineralised (electrical conductivity: 665 $\mu S\ cm^{-1}$). No contemporary hydrological monitoring is thought to be going on in the area.

Groundwater monitoring is conducted regularly by the BP AGT environmental team, and laboratory results between 2004 and 2010 were made available to RSK for the purposes of the SCPX ESIA baseline study (see Section 7.6.4.2).

7.5.3.4 Jandar Lake

Jandar Lake is a medium-sized lake with a surface area of approximately 10km^2 and is situated on the border between Azerbaijan and Georgia. The lake is an important site for migratory and nesting birds and also mammals, amphibians and reptiles. In addition, the lake is also a favoured site for local fishermen.

The proposed pipeline route passes approximately 2km to the south of Jandar Lake.

7.5.3.5 Canals

There is a well-developed network of canals within Azerbaijan, which make it possible to irrigate a large proportion of the country's lowlands. The proposed pipeline route crosses numerous canals, particularly in the predominantly agricultural area between Kurdemir and Yevlakh. The most significant canal traversed by the pipeline is the Karabakh canal, the crossing point of which is approximately 20km west of Yevlakh (KP189). The Canal is 107 miles in length and provides an important link between the Aras River and Mingechevir Reservoir, supplying irrigation water to over 250,000 acres of land and offering an important source of industrial use water.

After the Karabakh, the next most significant canal crossed by the proposed pipeline is the Agsu canal, which is crossed at approximately 20km south-east of Kurdemir (KP54). The Agsu is a branch of the Shirvan Canal and links the district of Agsu with the Kura, and is an important source of irrigation water.

7.5.3.6 Description of rivers crossed by the SCPX route

During sampling of the watercourse crossings for the proposed pipeline, a number of observations were made during both the high- and low-flow surveys, which have been outlined in Table 7-15.

Table 7-15: Watercourses Crossed by the Proposed Pipeline Route and Observed Features

Watercourse	Approx. SCPX KP	Features
Agsu Canal	54	Wide canalised river. High sediment load. Low apparent ecological sensitivity. Agriculture adjacent to sample location.
Geokchay	115	Narrow canalised river in deep cutting. Vegetation indicates wide fluctuations in water level. High sediment load. Diverse bank flora and bird life.
Turianchay	137	Heavy vegetation with very steep banks. It was not possible to access exact crossing location due to density of vegetation.
Kura East	167	Wide fast flowing river with extensive fishing and wildlife. Reedbed downstream from crossing point. Agriculture close to crossing point.
Karabakh Canal	189	Canalised river with marginal vegetation. Low apparent ecological sensitivity. Farm adjacent to sample location.
Goranchay	202	River was dry at the time of the survey.
Kurekchay	221	Wide braided channel – only narrow channels flowing. Mud cliffs have abundant holes. River well used by villagers for washing etc. Also used widely for watering livestock.
Korchay	237	Narrow flowing channels within extensive areas of marshy reedbeds. Used widely for watering livestock. River flows into a large holding pond, within which oil was observed on the surface.

Watercourse	Approx. SCPX KP	Features
Ganjachay	240	Channel of variable width but negligible flow. Many burrows in cliffs. Litter observed on riverbanks. River has been widened and erosion protection installed at BTC/SCP crossing point.
Ganacachay	247	River appears to have been dry for a very long time, several years minimum based on the height of trees now present.
Sarisu	261	Braided river with steep grassy verges. Livestock observed close to river. Construction works taking place at BTC/SCP crossing at time of survey.
Goshgarachay	261	Fast flowing with good species diversity. Also used widely for watering livestock. Ploughed fields and livestock observed close to crossing point. Gabions and mattresses were being installed at SCP/BTC crossing point during low flow survey.
Karasu	266	Narrow watercourse within a wide channel, mainly vegetated by reeds. Access to crossing point was not possible due to reeds.
Shamkirchay	277	Shallow riverbed was predominantly dry at the time of the high flow survey and totally dry during low flow survey. Very low ecological value or sensitivity. The river bed has been extensively exploited for gravel extraction. Erosion protection construction was occurring downstream of crossing point at time of survey. Extensive fly-tipping was observed approximately 300m upstream, 100m inland from the river.
Zeyamchay	303	River was dry at time of high flow survey. Very low ecological sensitivity and almost no flowing channel. Litter observed on banks. During low flow survey flowing water was identified approximately 400m downstream
Asrikchay	323	River was fast flowing at time of survey, although heavy rains occurred two days previously. Livestock observed close to river, and farm close to sample location.
Tovuzchay	324	Wide cobbled braided riverbed. Flow may increase in spring. Livestock observed on riverbank.
Hasansu	345	Fast flowing clear ‘mountain’ stream. Livestock observed drinking from the river. Local was observed fishing.
Kura West	358	Fast flowing and wide. Flotsam was observed in the river and some had been deposited on the banks, mainly plastic bottles. Excavation works were occurring upstream of the crossing point at the time of the survey. SCPX crossing point was not accessible and therefore the sample was taken from further west.
Kurudere	369	Narrow flowing channel with sand/silt substrate. Cobbles/sand throughout dry portions of riverbed. Sand cliffs downstream provide potential nesting habitat. Garayazi wetland downstream increases sensitivity.

Other rivers taken into consideration

A number of sections here refer to the Girdemanchay, which is a large braided river originating in the Greater Caucasus, close to the settlement of Lahich. The most significant tributaries of the Girdemanchay have been canalised and converge with the Agsu Canal approximately 5km north of where the proposed pipeline crosses the Agsu.

The Djeyrankechmez and Pirsaat rivers are also referred to; these originate in the Greater Caucasus and are located in the east of Azerbaijan. While they are not crossed by the proposed SCPX route, they are crossed by the BTC/SCP pipeline, at BTC KP9.3 and BTC KP42.1, respectively.

7.5.4 *Surface Water Run-off and Flooding*

The climate of the proposed pipeline route varies from semi-desert at the eastern end to more humid and continental conditions near the Georgian border, with average annual precipitation increasing from approximately 150mm in the east to around 500mm in the west. Mean annual potential evapotranspiration rates are very high all along the pipeline route, with rates exceeding 800mm in the east and 600mm in the west during the main evapotranspiration season (April–October) (Eyubov, 1993). These rates are far greater than rainfall inputs for the corresponding areas.

High evapotranspiration rates have several hydrological and geomorphological implications:

- Creation of substantial water resource shortages and the need for irrigation systems to support intensive agriculture, which is extensive in the central parts of the corridor (Wolfson and Daniell, 1995). Irrigation may be seasonal: for example, water is used to irrigate maize in August and September
- Generation of semi-arid hydrological systems and landscapes, with sparse vegetation cover and severe soil erosion and gullying problems related to intense rainstorms, fine erodible soils, little vegetative protection and flash flooding, especially in the eastern part of the route
- River run-off that decreases with distance from the mountain source areas. River discharges, after first increasing within the headwater zone, often then reduce downstream. This trend is exacerbated by increasing abstraction and irrigation in lowland agricultural areas and by transmission losses through permeable gravel riverbeds.

All rivers crossed by the proposed route have highly seasonal regimes. Peak flows typically occur between April and June on average, with the low-flow period from September to February. Around 15–25% of total annual flow takes place in May alone (Table 7-17). For half of the rivers, more than 50% of total annual discharge occurs in the three-month period of April–June (Table 7-17).

Heavy snowpacks accumulate in the Greater and Lesser Caucasus in winter affecting the rivers sourced in those zones and which the pipeline crosses. Assisted by rainstorms, ablation of the snowfields occurs in the spring as radiation receipts and air temperatures rise (see Figure 7-22). The considerable quantities of discharged melt water can then generate significant flooding downstream. Although any snow disappears from the pipeline corridor at the end of March, snowpacks persist in the mountain-river source areas until the end of May/early June. A risk of flooding at pipeline river crossings can remain until late June.

There is a tendency for the month of peak flow to shift from May to June the further east the river is located. It is considered this is due to easterly rivers being sourced at higher altitudes in the Greater Caucasus mountains, at approximately 3000m. Snowmelt onset is delayed until May or June in these high altitude basins, in contrast to April/May for the Lesser Caucasus catchments in the west.

Many of the tributary rivers crossed by the route are sourced at high altitude (1900–3680m) in either the Great Caucasus (Kura left-bank tributaries in the east) or the Lesser Caucasus (Kura right-bank tributaries in the west) (Table 7-16 and Figure 7-21). Average annual precipitation totals, principally in the form of snow, rise to approximately 1000mm per annum in the Great Caucasus and to around 800mm per annum in the Lesser Caucasus.

Despite low annual precipitation receipts, intense rainstorms occur, on average, every two to four years. The presence of relatively large, steeply sloping and poorly vegetated basins in the region, can result in significant floods downstream when the rainstorms occur. High flows tend to lead to bank erosion and increased sediment loads in the channel networks (which may be dry or at low flow for much of the year). This is especially true at the drier, eastern end of the line.

Hydrological extremes (flood/drought intensity, frequency and duration) are considered more important than flow averages when assessing pipeline security and environmental impacts. Values for flow minima and maxima are shown in Table 7-14. Substantial flows have been recorded at some time for most rivers. The data suggest that the easterly, Greater Caucasus rivers have produced the region's highest discharges partly because the mountain source areas receive slightly higher precipitation. The extreme flow events of $246m^3s^{-1}$, $287m^3s^{-1}$ and $393m^3s^{-1}$ estimated respectively for Agsu, Pirsaat and Djeyrankechmez are considered to represent flash floods produced as a result of infrequent but intense rainstorms within the catchment area.

Figure 7-21: Relief Map of Azerbaijan (Eyubov, 1993)

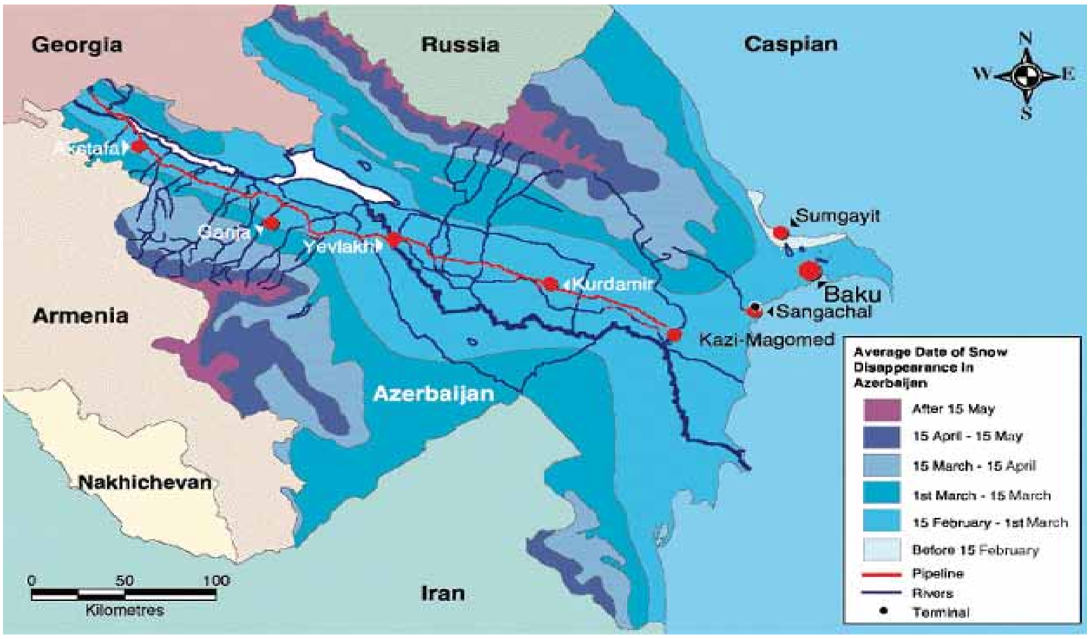


Figure 7-22: Map Showing the Average Dates of Snow Disappearance across Azerbaijan (Eyubov, 1993)

Table 7-16: Basic Hydrological Data for the Main Drainage Basins Crossed by the Proposed Pipeline Route (Kashkay, 1996)

River	Station	Length of Record (years)	Station Altitude (m)	Distance from Confluence (km)	Length of River (km)	Source Height (m)
Kura system in Azerbaijan						
Kura	Kurzan	20	149.3	739	1364	2,770
Kura	Yevlakh	42	5.23	566	1364	2,770
Rivers of the Great Caucasus southern slopes						
Turianchay	Savalan	53	118	106	180	3,680
Geokchay	Geokchay	47	89	37	115	1,980
Agsu	Agsu	26	N/A	48	85	2,100
Pirsaat	Shosseyni y most	14	N/A	144	119	2,400
Djeyrankechmez	Sangachal	N/A	-28	1	88	N/A
Rivers of the Lesser Caucasus north-east slopes						
Agstafa	Krivoy Most	28	527.12	42	133	3,000
Akhindjachay	Agdam	33	529.6	30	76	1,950
Tovuzchay	Oysuzlu	9	554.47	7	42	1,900
Zeyamchay	Yanihli	N/A	641.52	37	90	2,020
Shamkirchay	Barsum	53	688.73	42	95	3,220
Kushkarachay	Saritapa	25	N/A	32	76	2,360
Ganjachay	Zurnabad	60	872.48	58	99	2,814
Kurekchay	Dozular	49	617.64	87	126	3,100
Goranchay	Agjakend	51	1210.5	60	81	3,100

Table 7-17: Average Monthly Distribution of River Discharges (%), Showing High Flow Seasonality (Kashkay, 1996)

River	Station	Months													Proportion of flow in April–June (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	
Kura system in Azerbaijan															
Kura	Kurzan	4.3	4.6	7.0	18.4	21.4	14.5	6.9	3.9	4.2	5.2	5.0	4.6	100.0	54.3
Kura	Yevlakh	10.1	10.6	9.1	7.1	7.2	8.8	8.8	7.9	6.7	6.8	4.5	9.4	97.0	23.1
Rivers of the Great Caucasus southern slopes															
Turianchay	Savalan	6.7	6.8	7.6	9.8	11.4	11.4	8.3	6.7	8.8	8.6	7.3	6.6	100.0	32.6
Geokchay	Geokchay	6.2	6.3	7.4	11.4	12.7	13.5	8.4	6.7	6.9	7.6	6.5	6.3	99.9	37.6
Girdemanchay	Garanour	4.1	4.6	7.7	16.7	15.5	14.3	7.3	5.7	8.6	6.5	4.8	4.2	100.0	46.5
Agsu	Agsu	6.3	7.5	11.3	16.7	14.7	11.4	5.8	3.8	4.2	5.5	5.8	7.0	100.0	42.8
Pirsaat	Shosseyni y most	0.8	1.0	6.5	14.1	16.9	24.3	4.4	3.7	4.0	10.9	7.8	5.1	99.5	55.3
Rivers of the Lesser Caucasus north-east slopes															
Westerly rivers															
Agstafa	Krivoy Most	1.5	1.7	5.2	21.5	25.1	17.6	9.2	4.7	3.7	4.3	3.5	2.0	100.0	64.2
Akhindjachay	Agdam	2.6	3.1	7.2	18.7	23.0	15.5	8.6	4.3	4.8	5.0	4.1	3.1	100.0	57.2
Tovuzchay	Oysuzlu	0.8	1.9	8.3	19.4	16.7	20.6	11.3	8.5	2.6	3.6	5.5	0.7	99.9	56.7
Zeyamchay	Agbashlar	3.0	3.1	6.2	16.1	18.2	15.1	10.1	6.9	6.6	6.1	4.9	3.7	100.0	49.4
Zeyamchay	Yanihli	2.3	3.0	6.2	17.1	19.7	19.9	12.1	4.8	4.9	3.9	3.5	2.6	100.0	56.7
Shamkirchay	Barsum	2.9	3.0	5.2	13.9	19.8	17.6	11.2	7.4	5.4	5.5	4.6	3.5	100.0	51.3
West-central rivers															
Goshgarachay	Saritapa	3.4	3.9	7.9	14.2	13.9	19.4	8.7	7.6	6.4	5.4	5.1	4.1	100.0	47.5
Ganjachay	Zurnabad	3.1	3.2	5.3	12.7	18.4	19.3	10.9	7.2	5.8	5.7	4.7	3.7	100.0	50.4
Kurekchay	Dozular	3.8	3.7	4.9	10.5	15.5	19.5	12.7	7.8	6.3	5.9	5.1	4.3	100.0	45.5
Goranchay	Agjakend	3.5	3.5	4.5	9.2	17.5	20.5	12.2	7.7	6.3	5.8	5.1	4.2	100.0	47.2

7.5.5 River Hydraulics

7.5.5.1 Hydraulic data and desk studies

Basic flow information is available for the gauging stations on the main rivers crossed by the proposed route (Table 7-14). Note that these stations may be some distance upstream (and occasionally downstream) of pipeline crossings and they may not fully reflect conditions at the crossing points.

River gradients on the mountain rivers are steep, ranging up to 0.034 (Table 7-14). Table 7-14 shows that channel slopes in the vicinity of the proposed pipeline are generally higher for the Lesser Caucasus rivers in the west. This means that, despite rough gravel beds and relatively shallow depths, flow velocities are generally likely to be substantial at higher flows. The achievable velocities are probably sufficient to mobilise the gravel bed material and to create potential channel instability, which has implications for the location and design of the watercourse crossings. Average stream powers in Azerbaijan are high by global standards, reflecting the high discharges and slopes of their montane character.

7.5.5.2 Travel time for contaminant releases to watercourses

The velocity data from Table 7-14 can be used to estimate approximate travel times for introduced contaminants (although they do not account for behavioural/density differences between fuel/oil and water, or seasonal changes in flow). It is evident that, under high-flow conditions in late spring/early summer (April–June), contaminants introduced at the upper Kura near Kurzan have the potential to reach Shamkir Reservoir (7km downstream) in approximately one hour (Table 7-14). Any spillage directly into one of the right-bank, Lesser Caucasus tributaries (see Table 7-17 for list of rivers) has the potential to reach the main Kura River in less than six hours. A spill into Ganjachay, 10km from Mingechevir Reservoir, could reach the reservoir in less than four hours.

Contaminant migration times will vary with river flow conditions. In the early-summer flow peak, river discharges and velocities will be higher and contaminant migration speeds increased. Under low-flow conditions (September–February), velocities will be much lower and travel times much longer, but less dilution of the injected pollutant will take place and contaminant concentrations may therefore be higher. This means that ecologically undesirable effects may also be highly significant at low flow conditions, though they are more likely to be more localised at these times.

The simple scenarios provided above may be useful when designing crossings, timetabling refurbishment tasks to avoid high-flow periods when velocities and dispersion potentials are maximised, planning protection measures, and establishing environmental management plans and emergency response plans.

7.5.6 River Channel Instability

Braided channels such as those commonly found on the rivers in Azerbaijan normally exhibit large width–depth ratios, steep channel slopes, high-energy conditions, high bed-load transport rates, a flashy discharge regime and active lateral instability.

Many of the fluvial systems crossed by the route are active, dynamic and meandering or braided, especially in the west, where the proposed route approaches the foothills of the Lesser Caucasus. Many of the Kura tributaries are high-energy, mountain rivers, many occupying laterally mobile floodplain zones or incised into narrow gorges (see Section 7.5.3.2).

Mudflows have been identified as significant events affecting seven rivers crossed by the proposed route. Of the 41 documented events, 34 occurred in the three main Great Caucasus river basins (Turianchay, Geokchay, and Agsu), where damage was also greatest. All mudflows took place between April and October (peak frequency in May, June and July. However the pipeline crosses these rivers a considerable distance from their source where they are slower flowing and have often been canalised. Therefore, mudflows are less likely to have a significant effect.

7.5.6.1 Indicators of channel dynamism

Dynamic channels result from the interaction of high river energy levels with erodible boundary materials. Strong indicators of channel dynamism in the major Kura tributaries crossed by the pipeline (see Table 7-14 for a list of the rivers), especially in the west, include:

- Extensive and severe bank erosion at many of the sites visited, including around existing pipelines and structures evidenced by:
  - Undercut bank profiles creating overhangs
  - 'Fresh', steep, bare, bank faces supporting limited short-root vegetation, with concave-upward bank profiles
  - Erosion cliffs running for many metres upstream and downstream of the crossing locations
  - Tension cracks behind certain bank faces (often the precursor to mass failure)
  - Loose, easily-erodible sand and gravel bank materials, readily disturbed by touch or walk-over
  - Some damage to existing revetments and other bank protection works
  - Damage to bridge supports and old pipelines in places
- Sparse vegetation on the braid bars, and an absence of algae on the gravel bed material: this normally indicates recent particle transport (Dames & Moore, 2000)
- Velocities and stream power levels high enough to set typical bed materials in motion and to deform the channel boundary
- High suspended sediment concentrations and loads.

7.5.6.2 Assessment of channel stability at pipeline crossings

Bank erosion and channel-change problems should always be viewed in a drainage basin context, because:

- Instability zones can themselves migrate downstream over timescales similar to the design life of a pipeline
- Coarse sediments from upstream activities can change local cross-section shapes and sizes and influence velocity structures and bed scour and bank erosion rates in the vicinity of pipelines
- The river flows responsible for on-site erosion are generated by snowmelt and/or rainstorms in headwater zones.

Line-walk data (see Section 7.5.2.1) have revealed fairly widespread lateral channel activity along the pipeline route, indicating regional-scale instability. Bank materials are relatively fine-grained in the lowland river reaches, but are coarse in the mountain rivers, especially in the west. Bank erosion scars are numerous and affect a number of crossings (see below for specific rivers). The main retreat mechanism appeared to the surveyors to be mass failure, with some tension cracking in the riparian zone evident. In some of the meander bends, undercutting of the outer banks has been reported, with associated cantilever collapse of the overlying sediments. Bank protection schemes have already been implemented, indicating an awareness of previous problems by the authorities. Some rivers (e.g. Girdemanchay in the east) have been channelised for long stretches to stabilise flows and reduce erosion problems.

7.5.6.3 Sensitive river crossings

The following is primarily based on the information gathered as part of the SCPX-specific line walk undertaken in 2011 (see Section 7.5.2.1). Information has also been drawn from the reasonably detailed AEO Report by Dames & Moore (2000) and the BTC/SCP and WREP river-crossing data from 2010. There are many gaps in the Dames & Moore (2000) dataset, and no details are given of how the variables have been derived (e.g. bed material sampling: has this been achieved through a Wolman count to give frequency-by-number particle size distribution data or bulk-sieving or image analysis). Nor is information presented on particle size distribution measures, average river discharges or scour depth calculations.

Table 7-18 outlines the key findings derived from the above information for particular river crossings.

Other river crossings

Fookes and Bettess (2000) identified crossings of the smaller wadis in the drier eastern parts of the route as requiring extra attention. Although semi-arid channels by nature, and generally dry, they can be subject to intense flash flooding. This normally leads to considerable scour-and-fill of the bed, upslope migration of gully headcuts (e.g. Leopold et al., 1964), and some lateral instability.

The Sarisu was identified in Section 7.3 as being in an area that is susceptible to erosion (see Section 7.3.3.7).

Table 7-18: Sensitive River Crossings

Water Crossing	Width	Bed Material	Left Bank	Right Bank	Additional Information
Agsu canal	20m	Sand and silt	Steep averaging 5m high Mainly stable but locally are collapsing on a small scale Overbank flooding constrained by raised parallel dirt road	Steep averaging 5m high Mainly stable but locally are collapsing on a small scale Overbank flooding constrained by raised parallel dirt road	Major flow variation evident at crossing owing to presence of mud deposits Channel depth is approximately 5m
Asrikchay	<50m	Pebble gravel	Locally vertical up to 1m high Cut into river bed gravel Bank retreat is limited by closely confining valley walls Small-scale channel realignment is possible through braiding and meandering tendencies	Locally vertical up to 1m high Cut into riverbed gravel Bank retreat is limited by closely confining valley walls Small-scale channel realignment is possible through braiding and meandering tendencies	There is a degree of channel instability that requires assessment of scour potential Identified in Section 7.3 as being in an area that is susceptible to erosion (see Section 7.3.3.7)
Zeyamchay		Large to small pebble gravel	Gentle slopes or vertical banks 3m high in places and cut into the terrace	Protected by a short length of rip-rap Currently stable but protection is unlikely to be adequate should the minor channel shift against this bank Upstream of crossing bank is 3m high and cut into the terrace	No right or left bank floodplain and the river avulses across the full width of the corridor A variety of minor and major channels occupies the valley floor and any of these could switch location or grow in size, impinging on river margins and cause bank retreat.
Ganjachay	20–30m	Pebble and cobble gravel	Approximately 2m high, except where river impinges on river cliffs that are up to 6m high and are steep and unvegetated Protected by gabions A narrow 5m ‘floodplain’ immediately adjacent and above this a terrace level 2 - 3m above the river bottom	Approximately 2m high, except where river impinges on river cliffs that are up to 6m high and are steep and unvegetated Protected by gabions A narrow 5m ‘floodplain’ immediately adjacent and above this a terrace level 2m above the river bottom	Flood flows can be >2m deep, which flood the terrace surface. Immediately below the crossing a recent flood has formed linear erosion grooves, although no other evidence of significant lateral movement. A recent slope failure was noted immediately downstream of the crossing. The river is not especially sensitive to change, but this is dependent on there being no significant human intervention in the future.

Water Crossing	Width	Bed Material	Left Bank	Right Bank	Additional Information
Geokchay	25–30m	Silt, sand and mud	Very steep Often exhibiting large open areas of unvegetated silt soils Small-scale rotational failures are common. Large-scale rotational failure possible after deep scour.	Very steep Often exhibiting large open areas of unvegetated silt soils Small-scale rotational failures are common Large-scale rotational failure possible after deep scour.	The active zone is 50m wide. Avulsion is not possible. Channel is deeply entrenched and approximately 6m deep
Goranchay	5–10m	Fine sand, silt and mud	Poorly defined with intermittent development of vegetated tussocks Locally steep with a height of 1.5m owing to propensity for the stream to meander. No defined floodplain Scrub rangeland and the river may spill across as intermittent rills	Poorly defined with intermittent development of vegetated tussocks Locally steep with a height of 1.5m owing to propensity for the stream to meander No defined floodplain Scrub rangeland and the river may spill across as intermittent rills	Ephemeral rangeland stream Channel depth is approximately 1m Avulsion is possible (although not probable) if the channel becomes blocked by ephemeral vegetation growth. New road bridge built upstream of crossing has impacted channel behaviour upstream of crossing
Hasansu		Pebble and coble gravel	Cut into narrow terrace or high friable bedrock cliffs At risk of slope failure (enhanced erosion of the slopes) or high discharges No floodplain. WREP slope drainage is locally channelled via herringbone gravel filled drains, which has caused slope failure at the top of the gully.	Cut into narrow terrace or high friable bedrock cliffs At risk of slope failure (enhanced erosion of the slopes) or high discharges No floodplain	Single thread channel incised deeply into soft bedrock creating tight meanders against steep valley wall bluffs. Conducting scour calculations is important. Avulsion is not possible other than the possibility of protection works owing to exceptionally high flows. Identified in Section 7.3 as being in an area that is susceptible to erosion (see Section 7.3.3.7)
Shamkirchay		Pebble and cobble gravel	Slopes back gently to steepening slopes No well-defined floodplain Can flood out at least 200m from the bank	Slopes back gently to steepening slopes below a main road	Extensive gravel mining has disturbed the channel and irrigation supplements to natural flow regime. Riverbanks upstream are cut into braided stream deposits resulting in erodible gravel banks up to 1.5m high. The crossing is protected by a concrete sill Avulsion is possible, outflanking the concrete control structures on either bank due to aggradation upstream of the sills. The crossing is at risk from general, local, confluence and bendway scour.

Water Crossing	Width	Bed Material	Left Bank	Right Bank	Additional Information
Karabakh canal	15m	Silt and mud	No floodplain No evidence of bank erosion Bank line is highly stable	No floodplain No evidence of bank erosion Bank line is highly stable	Concrete lined canal No evidence of bank erosion at the crossing Avulsion cannot occur due to natural process Seepage has been observed and no levee maintenance was observed. The water level is higher than surrounding areas and swift current would occur following levee failure.
Kura River East		Sand and silt with a local component of pebble gravel	Currently stable at the crossing Approximately 10m width of gently sloping grassed point bar A floodplain around 100m wide, and an active zone width of 100m	Sand and silt approximately 5m high and retreating Extensive floodplain and currently subject to active retreat	Actively meandering cutting banks both upstream and downstream of the crossing High probability that gravel mining could destabilise the channel Exceptional release of water from the Mingechevir reservoir could affect channel stability. Avulsion is unlikely as the river has a tendency to meander.
Kura River West	220m	Pebbles, cobbles and some sand	Around 1.5m high consisting of unconsolidated gravel and is currently unprotected and is retreating A 30m stretch of loose blockstone on the left bank is of limited utility, as the river is now cutting laterally both upstream and downstream of this poor quality revetment. Any movement of a channel towards the left bank will result in further bank-line recession. The floodplain extends for 420m after which a slope rises very gently to river cliffs of hard rock some 30m high.	Around 1.5m high and consists of unconsolidated gravel and is currently protected by blockstone, which is around 100m in length. This poor-quality protection will not withstand the erosion from any large channel migrating laterally towards it in the future. Downstream of the blockstone the bank is retreating which indicates the channel currently is trying to move to the right. The floodplain is around 350m from the blockstone revetment noted above to a 3m-high terrace edge. Notably a distributary cuts across the floodplain that is dry during low flows but conducts water from the main river downstream across the plain. This could be the route of a future avulsion.	Subject to rapid and major channel realignments and scour. Gravel bars in the vicinity of the crossing are mobile and change shape, size and location annually. A railway bridge is upstream of the crossing that constrains river flow and causing a lag in the distance downstream before the river begins to broaden and become less laterally stable. The river is sensitive to change in terms of lateral stability, incision and scour. Immediate avulsion within the current wetted course is possible with major channels developing which could impinge either riverbank causing rapid recession. Avulsion can also occur across either floodplain with the right floodplain being particularly at risk due to the presence of the distributary noted above. Identified in Section 7.3 as being in an area that is susceptible to erosion (see Section 7.3.3.7)

Water Crossing	Width	Bed Material	Left Bank	Right Bank	Additional Information
Kurekchay	100m	Gravel	1.5m high and rip rap protected for around 200m but footings may be non-existent. The bank is also actively retreating locally. There is significant risk of avulsion upstream of rip rap armour.	Slopes gently to 1.5m height and is well grassed although the bank is actively retreating locally.	Sill placed at the BTC line has stabilised the bed upstream and the consequent aggradation has reduced upstream channel capacity. Downstream of the sill, the gradient steepens and the river is incised 4m into silt banks.
Kurudere	40m	Fine sand, silt and mud, with small quantities of gravel	Non-existent due to aggradation, and grades imperceptibly into the floodplain Evidence of overbank flows Broad floodplain surrounded by a low terrace High risk of avulsion as channel aggradation has increased flooding	2m-high bank protected by gabions Stable, but there is potential risk of erosion immediately downstream of the protection works Floodplain is extensive but probably does not flood frequently as it is higher than the left bank floodplain.	Bed degradation is already occurring along the upstream edge of the sill as water is diverted to the left and runs in parallel along this edge onto the left floodplain. The protection works are at serious risk of being out flanked in the next flood.
Tovuzchay		Mainly pebble, also cobbles present	Cuts into the low terrace level resulting in 1m high vertical cut banks and locally sub-channels are impinging on the valley-side bluffs The low terrace acts as a flood surface during major floods but is not more than 100m in width.	Cuts into the low terrace level resulting in 1m high vertical cut banks and locally sub-channels are impinging on the valley-side bluffs The low terrace acts as a flood surface during major floods but is not more than 100m in width.	Locally the river has one channel but elsewhere there are two or more channels separated by gravel bars. Low lateral terraces are narrow, abut gentle hill slopes and are probably flooded during high flows, which could fill the valley between hill slope bluffs. This kind of river is sensitive to disturbance, with further incision possible and probable. Shifting of any major channel towards either bank line could result in extensive local bank-line recession. Avulsion is possible in this system both with respect to minor and major channel shifts across the full channel corridor. Impingement of major channels on either bank due to avulsion could result in significant local bank-line retreat.
Goshgarachay		Pebbles	Has receded by around 50m immediately upstream of protection works to form a large embayment A major risk of avulsion and outflanking of all the protection works Around 100m width of low ground floodplain across which the river is threatening to avulse	Stable and is protected by recent gabion works at the crossing No floodplain	A lowland single thread stream The gradient of the river is relatively steep and consequently the river is very powerful in flood. Avulsion is possible here and highly probable in the immediate future.

7.5.7 River Water Quality

This section reviews the findings of surface water quality surveys undertaken during high flow (May and December 2011) and low flow (September 2011) conditions. The methodology for the surveys was provided in Section 7.5.2.2, including details of the rivers surveyed (see Figure A7-1, Appendix A and Figure A5-5 to Figure A5-16 in Appendix A, ESBR).

7.5.7.1 SCPX surface water quality standards

Based on a review of applicable international and national legislation and guidance, the SCPX Project developed quantitative Project standards (see Environmental and Social Management and Monitoring Plans, Appendix D), which have been used in this section where applicable to assess water quality. The standards used for ambient surface water quality have been primarily based on International Finance Corporation (IFC) environment, health and safety guidance and for all parameters identified by SCPX, the following have been applied:

- EU Water Framework Directive (2000/60/EC) (WFD)
- Priority Substances Directive (2008/105/EC)
- The Surface Waters (Dangerous Substances) (Classification) Regulations 1998.

The EU Freshwater Fish Directive (2006/44/EC) (FFD) was initially used in developing SCPX Project standards, although this is to be repealed by the WFD in 2013. The WFD was therefore used in preference to the FFD when assessing baseline quality. Within the WFD and FFD the standards for certain parameters vary depending on whether the river is classed as either cyprinid or salmonid. All of the rivers discussed within this section have been classed as cyprinid (SCPX Fish Survey, 2011) and have been assessed as such.

The SCPX Project standards do not include all parameters discussed in this section. To maintain continuity, the Directives and Regulations mentioned above have been applied where possible to determine standards for assessing the parameters not included. The standards for different parameters are further discussed within the individual sections below.

7.5.7.2 Water temperature

River temperatures have a strong influence over contaminant plume behaviour and ecological systems. Environmental quality standards developed under the European Water Framework Directive state that river temperatures for warm water should be below 28°C to achieve a good status. All water temperatures taken as part of the current survey were either 28°C or below during both high and low flow (Table 7-19). The Agsu Canal had the highest temperature recording, at 28°C, which was recorded during high flow conditions. The lowest temperature recording was 0.4°C, which was taken at the Kurudere. However, this sample was taken in December during a period of cold weather, while all other samples were taken during the late spring and summer months. Excluding the Kurudere the next lowest temperature recording was 15°C, which was taken at the Zeyamchay during the low flow survey.

For the majority of rivers the temperature decreased during the low flow conditions, which is likely to be a reflection of the decrease in ambient temperature. It is also possible that a reduction in total suspended solids also contributed towards a reduction in temperature (Section 7.5.7.3). In all rivers, the difference in temperature between the two surveys was either 3°C or less, with the exception of the Korchay and Karabakh Canal, which varied 4°C and 8°C respectively.

7.5.7.3 Total suspended solids and turbidity

High levels of total suspended solids (TSS) and turbidity can cause a reduction in the amount of light reaching submerged vegetation, inhibiting their growth, and can also lead to an increase in water temperature. Higher TSS levels can also clog fish gills, reduce fish growth rate, decrease resistance to disease and prevent egg and larval development. One of or a combination of the following can often cause high sediment levels within rivers:

- Storm water run-off
- Riverbank erosion
- Disturbance due to human activities, e.g. construction work.

The WFD states that the concentration of suspended solids within controlled water should not exceed 25mg/l. In addition to this, water with TSS over 150mg/l is generally considered dirty, below 25mg/l clear and cloudy in between. TSS readings in the rivers sampled showed considerable variation within several of the rivers between the high and low flow surveys (Table 7-19). This was most apparent in the Korchay, which was 14.2 mg/l, clear, during high flow and 323 mg/l, dirty, during low flow. The location of the Korchay crossing, where the sample was taken, was very shallow and dense with reeds during the low flow survey, making it difficult to obtain a sample without disturbing the river bed; this is possibly the reason for the elevated TSS reading.

In the majority of watercourses, apart from the Korchay, Hasansu and Karabakh Canal, TSS was lower during low flow conditions. This is likely to be caused by a reduction in the amount of run-off caused by seasonal rain, and also a reduction in flow, which will allow for suspended solids to settle more easily.

Turbidity is a physical characteristic of water and is caused by suspended matters or impurities that interfere with the clarity of the water, and as such is often closely associated with TSS concentration. Turbidity results from the SCPX river crossings survey follow this trend, with watercourses that have the highest turbidity also having the highest TSS concentrations.

With the exception of the Asrikchay, the watercourses with the highest suspended sediment concentrations and levels of turbidity all drain from the Greater Caucasus: the Turianchay, Geokchay and Agsu Canal. This supports data that was taken by Kashkay (1996) and ERM (2000), which suggested that rivers draining from the Greater Caucasus have the highest mean sediment concentrations. The reason for the high sediment loads in these rivers has been suggested as being caused by high erosion rates, which are driven by seasonal snow melt, flash floods, steep slopes, limited vegetation cover and fine erodible soils. High soil erosion and sediment transport are likely to emerge as key issues with regards pipeline planning and construction. The elevated concentrations in the Asrikchay can possibly be explained by heavy rainfall that had occurred in the two days prior to the sample being taken. Low flow data for the Asrikchay was not available because the river was dry at the time of the survey.

Turbidity data for the Turianchay, Geokchay and Agsu Canal during low-flow conditions is not available due to an error that occurred with the field sampling equipment.

Table 7-19: Temperature, TSS and Turbidity at SCPX River Crossings during 2011 High- and Low-Flow Conditions

River	Temp. (ºC)		TSS (mg/l)*		Turbidity (NTU)	
	High	Low	High	Low	High	Low
Kura West	22	19	592	100	584	125
Hasansu	20	17	15	88	7.5	0
Tovuzchay	24	24	48	2	61	0
Zeyamchay	-	15	-	5.4	-	2.6
Shamkirchay	22	-	96	-	96	-
Sarisu	21	21	60	46.5	42	63
Goshgarachay	23	21	41.7	11.9	37	9.6

River	Temp. (ºC)		TSS (mg/l)*		Turbidity (NTU)	
	High	Low	High	Low	High	Low
Karasu	22	21	36.8	27.9	28.7	25.9
Ganjachay	18	17.2	71.3	67.6	69	6.9
Korchay	20	16	14.2	323	8.6	57.8
Kurekchay	20	23	117	2.8	54	0
Karabakh canal	18	26	2.9	18.8	7.8	9.2
Kura east	18	21	91	37.7	90	43.8
Turianchay	24	22	1880	733	817	-
Geokchay	22	21	1150	1120	1780	-
Agsu Canal	28	25	2080	1820	2400	-
Asrikchay	20	-	367	-	669	-
Kurudere**		0.4		17		60.9

* Red is above 150 mg/l, green is below 25 mg/l and orange is in between.

**The Kurudere sample was taken in December, while the other high flow samples were taken in September.

7.5.7.4 Dissolved oxygen

Dissolved oxygen (DO) is a relative measure of the amount of oxygen carried in a river and can be an important gauge of a rivers health, as many aquatic animals depend upon it for their survival. Additions of organic matter such as discharges from agricultural sources and storm overflows reduce dissolved oxygen due to enhanced microbial respiration. When measured against temperature, the concentration of DO (mg/l) can be used to determine the percentage of saturated oxygen (%DO).

Using environmental quality standards developed under the European WFD the %DO within all of the rivers crossed by the proposed pipeline, for both high and low flow conditions, can be classed as fairly good or above. In all watercourses the %DO was higher during the low flow surveys. This is considered to be reflecting a reduction in water temperatures (Section 7.5.7.2), as oxygen is more easily dissolved in colder water. The Tovuzchay had the highest %DO, which was 140 during the low flow survey, while the Sarisu had the lowest, which was 62 during the high flow survey. However, during the low flow survey the %DO at the Sarisu had increased to 100.

Other factors that can influence the amount of DO within a river include biological oxygen demand (BOD) and chemical oxygen demand (COD). BOD measures the amount of oxygen that bacteria will consume while decomposing organic matter under anaerobic conditions. It is generally considered that pristine rivers have a BOD below 1 mg/l, while moderately polluted rivers will have a BOD between 2 mg/l and 8 mg/l. The WFD states that the BOD for controlled water entering cyprinid watercourses should be less than 6 mg/l. The majority of watercourses, during both high and low flow, had a BOD of less than 1 mg/l (see Appendices E-3 and E-4, ESBR); only the Karasu and Ganjachay exceeded this. The highest observed BOD was 1.7 mg/l, which was in the Karasu during low flow conditions, while Ganjachay BOD was 1.5 mg/l during high flow and 1.2 mg/l during low flow.

COD is a measure of the total quantity of oxygen required to oxidise all organic material into carbon dioxide and water. Within all of the rivers in the current study, during both high and low flow surveys, COD was found to be low in comparison to the wastewater discharge limit of 125 mg/l outlined in the IFC EHS guidance for wastewater and ambient water quality. During high flow the Karabakh Canal and Korchay had a COD of 26 mg/l and 22 mg/l respectively, although all other watercourses, during both high and low flow, had a COD of less than 10 mg/l (see Appendix E-3, ESBR).

7.5.7.5 Microbiology

Coliform count is one of the key determinants for human health with regards water quality. While coliforms are not normally the cause of illness, their presence is used to indicate that other pathogenic organisms of faecal origin may be present, such as viruses, protozoa and mulitcellular parasites.

The IFC EHS guidance for wastewater and ambient water quality has a recommended total coliform count of 400/100ml in treated sewage discharges. Total coliform count at the Kurudere was <1/100ml, however at all other watercourses, during both high and low flow surveys, the count was above the IFC recommended limit. In only the Sarisu and Karabakh Canal the count was below 1000/100ml, which was 987 and 923 respectively, both of which were during the high flow survey. All other counts for both high and low flow were above 1200/100ml, with the highest count taken from the Geokchay during the low flow survey, which was >34,000/100ml (see Appendices E-3 and E-4, ESBR).

E. coli are almost exclusively of faecal origin and their existence is an effective confirmation of faecal presence. The faecal coliform can enter watercourses through direct discharge of waste from mammals and birds, from agricultural and storm run-off and from human sewage. The World Health Organization recommends a limit of <1000 counts/100ml of faecal coliform in unrestricted irrigation water.

E. coli count at the Kurudere was <1/100ml, below the method detection limit (MDL), however at all other watercourse crossings *E. coli* was above the MDL with a maximum count of 16000/100ml in the Asrikchay during the high flow survey (see Appendix E-3, ESBR). Ten of the crossings were found to have an *E. coli* count that was higher than 1000/100ml during either the low flow or high flow surveys (see Appendix E-4, ESBR).

All microbiology samples were analysed within 15 hours of being taken and as such the results would not be influenced by storage time and can be considered reliable.

7.5.7.6 Heavy metals

Heavy metals can accumulate in rivers and cause toxic effects on aquatic life and increase risks to humans as drinking and irrigation water. These chemicals are typically at very low concentrations within the natural environment and are often introduced through human activity. Within the Kura River, heavy metal contamination has been shown to originate from mining sites and the leather industry (UNECE, 2007).

The sample analyses for several of the parameters from the current study were compared against the ‘target concentrations’ for controlled waters using General Assessment Criteria (GAC) developed in line with the WFD. The number of heavy metal parameters exceeding target concentrations at each of the rivers for both high flow and low flow surveys is outlined in Table 7-20. With a limited number of exceptions, the concentration of heavy metals was generally lower during the low flow survey (see Appendix E-4, ESBR). This is likely to reflect a reduction in the amount of run-off caused by seasonal rain and snowmelt. The Turianchay, Geokchay and Agsu Canal all have relatively high heavy metal concentrations during both high-flow and low-flow surveys. As considered in Section 7.5.4, these rivers all drain the Greater Caucasus, which have a high erosion rate and may explain the relatively elevated levels.

Table 7-20: Heavy Metals Exceeding Target Concentrations

River Name	Heavy Metals Exceeding General Assessment Criteria Target Concentrations	
	High Flow	Low Flow
Kura West	Al, Cr, Cu, Fe, Hg, Mn, Ni, Zn	Al, Fe, Hg, Mn
Hasansu	Cr	Hg
Tovuzchay	Al, Cu, Fe	Hg
Shamkirchay	Al, Cr, Cu, Fe, Hg, Mn, Zn	-
Sarisu	Al, Cr, Cu, Fe, Hg, Mn, Se	Al, Hg, Se
Goshgarachay	Al, Cu, Fe, Se	Hg
Karasu	Al, Cr, Cu, Hg, Mn, Se	Cu, Hg
Ganjachay	Al, Cd, Cr, Cu, Fe, Se	Cr, Hg, Zn
Korchay	-	Hg

River Name	Heavy Metals Exceeding General Assessment Criteria Target Concentrations	
	High Flow	Low Flow
Kurekchay	Al, Cr, Cu, Fe, Mn, Zn	Hg
Karabakh Canal	Cr, Cu, Se	Al, Hg
Kura East	Al, Cu, Fe, Mn, Se	Al, Hg
Turianchay	Al, As, Cr, Cu, Fe, Hg, Mn, Ni, Zn	Al, Cr, Cu, Fe, Hg, Mn, Zn
Geokchay	Al, As, Cr, Cu, Fe, Hg, Mn, Pb, Ni, Zn	Al, Cr, Cu, Fe, Hg, Mn, Ni, Zn
Agsu Canal	Al, As, Cr, Cu, Fe, Hg, Mn, Pb, Ni, Zn	Al, Cr, Cu, Fe, Hg, Mn, Ni, Zn
Asrikchay	Al, Cr	-
Kurudere*	-	-

*The Kurudere sample was taken in December, while the other low-flow samples were taken in September.

The only heavy metals for which a GAC was not available were barium and calcium. In all rivers the barium concentration was within natural background levels, with the highest levels being found in the Geokchay during the high-flow survey at 0.44 mg/l (see Appendix E-4, ESBR). Calcium concentrations were slightly elevated above expected natural background levels in four of the watercourses:

- Sarisu
- Korchay
- Geokchay
- Agsu Canal.

The highest concentration was in the Korchay during the low-flow survey at 452 mg/l.

7.5.7.7 *Organics*

THC concentrations were below the MDL at all watercourses during the high flow survey and the majority of watercourses during the low-flow survey, with the exception of the Sarisu, Karasu, Karabakh Canal, Geokchay and Kurudere, which were 73 µg/l, 24 µg/l, 22 µg/l, 21 µg/l and 64 µg/l respectively (see Appendices E-3 and E-4, ESBR).

Analysis revealed elevated concentrations of gasoline range organics, aliphatic C_6–C_{10}, in all of the rivers sampled during the May/June high flow surveys. Total concentrations ranged from 0.23 µg/l in the Kura West to 4.13 µg/l in the Sarisu. All low flow samples were below the MDL for this range of organics.

Aliphatic C_{16}–C_{35} range organics were below the MDL for the majority of rivers during the high flow, although slightly elevated concentrations were observed in the Hasansu, Tovuzchay, Karasu, and Ganjachay (see Appendix E-3, ESBR). During the low-flow survey all samples were above the MDL for this range of organics, ranging from 10.6 µg/l in the Korchay to 66.9 µg/l in the Sarisu.

PAH were below the MDL for all water samples in both the high flow and low flow surveys. Analysis for benzene, toluene, ethylbenzene and xylenes (BTEX) was also below the MDL for high- and low-flow surveys at all rivers with the exception of the Asrikchay high-flow sample, which had a total of 0.063 µg/l.

Aromatic C_8–C_{12} range organics were below the MDL at all rivers during both high- and low-flow surveys with the exception of the Sarisu high-flow sample, which contained 0.36 µg/l of aromatic C_8–C_{10}.

While natural hydrocarbon seepage has been shown to take place in Azerbaijan (Guliev and Feizullayev, 1996), it predominantly occurs in the east of the country and not in proximity to watercourses crossed by the proposed pipeline. Although the concentrations of hydrocarbons are relatively low within all of the rivers, it is likely that their presence has been caused by anthropogenic influences. These compounds are widely used domestically, agriculturally and in industry. The relatively low concentrations would not suggest a significant contamination problem and are likely to be explained by run-off from agricultural machinery or domestic vehicles, particularly as washing of domestic vehicles in rivers is a common practice in Azerbaijan.

7.5.7.8 Acidity

The pH of water affects the solubility of many toxic and nutritive chemicals; as acidity increases most metals become more soluble and more toxic. The pH levels within all of the samples, for both high- and low-flow surveys, were slightly alkaline and are consistent with the limestone-dominated geology in the mountain source areas. Ambient water quality standards developed following WFD guidance recommend a pH of 6–9. The most alkaline were the Asrikchay and Tovuzchay at pH8.5 and the least was the Korchay and Turianchay at pH7.6 (Table 7-21).

7.5.7.9 Chloride and sulphate

Both chloride and sulphate have the potential to cause corrosion in materials used in pipeline construction. Chloride is one of the major anions commonly found in rivers and may come from several sources including agricultural run-off, wastewater from industries and municipalities and produced water from oil and gas wells (UNECE, 2007). Chloride concentrations showed relatively little variation within individual watercourses between the high and low flow surveys. However, greater variation was observed between rivers, with the highest concentration observed in the Korchay high flow sample, at 394 mg/l, which was significantly higher than other rivers, which were all below 195mg/l (Table 7-21). The lowest concentration was 1.8 mg/l, taken at the Shamkirchay during the high flow survey (Table 7-21).

Sulphate is widely distributed in nature and can be present in natural waters across a broad range of concentrations. Sulphate may be leached from soil and decaying plant and animal matter, but can also originate from fertilisers and fossil fuels. The World Health Organization has estimated that typical sulphate values in fresh water range from 0 to 0.63 g/l. Four of the watercourses had concentrations above this: the Sarisu, Karasu, Korchay and Agsu Canal. The highest concentration was observed in the Korchay low-flow sample, at 1.2 g/l, while the lowest was 0.11g/l in the Shamkirchay high-flow sample.

7.5.7.10 Electrical conductivity

Electrical conductivity is a good measurement with which to make baseline comparisons, as rivers tend to have a relatively consistent range of values. A straight-line relationship exists between conductivity and the amount of dissolved ions in the water; with conductivity increasing as the number of ions increase. Rivers normally have conductivity between 10 and 1,000µS/cm, and significant changes may indicate a source of contamination has entered the waterway. Samples in the current survey ranged from 290 µS/cm, taken during the high flow survey at the Shamkirchay to 2948 µS/cm, taken at the Korchay during the low flow survey (Table 7-21). Nine of the rivers, including the Korchay, had conductivity of above 1000 µS/cm for either or both the high-flow and low-flow survey, comprising the Tovuzchay, Zeyamchay, Sarisu, Goshgarachay, Karasu, Kurekchay, Agsu Canal and Kurudere (Table 7-21).

The largest difference in conductivity between the high flow and low flow surveys was observed in the Tovuzchay, which were 367 µS/cm and 1150 µS/cm respectively.

Table 7-21: Acidity, Chloride, Sulphate and Conductivity at SCPX River Crossings during 2011 High- and Low-Flow Conditions

River	pH		Chloride (mg/l)		Sulphate (g/l)		Conductivity (uS/cm)	
	High	Low	High	Low	High	Low	High	Low
Kura West	8.2	8.1	11.5	17.8	0.21	0.28	350	680

River	pH		Chloride (mg/l)		Sulphate (g/l)		Conductivity (uS/cm)	
	High	Low	High	Low	High	Low	High	Low
Hasansu	8.3	8.3	33.6	31	0.23	0.26	726	954
Tovuzchay	8.4	8.5	13.8	36	0.13	0.46	367	1150
Zeyamchay	-	8	-	11.1	-	0.18	-	1296
Shamkirchay	8.2	-	1.8	-	0.11	-	290	-
Sarisu	8.2	8	193	145	1.1	0.92	2550	2257
Goshgarachay	8.3	8	105	88	0.35	0.45	1140	1483
Karasu	7.8	7.9	173	126	0.87	0.7	2100	2008
Ganjachay	7.9	8	10.3	24	0.13	0.18	374	815
Korchay	7.6	7.7	394	346	0.91	1.2	2740	2948
Kurekchay	8	8.1	18.9	79	0.13	0.5	580	1209
Karabakh Canal	8.1	8.4	22	16.3	0.16	0.14	518	405
Kura East	7.9	8.2	21	21	0.18	0.38	558	510
Turianchay	8	7.6	7.4	5.8	0.2	0.17	550	422
Geokchay	8.1	8.2	4.7	7.4	0.19	0.14	450	404
Agsu Canal	8	8.1	80	55	0.86	0.65	1890	1423
Asrikchay	8.5	-	11.9	-	0.16	-	641	-
Kurudere*	-	7.98	-	50	-	0.33	-	1017

*The Kurudere sample was taken in December, while the other low flow samples were taken in September.

7.5.8 *Temporary Facilities*

Poylu Rail Spur and Offloading Area and Poylu Pipe Storage Area are both approximately 150m south of the Kura river. No other temporary facilities are within close proximity to a major water course. However, there are irrigation ditches on the borders of most of the temporary facility areas, for example Kurdemir pipe storage areas and Kurdemir Camp option 5. Section 8.5.8 has further details on each of the sites.

7.5.9 *Environmental Change*

The Caspian Sea experiences significant short- and long-term water level fluctuations and is one of the few water bodies in the world where the water level is lower than that of the world's oceans. Measurements of the Caspian Sea water level have been carried out since the beginning of the 19th century.

Sea levels fell during the 1930s as a result of the construction of several major dam projects on the Volga River. This fall continued until the 1970s. From around 1978, however, there has been a marked increase in Caspian Sea level, which, when averaged, amounts to an increase of around 10cm per annum.

The trend of water level rise, since 1978, began to show signs of reversal and in 1996, the sea level rise slowed and levels returned to approximately 27m below sea level. Measurements from June 2002 to January 2006 (Kostianoy & Lebedev, 2006) have shown that the Caspian Sea level again began to rise at a mean rate of +7.5 cm/year. This rise in sea levels resulted in the inundation of low-lying areas, the formation of lagoons and the development of islands.

Most recent data (Arpe et al., 2010) suggests that the Caspian Sea level again began to fall in 2010. This was explained by a drop in precipitation over the Volga basin and was expected to result in a drop in the average level in the Caspian Sea of approximately 22cm. Continued fluctuations in the sea level have resulted in a coastline which to one degree or another differs from the majority of existing maps. These variations may also have repercussions for groundwater levels, quality and flow directions in the coastal region of the country. However the proposed pipeline route is likely to be too far inland to be of any influence.

Given these significant past changes over the last century in the Caucasus region, and predictions of future climates by general circulation models, there exists the distinct possibility of future environmental changes along the proposed pipeline route. These include changes in climate (precipitation and temperature), land use and agricultural activities, groundwater levels and flow directions, and Caspian Sea level. These changes may alter hydrological regimes and water quality, and affect future flood intervals, river and soil erosion and contamination risks over the design life of the pipeline. In particular, future economic development in Azerbaijan may well generate significant agricultural land-use changes in the pipeline corridor that could alter river flows and surface-water and groundwater quality.

7.5.10 Sensitivities

The bullet points below summarise sensitivities relating to hydrology with regard to the proposed SCPX Project:

- Most of the rivers crossed have strongly seasonal flow regimes with increased chance of flooding during spring and autumn. This in turn has implications for programming of water-crossing installations, seasonal sensitivity of watercourses to pollution, emergency response planning and the availability of, and impacts of using, river water for pipeline hydrostatic testing
- Many of the rivers have a high sediment load, and four river crossings (Sarisu, Asrikchay, Hasansu and Kura West) are in areas that have been identified in Section 7.3 as having a high susceptibility to erosion (see Section 7.3.3.7)
- Many of the rivers crossed have highly dynamic river channels with a high degree of channel instability at many river crossings, including lateral erosion of riverbanks and highly mobile river beds during flash flood/high flow events. This has consequent implications for pipeline river-crossing location, design, integrity, inspection and maintenance
- Water quality in the rivers is variable, with elevated levels of contaminants recorded in many rivers that need to be considered when assessing the use of any water, and the impacts of any releases, during construction, including:
    - Elevated concentrations of heavy metals in many rivers in comparison to target concentrations developed following WFD guidance
    - TSS above the limit for controlled waters recommended by WFD guidance
    - High coliform counts at all rivers apart from the Kurudere.
- The watercourses crossed are generally important for agriculture and industry.

7.6 Groundwater

7.6.1 Introduction

The purpose of this section is to provide a description of groundwater conditions along the proposed pipeline route in Azerbaijan. The baseline data presented here will be used to identify and assess potential impacts to groundwater of the SCPX Project, including the temporary construction camp and pipe storage areas, block valve (BV) sites and pigging station. This section is based on existing reports and expert opinion as listed below.

7.6.2 Methodology

7.6.2.1 Data sources

This section was compiled from a review of the hydrogeology baseline information presented in Part 3 of the Technical and Baseline Appendices to the South Caucasus Pipeline (SCP) Environmental and Social Impact Assessment (ESIA), May 2002. In addition, information from subsequent groundwater monitoring carried out by BP has been described and incorporated.

The list of sources of information below comprises all sources referenced in the 2002 Hydrogeology Baseline appendix.

- Results of analysis of sediment samples collected during field trips, performed by Caspian Environmental Labs of Baku, October 2001
- Groundwater quality laboratory results (Akvamiljo Caspian reports) for borehole and monitoring well sampling carried out as part of the BTC water sampling programme, 2003-2004
- Discussions with Azerbaijani specialists, in particular, Dr F. Aliyev, Dr A. Alekperov, Dr I. Tagiev (State Committee for Geology, Ministry of Environment and Natural Resources), Dr R Israfilov (Institute for Geology) and Dr N. Katz. These were held during preparation of the BTC and SCP ESIAs during 2001
- Results of Shah Deniz midstream geotechnical investigations (Gibb) 2001
- BTC and SCP ESIAs, produced by RSK, 2002
- Western Route Export Pipeline in Azerbaijan (WREPA) EIA, produced by AETC in April 1997
- Reports compiled for BP by Dr F Aliyev (2001) and Dr Tagiev and Dr Alekperov (2001)
- Published geological (Nalivkin et al., 1976) and hydrogeological (Aliyev et al., 1992) maps
- Records of exploration boreholes (pumping test results, geological logs), maps and sections provided by the State Committee for Geology, 1992
- Published scientific literature and international guidance documents available via the Internet.

7.6.2.2 *Assessment of importance and sensitivity of groundwater*

An assessment has been made of the importance of the groundwater resources along the proposed pipeline route and their potential sensitivity to change. As a result, the importance and sensitivity of the groundwater resources has been classified into categories that range from very low to very high. Information on this process is given in Chapter 3 and the assessment table, defining the categories used, is also included in Appendix B of the ESBR.

7.6.2.3 *Technical difficulties or uncertainties*

It should be noted that there is a degree of subjectivity in the classification of subsoil permeability applied by Gibb (2001) for the following reasons:

- Trial pit logs did not reach to 4m; therefore, the assessment is made of only a partial profile. Classifications based on borehole data are thus more representative than those based on trial pits
- The relevant section of the logs may contain different lithologies. In most cases, the interpretation has erred on the side of caution. For example, if the 3m section (1–4m) contained 1.5m silt and 1.5m gravel, the location has received a "4" rating (see Section 7.6.3.1 below). If, however, the gravel was only a thin bed within silts, a compromise designation of "3" may have been chosen
- The trial pits and boreholes were not evenly distributed along the borehole route and did not reach a density of one per kilometre. Thus, a significant amount of interpolation between investigation points has been necessary. For example, between KP361 and KP373 there is no available trial pit/borehole information.

Regarding groundwater vulnerability, it should be noted that the classification system used is not ideally suited to the situation along the proposed pipeline route for several reasons:

- It takes an inexplicit account of water quality (e.g. whether water is potable or not)
- Along parts of the proposed pipeline route, there may exist a vertical sequence comprising an unconfined aquifer complex and several confined aquifer complexes
- It does not recognise that a deep unconfined aquifer may be overlain by a substantial protective (though not confining) layer of silt and clay, whereas a confined aquifer may be very shallow and confined by only a relatively thin layer of clay
- Data regarding the rate of abstractions on groundwater resources is not known and was therefore not taken into consideration.

However, these factors have been taken into account when reaching overall conclusions of aquifer/groundwater importance and sensitivity in the sections below.

7.6.3 Pipeline Route

7.6.3.1 Hydrogeological classification of the pipeline route

The proposed pipeline route has been assessed according to two measures:

- Soil/subsoil permeability from depth 1m to depth 4m, according to the following scale, using data from the Shah Deniz midstream geotechnical investigations (Gibb 2001):
  - Class 1 = very low permeability (clay)
  - Class 2 = low permeability (silt and fine sand)
  - Class 3 = medium permeability (medium to coarse sand)
  - Class 4 = high permeability (gravels/cobbles)
  - Class 5 = very high permeability (fissure flow).

- Groundwater vulnerability, based on type and importance of aquifer, using the following scale:
  - Class 1 = Non-aquifer
  - Class 2 = Confined aquifer - local importance
  - Class 3 = Confined aquifer - regional importance
  - Class 4 = Unconfined aquifer - local importance
  - Class 5 = Unconfined aquifer - regional importance.

In general, groundwater can be regarded as vulnerable to contamination from pipeline construction or operation where the subsoil permeability is high, and where there exists an unconfined aquifer of local or regional importance.

The results of the classification are displayed graphically in Figure A6-1, Appendix A, ESBR.

7.6.3.2 East of Yevlakh

The Shirvan Plain (KP0–KP167) occupies the majority of the landscape east of the Kura River crossing at KP167, including the proposed temporary Alternative 1 and Alternative 2 temporary construction camps and pipe storage areas located at Mugan, Kurdemir and Ujar, BV sites BVR A6 (KP21) and BVR A7 (KP95) and the pigging station located at KP0.

On the Shirvan Plain, head gradients are low (0.03 to 0.0007) and decrease in the direction of the Kura River. The thickness of significantly transmissive strata also decreases towards the Kura River and is believed to be 10–20m in the proposed pipeline corridor. Hydraulic conductivities are believed to be 0.1 to 3m day^{-1} in the water-bearing strata. Groundwater mineralisation is generally very high, typically in the range 5-100g/l, meaning that the water is unsuited for potable and many other uses. The water table is generally within 3m of the ground surface over 90% of the area, partially owing to protracted infiltration of irrigation water from canal systems. On the proposed pipeline route, only in the regions of Kurdemir and Shakyar-Kobu is the groundwater level expected to be deeper, approximately 5–10m below ground level (bgl) (Aliyev, 2001).

The value (importance) and sensitivity of the groundwater in this area is therefore generally very low or low. However, it should be noted that three potential exceptions to this exist, where the sensitivity would be higher:

- There may exist small (unmapped) pockets or lenses of fresh groundwater along the route. These, if they exist, are likely to be extremely important to local herdsmen, nomads and even villagers in this arid region because fresh groundwater reserves are so scarce
- Where permeable strata exist, groundwater resources are likely to be brackish or saline and thus of little use as a drinking water resource. However, they may have a potential use as irrigation water (under some circumstances) or as a water resource for industrial use. Such uses of water are obviously less sensitive to contamination than potable usage. Even where usable groundwater resources do not exist, permeable strata in the subsurface may be efficient at transporting spilled or leaked contaminants to surface water receptors such as streams or irrigation canals, where the presence of contamination could have an adverse impact
- In the immediate vicinity of the Kura River, high permeability alluvial sediments occur, which are assumed to have potential value as aquifers (KP162–170). Such deposits are also likely to be efficient at transporting spilled or leaked contaminants via the subsurface to the Kura River.

7.6.3.3 West of Yevlakh

The pipeline route west of the Kura River comprises the Karabakh Plain (KP169–KP202) and Ganja-Gazakh Plain (KP202–KP390). These areas encompass BV sites BVR A8 (KP172), BVR A9 (KP243) and BVR A10 (KP334) and also the following Alternative 1 and Alternative 2 camp and pipe storage areas (see Figure A7-1, Appendix A) for details of the locations mentioned within this section):

- Yevlakh*
- Goranboy Camp Option 3
- Camp and Pipe Storage Goranboy 1*
- Dallar Pipe Storage and Dallar Rail Spur and Offloading
- Samukh Camp Option 3
- Tovuz Camp Option 5*
- Agstafa Pipe Storage and Offloading Options*
- Agstafa Camp Option 3.

* refers to previous options that have been rejected.

West of the Kura East River, through Yevlakh and in the western outskirts of Yevlakh, confined aquifers exist that are exploited for reserves of fresh groundwater. These are likely to be used mainly for domestic and agricultural purposes. This confined groundwater is not believed to be vulnerable to contamination from construction or operation of the proposed pipeline, as it is confined typically by at least 10m of clay. In this area, shallow "unconfined" groundwater is encountered at depths of only 1–2m bgl, typically in sands and loamy sands with hydraulic conductivities of 0.1 to 3m day-1. Figure A6-2 in Appendix A of the ESBR shows the typical depths to the shallow water table. It is usually highly mineralised (10–15g/l) and generally unsuited to potable supply, but may conceivably have applications for industrial usage dependent on capacity, use and aquifer recharge rates (Figure A6-3, Appendix A, ESBR). The subsurface may also permit spilled contaminants to migrate to surface water recipients or permit vapours to migrate into dwellings. In general, the value (importance) of the groundwater in this area varies from very low to medium (if used for industrial purposes) and the sensitivity of groundwater to contamination is regarded as low.

Further west, especially west of the Goranchay, on the Ganja-Gazakh Plain, unconfined groundwater becomes progressively fresher and regarded as an exploitable resource. Its vulnerability to contamination thus increases. Users of the aquifer in this area are likely to comprise mainly domestic and agricultural users. The aquifer complex here comprises proluvial and alluvial deposits of sands, gravels and cobbles, alternating with silty/clayey interlayers. The complex generally becoming finer grained away from the Lesser Caucasus towards the Kura River West. The aquifer horizons here are conventionally divided into one upper, partially unconfined aquifer complex (Russian *gruntovaya voda*) and four confined aquifer complexes (Russian *napornii vodonosnii gorizont*), largely on the basis of stratigraphic proximity of aquifer horizons with similar water chemistry. These subdivisions are largely symbolic and arbitrary as the real structure of the aquifer is complex with many alternating coarse and fine layers that vary laterally. Ultimately, the sedimentary succession must be viewed as a single unit.

On the Ganja-Gazakh Plain, depths to groundwater are low (<5m) in the Goranboy/Goranchay area and in the valleys of the main rivers increasing to 25m or more in the interfluve areas. Groundwater is generally fresh (<1g/l mineralisation) except in the area immediately north and north-east of Goranboy. The hydraulic conductivity of the sediments comprising the upper aquifer complex is stated by Tagiev and Alekperov (2001) to be in the range 0.1-13.4m day^{-1}, although discussions with the State Committee of Geology and Mineral Resources suggest that values of 20–100m day^{-1} may be more typical for the gravelly/cobbly strata.

In the valleys of the major rivers (Tovuzchay (KP324), Zeyamchay (KP303), Shamkirchay (KP277), Goshgarachay (KP261), Kurekchay (KP221) and Goranchay (KP202)) draining the north-eastern slope of the Lesser Caucasus, vulnerability of groundwater is regarded as extremely high, for the following reasons:

- The immediate subsurface is generally sandy/gravelly/cobbly, with a high degree of interconnectivity
- The water table is relatively shallow
- The gravels of the immediate subsurface may have been "winnowed" of fine material by fluvial reworking; these deposits may thus be especially permeable.

In general, as with most of the areas covered by the proposed SCPX Project, the aquifers are likely to be used for mainly domestic and agricultural purposes. A spill in such valleys may have particularly severe implications because contaminants may migrate rapidly vertically downwards to groundwater resources, down-valley through fluvial sediments or laterally to the surface watercourse through fluvial sediments.

For similar reasons (shallow water table, gravelly/cobbly subsurface strata, highly permeable aquifer strata), and the fact that the Garayazi aquifer also supports an important wetland (see Section 7.5.3.3) that forms part of the internationally protected Garayazi Reserve (an IUCN Category Ia Reserve), large portions of this section of the proposed pipeline route are regarded as sensitive with regards to any spills that would contribute to groundwater contamination. Figure 7-23 illustrates the depth to groundwater in the Quaternary aquifer complex of the Garayazi Plain.

In contrast, in the immediate subsurface of interfluve areas of the Ganja-Gazakh Plain, there are often layers of silt or clay that will hinder (although not necessarily prevent) the downward migration of contaminants to the water table. Several confined aquifer horizons, with fresh groundwater reserves, also exist beneath most of the area. These are generally not regarded as being vulnerable to potential contamination from pipeline-related activities.

Throughout the Ganja-Gazakh Plain, both unconfined and confined aquifers are exploited by wells, boreholes, springs and karizes (canals) for potable, irrigation and industrial uses. In recent years, the total rate of production of subsurface waters for the entire plain was between 820,000 and 1,130,000 m^3/d (9500 to 13,100 l/s). Musaev and Panakhov (1971) reported more than 300 karizes in the unconfined aquifer of the plain, with a total flow of >6000 l/s. In the Garayazi Plain area, inhabitants are known to use shallow groundwater for drinking water supply. Shallow groundwater also supports wetland interests of considerable ecological value.

In general, the value (importance) of the groundwater in this area varies from high to very high, and the sensitivity of groundwater to contamination is regarded as high.

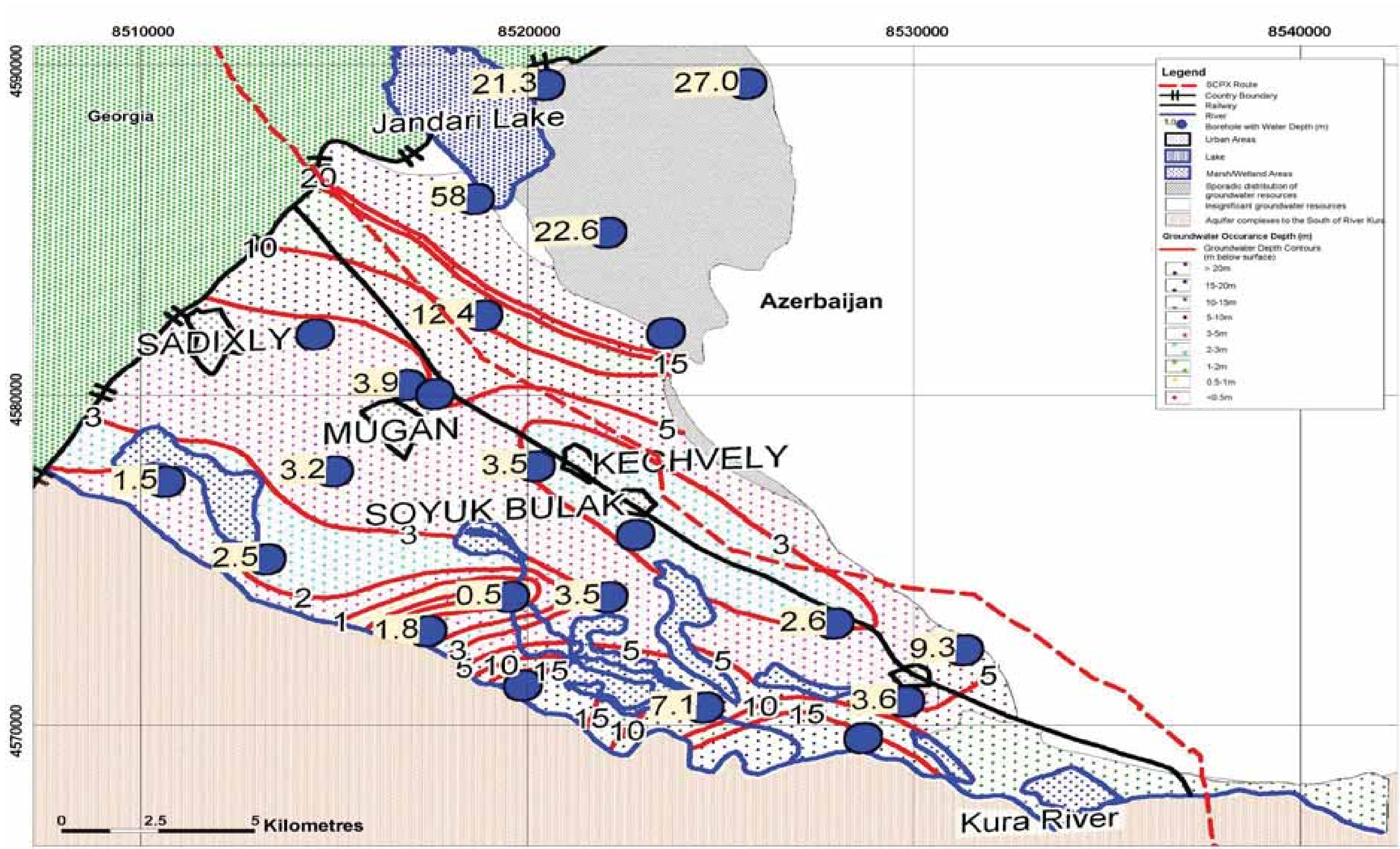


Figure 7-23: Depth to Groundwater in the Quaternary Aquifer Complex of the Garayazi Plain

7.6.4 Groundwater Monitoring

This section presents the groundwater sampling and laboratory testing results carried out for the BTC project for existing boreholes and wells along the pipeline route as well as in dedicated groundwater monitoring wells installed by BTC in the sensitive Garayazi aquifer.

7.6.4.1 Boreholes and wells along the pipeline route

Groundwater sampling was undertaken during 2003 and 2004 at selected locations along the BTC pipeline route, the results of which have been reviewed and used to inform the baseline groundwater conditions for the SCPX Project. The sampling locations along the route are listed in Table 7-22 and Figure 7-24.

Table 7-22: Monitoring Well Locations

District/Village	Northing	Easting	Name	Type
Boyuk Kesik	8516562	4584277	BoyA2	Artesian borehole in use
Boyuk Kesik	8516963	4584499	BoyA3	Artesian borehole in use
Garayazi	8520146	4574539	KarA1	Artesian borehole in use
Garayazi	8519934	4574312	KarA2	Artesian borehole in use
Soyukbulag/ Kokeltme	8525634	4571348	SoyA1	Artesian borehole in use
Soyukbulag	8523524	4576397	SoyS1	Sub-artesian
Soyukbulag	8522802	4576247	SoyS4	Sub-artesian
Salogli	8529722	4571546	SalS1	Sub-artesian
Salogli/ Kidney Spring	8527415	4570935	SalA3	Artesian borehole in use
Girag Kesemen	8539076	4563856	GKesA2	Artesian borehole (no pump) in use
Girag Kesemen	8538702	4564079	GKesA3	Artesian borehole (no pump) in use
Girag Kesemen	8538377	4564224	GKesA4	Artesian borehole (no pump) in use
Girag Kesemen	8537928	4564689	GKesA5	Artesian borehole (no pump) in use
Girag Kesemen	8540997	4562819	GKesA8	Artesian borehole in use
Govlar	8562186	4541583	GovS8	Sub-artesian in use
Duz Kirigli	8567926	4539380	DuzKA1	Water spring flows out from the ground on the depth 7–8 m below the surface and goes towards E-8568122 N-4539497 to Kura River. It is fresh water, used for drinking, irrigation and domestic purposes by local farms.
Kolkhozkend	8577383	4533154	KolS5	Sub-artesian borehole in use
Kolkhozkend	8578234	4533410	KolS12	Sub-artesian borehole in use
Kolkhozkend	8578573	4533535	KolS13	Sub-artesian borehole in use
Kolkhozkend	8577702	4533691	KolS15	Sub-artesian borehole in use
Dashbulag	8587574	4529782	DashS1	Sub-artesian borehole in use
Dashbulag	8587859	4529910	DashS2	Sub-artesian borehole in use
Dashbulag	8588335	4530311	DashS3	Sub-artesian borehole in use

District/Village	Northing	Easting	Name	Type
Deller Djirdahan	8589799	4528692	DDjrdS1	Sub-artesian borehole in use
Deller Djirdahan	8590226	4528559	DDjrdS2	Sub-artesian borehole in use
Plankend	8596309	4527282	PlanS3	Sub-artesian borehole in use
Plankend	8595851	4528794	PlanS13	Sub-artesian borehole / in use
Mamedalili	8601957	4526996	MamdS5	Sub-artesian borehole in use
Garajamirli	8601941	4524176	GarjS17	Sub-artesian borehole in use
Garajamirli	8603027	4523776	GarjS6	Sub-artesian borehole in use
Talish	8607623	4526259	TalA1	Artesian borehole
Samukh	8613346	4525562	SamS4	Sub-artesian borehole in use
Talish	8607316	4526674	TalA3	Artesian borehole in use
Seidler	8609271	4524603	SeidA3	Artesian borehole in use
Ali-Bayramli	8627924	4517930	AliBS6	Sub-artesian borehole in use
Hajialili	8622143	4520035	HajS16	Sub-artesian borehole in use
Bashirabad	8636772	4510911	BashS2	Sub-artesian borehole in use
Muzdurlular	8635994	4508591	MuzdS1	Sub-artesian borehole in use
Azizbekovo	8637970	4508041	AzizS2	Sub-artesian borehole in use
Elpak	8637180	4510050	ElpS2	Sub-artesian borehole in use
Gurbanzade	8631936	4515412	GurbS2	Sub-artesian borehole in use

The samples were tested at the Akvamiljo Caspian laboratory for a suite of inorganic parameters and TPH (report ref. 3613 Rev. 3 dated 4/5/03; report ref. 4108-02-R2 dated 3/6/04; report ref. 4172-01-R2 dated August 2004).

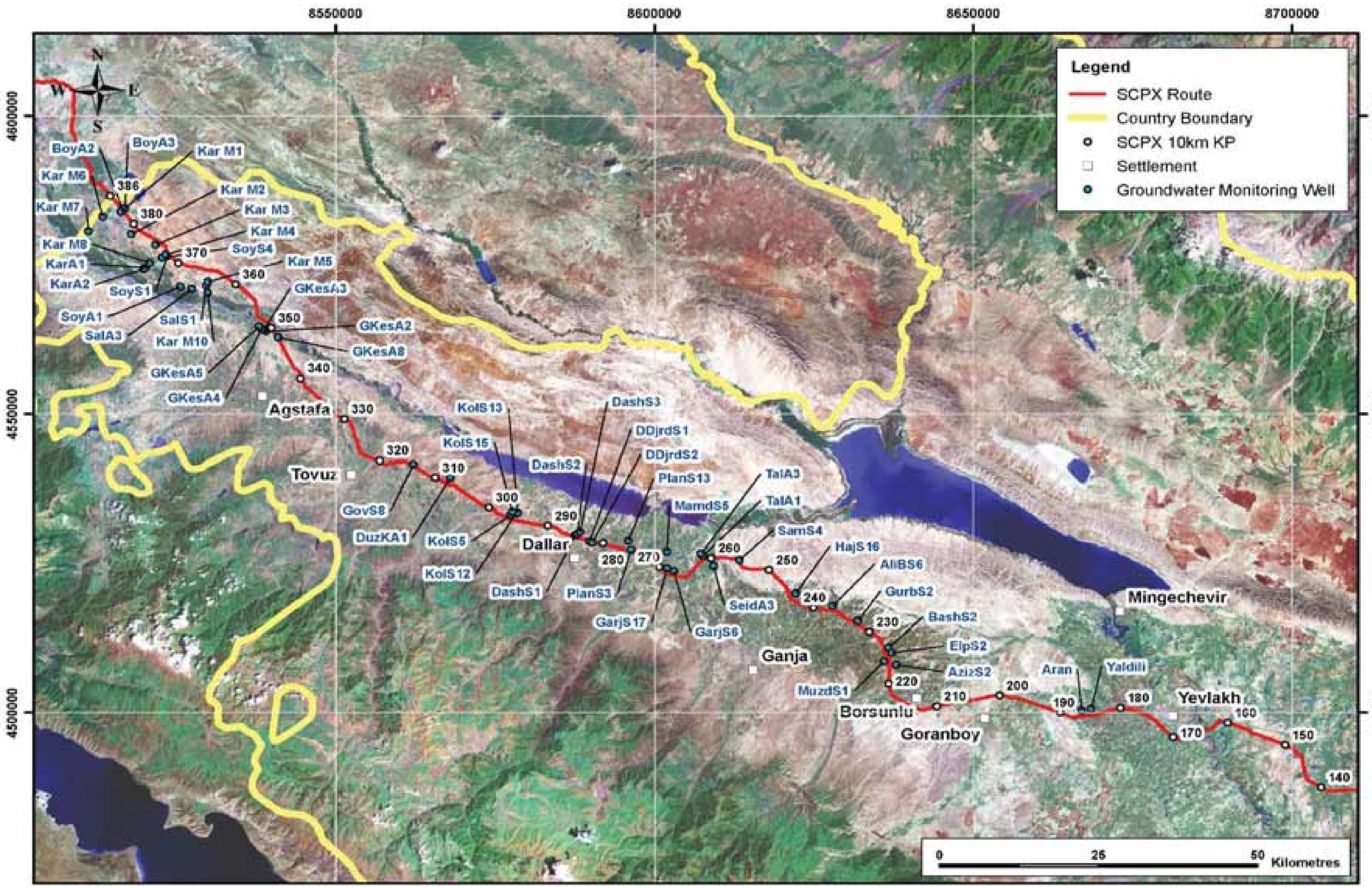


Figure 7-24: Groundwater Monitoring Locations along Proposed Pipeline Route

The laboratory testing results indicate that all concentrations of TPH in 2003 were below the laboratory detection limit. Two samples were found to exceed the detection limit for TPH in January 2004. Concentrations of 0.07 mg/l and 0.8 mg/l were detected in Boy A3 and Kar M3, respectively. The latter value exceeds the WHO/EU standard of 0.3 mg/l. Several concentrations of cations and anions were also found to exceed the standards presented in the laboratory report. No TPH values exceeded the detection limits in the August 2004 sampling event.

7.6.4.2 Monitoring wells in the Garayazi aquifer

Several groundwater monitoring wells were installed by the BTC project in the Garayazi aquifer to monitor changes in groundwater quality. The wells are listed in Table 7-23 and Figure 7-24. Monitoring is conducted regularly by the BP AGT environmental team, and laboratory results between 2004 and 2010 were made available to the Project for the purposes of the SCPX ESIA baseline study.

Table 7-23: Monitoring Well Locations in the Garayazi Aquifer

Well name	N	E
Kar M1	8516336	4583934
Kar M2	8517975	4580156
Kar M3	8521784	4578392
Kar M4	8523338	4576714
Kar M5	8529951	4572168
Kar M6	8513447	4583103
Kar M7	8511256	4480636
Kar M8	8520835	4575277
Kar M10	8529957	4570303

Groundwater samples were collected and analysed for the following parameters: TPH, BTEX and PAH. No PAH were detected in any samples except in Kar M2 in November 2009 at a concentration of 0.01ug/l. No TPH or BTEX was detected in any of the samples collected.

7.6.5 Sensitivities

Key issues relating to hydrogeology for the SCPX Project are as follows:

- Groundwater east of the Yevlakh area (KP0–approx. KP162) generally has a low importance and sensitivity, and is largely non-potable and unexploited. However, a possible exception to this is that there may exist small (unmapped) pockets or lenses of fresh groundwater along the route. These, if they exist, are likely to be extremely important to local herdsmen, nomads and even villagers in this arid region because fresh groundwater reserves are so scarce
- Groundwater is generally shallow and heavily exploited for potable and irrigation use to the west of the Yevlakh area (approx. KP162–KP390) and therefore is likely to generally have a high to very high importance and high sensitivity. The value of the aquifer increases further west, as the groundwater becomes progressively fresher
- Groundwater in the Garayazi aquifer, to the west of the Kura West River crossing (KP358–KP390), is considered to have a very high importance and sensitivity. It is particularly vulnerable owing to its shallow nature and highly permeable overlying strata and is exploited for potable and irrigation use. It also supports the Garayazi wetland, which forms part of the internationally protected Garayazi Reserve, an IUCN Category Ia Reserve.

7.7 Ecology

7.7.1 Introduction

This section presents a description of the ecological conditions along the proposed route of the SCPX Project in Azerbaijan. It is based on field survey data collected during ecological surveys of the proposed SCPX route carried out in May/June 2011 and August 2011, and a review of desktop data and reports (including the ESIA reports for the BTC pipeline and the SCP route). The purpose of the section is to provide.

- Detailed descriptions of all the terrestrial habitats crossed by the route (based on floristic data collected from transect surveys)
- Baseline data for future monitoring of plant species-diversity and vegetation cover
- An inventory of plant and animal species occurring along the route, including spatial meta-data (i.e. showing which species occur where)
- Habitat descriptions for a representative sample of the rivers crossed by the proposed pipeline route
- An evaluation of the relative ecological importance and sensitivity of the flora and fauna of the proposed pipeline route, identifying where the most sensitive habitats and species are located.

7.7.2 Methodology

7.7.2.1 Data sources

This section is based on four main sources of information:

- Desktop review of freely-available data regarding ecology and ecosystems in Azerbaijan
- Data prepared for the SCP and BTC pipeline ESIA reports, including desktop research and data from ecological surveys carried out in 2002
- The results of the ongoing botanical monitoring programme for the BTC/SCP ROWs between 2007 and 2011
- Field surveys carried out specifically for the SCPX Project in May/June 2011 and August 2011.

Data from these four sources have been combined to give as complete a picture as possible of the habitats and species crossed by the proposed SCPX route using maps and descriptions. The ecological surveys for the SCPX route included the following:

- Botanical recording along transects across the proposed route at 29 locations
- Habitat descriptions and records of flora and fauna at 16 river crossings (riparian habitat survey)
- A baseline flora and fauna description of the proposed pigging station at KP0
- Two surveys for fish in May/June 2011 (high river flow), and in August (low river flow) 2011.

7.7.2.2 Terrestrial vegetation surveys

The terrestrial vegetation surveys undertaken for the SCPX Project in May/June 2011 were based very closely on the procedure for vegetation monitoring developed for BTC/SCP biorestoration monitoring, which has been implemented on the BTC/SCP route annually since 2007. This procedure has been designed carefully to provide objective, quantitative data on the percentage cover and species-diversity of vegetation on the pipeline route. The method is based on quadrat samples collected from transects located in areas representative of each habitat crossed by the route. It is designed to allow repeat sampling to monitor long-term impacts of pipeline construction. The typical layout of each transect and the quadrats is illustrated below (Figure 7-25). This is the layout that was used for all of the transects in the SCPX surveys.

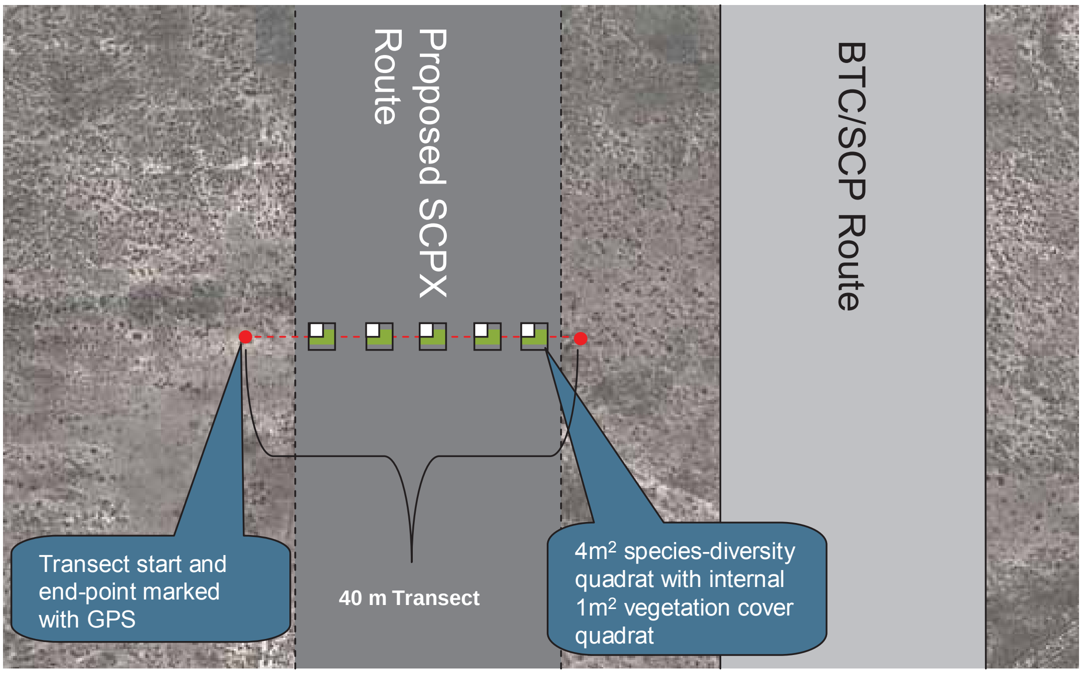


Figure 7-25: Transect and Quadrat Layout Perpendicular to the ROW

The vast majority of quadrats used for measuring species-diversity were 2m x 2m (i.e. 4m^2), except in shrub habitats where 5m x 5m quadrats were used. Vegetation cover was always measured in 1m x 1m square quadrats, sub-divided with string into 10cm squares to aid visual assessment of percentage cover. Percentage cover was recorded to the nearest 5%, in accordance with the existing BTC biorestoration monitoring procedure.

The start and end points of the transects were recorded using a high-accuracy global positioning system (GPS), which will allow the same points to be found for future monitoring.

In total, 29 transects were surveyed between KP0 and KP358. SCPX transects are referred to here with the prefix “AZT”, followed by a number. Provisional survey locations were assigned in a desktop exercise, aiming to coincide with the location of BTC/SCP biorestoration monitoring transects (referred to with the prefix “AZ”) and the locations were refined in the field. As a result, the AZT numbers do not run sequentially from west to east, and not all AZT numbers in the sequence were used (some locations assigned in the desktop exercise could not be accessed in the field). A complete set of the SCPX transect data is included in Appendix F-2, ESBR. The locations of both AZT and AZ transects are shown in Figure A1-1 in Appendix A of the ESBR.

The pigging station at KP0 was included in the survey. The block valve (BVR) stations were not surveyed (as their locations were not known at the time of the survey) but vegetation types have been identified here on the basis of existing BTC/SCP information. The locations of the pigging station and BVRs are shown on Figure A7-1 in Appendix A.

Temporary construction camp and pipe storage area sites had not been identified when the ecological survey was undertaken. However, it has been possible to describe the ecology of these sites, which are of generally low ecological importance and sensitivity, adequately from photographs taken for the soil and Phase 1 surveys or photographs taken during site reconnaissance visits by Project engineers. The locations of the proposed temporary construction camp and pipe storage areas are shown on Figure A7-1 in Appendix A.

7.7.2.3 Terrestrial fauna

Terrestrial fauna were recorded by an in-country zoologist with many years' experience of this kind of field survey including baseline surveys for the BTC/SCP route. Fauna were recorded during the SCPX terrestrial vegetation surveys undertaken in May/June 2011, which is during the main breeding period for most fauna in the region (including amphibians, birds and mammals). This is the period when the animals are most active and they are most easily seen. Sightings of animals or signs of animals (burrows, tracks, droppings, etc.) were recorded where they were seen. Evidence of fauna was also searched for during the riparian habitat surveys (see Section 7.7.2.4), with a focus on searching for evidence of riparian species strongly associated with rivers, such as *Arvicola amphibius* (water voles)[2]. These data are supplemented by previous survey results and by the known occurrence and distribution of fauna in Azerbaijan.

7.7.2.4 Riparian habitat surveys

The purpose of the riparian habitat surveys was to describe the river morphology, vegetation types and fauna. The survey area extended 50m upstream and 100m downstream of the proposed pipeline crossing. The width of the survey area extended up to the edge of the riparian habitats, where the vegetation becomes dominated by typical terrestrial species not associated with the river habitat.

The riparian habitat surveys were conducted at 16 river crossings, the locations of which are shown on Figure A7-1, Appendix A. The crossings were selected to provide a representative sample of the types of rivers that are crossed by the proposed route, broadly divided into three types: canals and canalised rivers, meandering rivers, and rivers with braided channels.

The survey methods broadly follow the river corridor survey technique developed in the UK (NRA, 1992), adapted for the purposes of this survey. The method centres on sketch-mapping of the river morphology, and recording flora and fauna of the river habitats using species-listing. For each distinct vegetation type a list of plant species was recorded and given an estimated score of abundance based on the DAFOR (Dominant, Abundant, Frequent, Occasional and Rare) scale. Animal species were recorded where they were seen, and a search was made for evidence of use by animals, such as tracks, burrows and droppings. A note was made if habitat was suitable for Red Data Book (RDB) species, even if they were not actually recorded.

7.7.2.5 Vegetation classification

The method of vegetation classification followed here is taken from Shukurov et al. (2008). This is a hierarchical scheme following a European-style phytosociological classification structure. Vegetation is classified initially according to a Formation Class – usually based on distinctive physical characteristics such as soil types. The secondary level of classification is the Formation, based on physiognomically dominant plant species, and the tertiary level is the Association, which is given a dual name using the dominant and sub-dominant plant species.

The basic classifications for vegetation types crossed by the proposed route is given in Table 7-24 and shown on maps in Figure A7-1 in Appendix A.

[2] *Arvicola amphibius* is the new name for *Arvicola terrestris*.

Table 7-24: Classification of the Vegetation Types Crossed by the Proposed Pipeline Route

Type	Formation Class	Formation	Association
Agriculture	n/a	n/a	n/a
Desert	Clayey deserts	Artemisieta lerchiana clayey deserts	Artemesietum-salsolosum dendroides clayey desert
Desert	Clayey deserts	Artemisieta lerchiana clayey deserts	Artemesietum-salsoletum nodulasae
Desert	Clayey deserts	Artemisieta lerchiana clayey deserts	Artemisietum lerchiana
Desert	Clayey deserts	Artemisieta lerchiana clayey deserts	Ephemeretum
Desert	Clayey deserts	Artemisieta lerchiana clayey deserts	Peganetum
Desert	Clayey deserts	Artemisieta lerchiana clayey deserts	Salsoletum nodulosae clayey desert
Desert	Solonchak deserts	Salsoleta, Kalideta, Halocnemeta and Suaedeta solonchak deserts	Kalidetum & Capparisetum spinosa clayey desert
Desert	Solonchak deserts	Salsoleta, Kalideta, Halocnemeta and Suaedeta solonchak deserts	Halocnemetum strobilaceum solonchak desert
Desert	Solonchak deserts	Salsoleta, Kalideta, Halocnemeta and Suaedeta solonchak deserts	Suaedetum microphylla solonchak desert
Semi-desert	Steppe-like semi-desert	Artemiseta lerchiana semi-deserts	Artemisetum botriochloasum semidesert
Semi-desert	Steppe-like semi-desert	Artemiseta lerchiana semi-deserts	Artemisetum lerchiana purum desert
Semi-desert	Steppe-like semi-desert	Artemiseta lerchiana semi-deserts	Artemisetum steppe with arid forest in stream bed
Lowland meadows	Saline meadows	Aeluropeta littoralis	Cynodonetum alhagiosum
Forests and shrubs	Plantation woodland	Plantation woodland	Plantation woodland
Forests and shrubs	Semi-natural forest and shrubs	Tamarixeta	Tamarixetum scrub
Forests and shrubs	Arid scrub	Caraganeta	Caraganetum-Paliurosum spina-christi
Wetlands	Reedbeds	Phragmiteta	Phragmitetum australis-typhosum[3]

7.7.2.6 *Fish surveys*

River selection

The proposed SCPX route includes 22 main river crossings (i.e. excluding small drainage channels). Selection of the rivers for the fish surveys was based on the following criteria:

- Proposed crossing methodology (i.e. open-cut or non-open-cut)
- Likely species present
- Likely sensitivity of watercourse
- Watercourse morphology
- Seasonality of flow.

The aim of site selection was to survey a representative sample of each of the main river functional fish habitat types in the rivers crossed by the proposed route, i.e. irrigation canals,

[3] This vegetation type is not shown on Figure A7-1, Appendix A as the areas are too small to map.

meandering rivers and braided channels. Nine rivers were originally selected during the desk-based survey planning.

During the May/June field surveys the site selection was refined according to field conditions, with the result that two of the above watercourses were not surveyed, and they were replaced with three other watercourses. The watercourses that were not surveyed were:

- Karabakh canal: the high flow and steep banks made this watercourse too dangerous to enter. However, the Karabach canal was surveyed during the second surveys in August 2011
- Karasu: this small stream was heavily choked with reeds and the only potential survey point was on the existing BTC/SCP crossing, which requires a permit to survey. The Sarisu is a very similar watercourse and is sufficient to cover this watercourse type in the sample selection; it was therefore surveyed in place of the Karasu.

Additional watercourses that were surveyed included:

- Goshgarachay: this medium-sized river was easily accessed as it was adjacent to the Sarisu; it replaced the Karasu
- Ganjachay: this medium-sized river was easy to access; it was included as an additional sample
- Kurekchay: this river has a braided channel and was included as an additional sample.

The final sample therefore included 10 rivers representing the various channel types encountered along the proposed pipeline route (see Table 7-25).

Nets

The fish surveys were undertaken using three types of net that are commonly used for fishing in Azerbaijan: a hand-net, a cast net and a seine net. The nets were deployed from the riverbanks and/or by wading in the rivers.

Hand nets

The hand net comprised a circular stainless steel ring of approximately 50cm diameter supporting netting with a mesh size of approximately 5mm. The net was attached to a 2m-long handle and was used to sweep along the riverbed and river channel margins for durations of approximately one minute to catch fish. This technique was the only practical method of surveying some narrow river channels containing dense stands of emergent macrophytes (e.g. lesser bulrush *Typha angustifolia* and common reed *Phragmites australis*).

Cast net/parachute net

A cast net is a circular piece of netting approximately 2m in diameter with small weights attached at regular intervals around the external margin of the net. The net is thrown, or cast, in a circular motion that ensures it spreads out over the water surface and sinks, thus trapping any fish underneath it. A landing line attached to the centre of the net is retained when casting the net and subsequently used to retrieve it. As the landing line is pulled towards the fisherman the bottom weights are drawn towards each other thereby ensuring that any fish are retained within the net during its retrieval. The mesh size on the cast net used in this case was approximately 10mm.

Seine net

In the May/June 2011 surveys an 8m-long by 1.5m-deep net with a 10mm mesh size (SN1) was used. Following a review of the data and methods from the May/June surveys, it was decided to also use a larger seine net with a smaller mesh size (15m long by 2m deep with a 3mm mesh size) for the August surveys (SN2). SN1 was used for the smaller rivers, where it was more practical than SN2, and SN2 was used for the larger rivers. This combination of nets allowed a greater catch and a better understanding of fish populations than would have been achieved with just one type of net.

Both nets were supported on the upper edge by a series of floats positioned at approximately 1m intervals. The bottom edges included a lightly weighted rope with additional lead being attached at approximately 1m intervals. To maintain a solid net wall as each net was drawn through the water, wooden poles (approximately 2m long) were attached to each end of both nets. This enabled the bottom of the net to be kept in close contact with the bottom of the river channel ensuring that fish could not swim under it.

During deployment, one end of the net was held in position in shallow water. The other end of the net was deployed by wading in a semi-circle with both ends gradually being drawn towards the shore. Fish were subsequently removed from the net for identification, enumeration and length measurements.

Seine net and hand net combination

At several locations the channel was deemed to be unsuitable for deploying SN1, SN2 or the cast net effectively. Typically, this was due to the channel being too narrow (i.e. < 3m width) but in some cases the presence of dense emergent macrophyte stands also represented a hindrance to net deployment. On these occasions SN2 was used in combination with a hand net. The seine net was positioned in the river channel so that the entire width was blocked by the net. A field surveyor then entered the river approximately 10m upstream of the seine net and proceeded to walk downstream towards the seine net creating lots of disturbance with the hand net to chase fish into the seine net. The seine net was subsequently closed and lifted clear of the water with any fish contained in it thus being captured.

Survey methods summary

Table 7-25 shows the methods used at each individual survey location including the dates on which surveys took place.

Table 7-25: Details of the Watercourses Where Fish Surveys Were Undertaken during May and June 2011

River Name	SCPX KP	Survey Date	Survey Methods*
Agsu canal	54	31/05/2011	HN & CN
		23/08/2011	HN & CN
Kura East	167	01/06/2011	SN1, CN & rod and line
		24&25/06/2011	SN1, SN2, CN, HN
Karabakh canal	189	n/a	n/a
		26.08.2011	CN, SN2
Kurekchay	221	07/06/2011	SN1
		27/08/2011	SN/HN
Korchay	237	02/06/2011	SN1
		29/08/2011	HN, SN1, SN2
Ganjachay	240	07/06/2011	SN1, CN
		30/08/2011	HN/SN
Sarisu	261	02/06/2011	SN/HN
		31/08/2011	SN2, HN
Goshgarachay	261	03/06/2011	SN1, CN, SN/HN, HN
		31/08/2011	HN, SN/HN
Zeyamchay	303	04/06/2011	SN1, HN, SN/HN
		01/09/2011	SN/HN, HN
Tovuzchay	324	04/06/2011	SN1, HN, SN/HN
		02/09/2011	SN2, HN

River Name	SCPX KP	Survey Date	Survey Methods*
Hasansu	345	06/06/2011	SN1, CN
		03/09/2011	SN/HN, HN, SN2

*SN1 = 8m seine net; SN2 = 15m seine net; HN = hand net; CN = cast net; SN/HN = seine net/hand net combination

Fish processing

Upon capture, fish were immediately removed from the nets and placed into a bucket containing fresh river water. All fish were subsequently identified to species level, measured and enumerated. Length was measured as fork length (to the nearest mm) or total length (to the nearest mm) in those species where the tail is not forked (e.g. the loaches). A digital photograph was taken of each species, for future reference. These photographs were also used for quality assurance purposes whereby a second fisheries expert screened a representative sample of the photographs to confirm species' identifications. Once all fish had been processed, they were returned to the river alive.

7.7.2.7 Assessment of likely ecological importance and sensitivity

Habitats

The scientific value of habitats for nature conservation has been assessed according to widely accepted criteria, of which the most important are naturalness, extent, rarity and diversity. These and others are described in an extensive literature. Rarity and extent are assessed at several scales: in the context of occurrence on the proposed pipeline route, in the context of the surrounding ecosystem, and at a national and international scale. For example, habitats that are rare at an international scale would be considered the most important for nature conservation, while habitats that are rare on the proposed pipeline route, but common in the context of the surrounding ecosystem, would be considered important at a site level. The ability of habitats to recover from change is also assessed based on desk-based research and the data and experience gained from post-construction monitoring of the BTC and SCP projects. National Strategy and Action Plan on Conservation and Sustainable Use of Biodiversity in Azerbaijan, published in 2008 and the fourth national report published in 2010, were also reviewed to assess national priorities for biodiversity conservation.

Species

The ecological importance of species has been assessed according to two main criteria:

- International significance according to the International Union for the Conservation of Nature (IUCN) Red List of threatened species
- Species listed in the Azerbaijan Red Data Book (RDB).

IUCN Red List Criteria are assessed according to several threat categories, shown in Table 7-26.

Table 7-26: IUCN Designations for Species of Plants and Animals

Abbreviation	Category
EX	Extinct
EW	Extinct in the Wild
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern

Previous baseline assessment for the BTC/SCP pipeline has also considered species' importance by reference to the report 'European Bird Populations: Estimates and Trends' (Birdlife International, 2001). However, because of its focus on the populations of bird species on the European continent, reference to this publication led to the inclusion of species that are threatened in Europe but are not threatened at an international level or in Azerbaijan. For this reason, only the IUCN Red List and the Azerbaijan RDB are referred to in the assessment of species' importance.

The Azerbaijan RDB is currently in revision, and this has been taken into account when interpreting the ecological importance of species occurring on the proposed route. The original Red Book emphasised rarity as the principal reason for inclusion, without consideration of relative threats to a species. Therefore, species that are naturally rare, but not currently threatened or undergoing population decline, were included alongside species that are widespread but undergoing population declines that could lead to a threat of extinction.

In practice, this particularly affects the significance that we consider should be accorded to plant species such as *Punica granatum* (pomegranate)[4], which have a naturally restricted distribution but are not under threat of extinction. Indications are that some species such as this will not be included in the new RDB.

Overall assessment of likely importance and sensitivity to change
On the basis of the above assessments the likely importance of the habitats and species that may be affected and their likely sensitivity to change have been classified into categories ranging from very low to very high. More information on this process is given in Chapter 3 and the categories are also defined in Appendix B of the ESBR.

By their nature these judgements are subjective, to varying degrees, based on the evidence available and the spatial scale at which they are applied. The assessments made are therefore qualified, where appropriate.

7.7.2.8 Technical difficulties or uncertainties

The baseline terrestrial field surveys were carried out between mid-May and mid-June 2011. This is an acceptable time of year for this type of survey, as most of the species are in flower and are readily identifiable. Early spring-flowering species may have been under-recorded during the surveys, although many of them are still identifiable from their vegetative parts without the flowers. However, a limited number of additional surveys in targeted areas are recommended to be carried out before construction where, on the basis of previous surveys, it is judged that protected or rare species may be identified if a further survey is undertaken at the optimum time of year for the species of concern.

Field identification of plants in Azerbaijan can be limited by the lack of an up-to-date field flora for the region. However, the specialist used for this survey (Vugar Kerimov) is a lecturer and academician of the Azerbaijan Institute of Botany with many years' experience in botanical field surveys in Azerbaijan (including past work on the BTC/SCP route). Therefore, although a few species may have been missed or were not identifiable, there is confidence that the vast majority of species were identified and recorded correctly.

Baseline assessment of terrestrial fauna relies on field recording of incidental sightings and on desktop data. Detailed, species-specific survey methods would probably record additional species, and the current assessment can only give an indication of species occurrence and population size. However, it is possible to assess the likely presence or absence of species known to occur in the area based on their habitat preferences and the occurrence of suitable habitat along the route, supported by sightings made on this and previous surveys. For example, *Emys orbicularis* (European pond turtle) was recorded at several river crossings. This species is widespread in central Azerbaijan, and many of the

[4] For the majority of plant species mentioned in this report, vernacular names are not used as they are ambiguous and geographically variable. Exceptions to this are where there are widely accepted vernacular names such as the two species here.

other river crossings are almost certainly used by the species, even though it was not recorded during these surveys.

High flows were encountered in the rivers during the May/June fish surveys, which limited access for safety reasons. However, there were several good reasons for undertaking a fish survey in late May/early June, including the fact that the braided side channels surveyed on some of the rivers would not be present when the second survey was undertaken in August.

7.7.3 Ecological Context

This section describes the overall ecology of Azerbaijan in terms of its importance for global biodiversity. It is taken primarily from the Biodiversity Assessment for Azerbaijan (USAID, 2000) and the Biodiversity Analysis Update for Azerbaijan (USAID, 2010).

Azerbaijan lies at a convergence of biogeographic provinces, where European species like *Cervus elaphus* (red deer), *Ursus arctos* (brown bear) and *Lynx lynx* (lynx) coexist with Asian species like *Gazella subgutturosa* (goitered gazelle). This geographic position combined with the country's varied climate, topography and geology has resulted in high levels of biodiversity.

Azerbaijan's biodiversity importance is internationally recognised, as part of the 'Caucasus Ecoregion', an area that is included as one the 25 most endangered and diverse ecosystems on Earth in global biodiversity assessments conducted collaboratively by major international conservation groups during the past decade.

There are six main ecoregions in Azerbaijan:

- Greater and Lesser Caucasus Mountains
- Kur-Araz Valley and Floodplain
- Talish-Lankaran Zone
- Absheron Peninsula
- Caspian Coastal Lowlands
- Nakhchivan Autonomous Republic.

The proposed pipeline route is located in the Kur-Araz Valley and Floodplain Ecoregion, which covers approximately 35% of the land area of Azerbaijan. The Kura River flows through this region, across central Azerbaijan from the mountains bordering Georgia, and is joined by the Araz River that flows along the Iran border, forming a broad floodplain as the water flows south-east into the Caspian Sea.

A few areas of remnant riparian forests (known as tugay forest) are found in the river valley. However, most of the floodplain consists of dry steppes with semi-desert vegetation dominated by grass, thorny shrubs and *Artemisia fragrans* (previously known as *Artemisia lerchiana*). Irrigation has opened some of this dry land to agriculture and grain crops, but sheep winter pastures dominate the scene.

The ecosystems of Azerbaijan provide a range of economic and environmental ecosystem services. Natural plant products are widely used for food and building, for example the reed *Arundo donax* is cut and used for roofing and fencing material. The semi-desert and desert regions are used for grazing sheep and the rivers are fished for domestic and commercial use.

7.7.4 Protected Areas

In Azerbaijan, the Law on Environment Protection (1999) and the Law of the Azerbaijan Republic on Specially Protected Natural Territories and Objects (2000) sets out the structure of protection for sites of importance for nature conservation. Article 5 of the law lists nine kinds of protected sites, and these are described in Table 7-27.

Table 7-27: Types of Nature Reserve in Azerbaijan

Designation	Description
State Natural Reserves Including Biosphere Reserves	Natural territories of Republic (national) importance. The MENR website currently lists 11 'State Nature Reserves'
National Parks	Natural territories of Republic (national) importance. The MENR website lists eight National Parks. They are areas having status of nature conservative and scientific-research institutions where natural complexes of preferential ecological, historical, aesthetic and likewise importance located on and, used for nature conservative, enlightenment, scientific, cultural and other purposes
Natural Parks	Specially protected natural territories of Republican or regional importance
State Natural Restricted Areas	Specially protected natural territories of Republican or regional importance
Natural Monuments	Specially protected natural territories of Republican or regional importance
Zoological Parks	Sites created for the purpose of protection, reproduction and use of fauna. Specially protected natural territories of local importance
Botanical Gardens and Dendrology Parks	Sites created for the purpose of protection and maintenance and enrichment of flora diversity of Republican or regional importance
Health Treatment Territories and Resorts	Specially protected natural territories of local importance

As of 2010, about 8% of the territory of Azerbaijan was covered by protected areas including eight national parks, 14 strict nature reserves, 22 sanctuaries and two game reserves (USAID, 2010).

Five protected areas are present within 10km of the proposed pipeline route[5], but none are crossed by it. The IUCN Global Protected Areas Programme places protected areas into one of seven categories according to their management objectives. Four of the protected areas within 10km of the proposed pipeline route are listed as Category IV in the IUCN Global Protected Areas Programme, and one is listed as Category Ia. Table 7-28 lists the IUCN protected area management categories.

Table 7-28: IUCN Protected Area Management Categories

IUCN Protected Area Category	Category Name	Description
Ia	Strict Nature Reserves	Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphical features, where human visitation, use and impacts are strictly controlled and limited to protect conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring
Ib	Wilderness Area	Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

[5] Protected Area names and descriptions are taken from the MENR website (www.eco.gov.az – accessed on 25 June 2012). Site boundaries are taken from the base maps produced for the BTC ESIA.

IUCN Protected Area Category	Category Name	Description
II	National Park	Category II protected areas are large natural or near-natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational and visitor opportunities.
III	Natural Monument or Feature	Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV	Habitat/Species Management Area	Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V	Protected Landscape/ Seascape	A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
VI	Protected Area with Sustainable Use of Natural Resources	Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Figure A7-1 in Appendix A illustrates the location of protected areas in Azerbaijan, and Figure A7-2 in Appendix A shows the distance between each of the protected areas and pipeline route. Table 7-29 gives details of each site.

Table 7-29: Protected Areas in the Vicinity of the Proposed Pipeline Route

Protected Area[6]	Reason for Designation	IUCN Management Category	Approx. Location Along Pipeline (KP points)	Approx. Distance From Pipeline (km)	Nearest Temporary facility area
Barda State Nature Sanctuary	The main purpose of the area is the preservation and restoration of the number of *Phasianus*, *Francolinus* and hares.	IV	KP145–160	5	

[6] Protected area names, designations and descriptions in this revision of the report are taken from the MENR website, accessed on 15.05.12.

Protected Area[6]	Reason for Designation	IUCN Management Category	Approx. Location Along Pipeline (KP points)	Approx. Distance From Pipeline (km)	Nearest Temporary facility area
Korchay State Nature Reserve	Korchay was established for the protection of the population of Persian gazelle (*Gazella subgutturosa*) and partridge.	IV	KP230–246	2.5	
Shamkir State Nature Sanctuary	The 10,000ha sanctuary was established for the preservation and restoration of the number of pheasants (*Phasianus*), *Francolinus francolinus*, partridge (*Alektoris kakelik*) and waterfowl birds.	IV	KP278–305	1	
Garayazi-Agstafa State Nature Sanctuary	Established for protection of forest landscapes, animals and birds. There are marals, wild boars, wolves, foxes and hares. In the past, a continuous line of tugay forest extended along the middle and lower reaches of the River Kura, which was surrounded by forest to an extent of 600km. The main protected objects are the biggest tract of tugay forests of the middle reaches of the Kura River and the rare and endangered ecosystems of tugay. Along the river, shrubbery of willow, hawthorn, barberry, and elaeagnus.	IV	KP381–389	1	50m - Saloghlu camp and pipe storage area
Garayazi State Nature Reserve	The smaller Garayazi State Reserve is for the protection of groundwater and many of the same species of flora and fauna mentioned above in the Garayazi-Agstafa State Nature Sanctuary	Ia	KP381–389	4	

7.7.5 *Forest Fund Areas*

As stated on the MENR website, forests are considered to be one of the most valuable natural resources of Azerbaijan. The Project wrote to MENR in 2012 to clarify the locations of any Forest Fund lands close to, or on the proposed route. It was confirmed that there are Forest Fund lands in the Hajigabul, Kurdemir, Ujar, Adash, Yevlakh, Goranboy, Samukh, Shamkir, Tovuz and Agstafa regions (see Figure 7-26). Further tree inventory work will be undertaken during pre-construction to identify the exact number of trees that may be impacted by Project construction. The figure below gives locations of Forest Fund areas based on data obtained during BTC/SCP and shows the number of Forest Fund areas that could potentially be in the proximity of the proposed SCPX Project route.

Figure 7-26: Indicative Forest Fund lands in proximity to the proposed SCPX pipeline route

7.7.6 Flora and Vegetation

7.7.6.1 Introduction

The proposed route can be broadly divided into two sections: the east and west Kur-Araz lowlands. The east Kur-Araz lowlands, also known as the Shirvan Plain, crossed by the proposed route between KP0 and KP169 (Kurdemir to Ganja) are characterised by a mixture of irrigated arable land and uncultivated, mostly saline and clayey soils. The dominant vegetation types outside of the cultivated areas in this section are the clayey and solonchak deserts grazed by sheep, and flat meadows with sparse vegetation cover. The landscape is intersected by a network of irrigation channels ranging from larger canalised rivers up to 10m wide (e.g. the Agsu and Karabakh canals) to small inter-field channels approximately 1m wide.

The west Kur-Araz lowlands, between KP169 and KP390 are characterised by a less arid climate than the east Kur-Araz lowlands, and a more varied topography with increasingly hilly land towards the west. The soils here are generally less saline and have a greater amount of stony material, resulting in better drainage and less compaction. The vegetation outside of cultivated areas here ranges from dry clayey desert in the east to steppe-like semi-desert and arid forests in river valleys in the west. This section contains some of the most species-rich vegetation along the proposed route.

Table 7-30: Relative Abundance of the Main Habitat Types Crossed by the Proposed Pipeline Route

Type	Total Length (km)	Percentage of Route
Agriculture	236.8	61
Desert	92.3	24
Semi-desert	29.9	7.5
Lowland meadows	29	7
Forests and shrubs	1.5	0.4
Wetland	0.5	0.1
Total	390	100

The individual vegetation types occurring on the route are described below, with reference to the locations where they were recorded during the SCPX route surveys and relevant SCP/BTC biorestoration monitoring transects. The relative abundance of each of these main habitat types is shown in Table 7-30, and the distribution of the habitats are shown in Figure A7-2 in Appendix A of the ESBR.

7.7.6.2 Agriculture

The majority (around 61%) of the proposed route crosses agricultural land, and three of the proposed BVs (BVR A8 (KP172), BVR A9 (KP243) and BVR A10 (KP334)) are located in agricultural land. This largely comprises fields that are cultivated for annual crops, such as cereals and vegetables, along with a small amount of forage crops and hay-cropped fields (e.g. Photograph 7-51). The agriculture in the region is relatively low-input, with most fields having a range of common weed species in addition to the main crop.

Photograph 7-51: Hay Cropping in an Agricultural Field near KP112

7.7.6.3 Solonchak deserts

Solonchak desert vegetation largely occurs on poorly drained, saline soils in the eastern part of the proposed route where the climate is most arid and the topography is relatively flat. Solonchak desert vegetation types recorded from the route are listed in Table 7-31.

Table 7-31: Solonchak Deserts

Type	Formation Class	Formation	Association	Length (km)	Transects
Desert	Solonchak Deserts	Salsoleta, Kalideta, Halocnemeta and Suaedeta solonchak deserts	Kalidetum & Capparisetum spinosa solonchak desert	0.7	AZT8 (KP119)
Desert	Solonchak Deserts	Salsoleta, Kalideta, Halocnemeta and Suaedeta solonchak deserts	Halocnemetum strobilaceum solonchak desert	20	AZ32 (KP153) AZ34 (KP153) AZ37 (KP154) AZ38 (KP157) AZT11(KP153) AZT12 (KP154)
Desert	Solonchak Deserts	Salsoleta, Kalideta, Halocnemeta and Suaedeta solonchak deserts	Suaedetum microphylla solonchak desert	9.9	AZT39 (KP3) AZT40 (KP5) AZT15 (KP205)

Kalidetum solonchak desert

This is a very species-poor vegetation type characterised by highly saline soils (see Photograph 7-52). Very few plant species can tolerate the combination of high salinity and aridity in this habitat. An example of this vegetation was recorded at Transect AZT8 (KP119). It is dominated by the halophyte *Petrosimonia brachiata*, which provides most of the vegetation cover, and characterised here by scattered bushes of *Tamarix meyeri*.

Photograph 7-52: Kalidetum and Capparisetum Spinosa Solonchak Desert (Foreground) at KP119

Halocnemtum strobilaceum solonchak desert

Two examples of this vegetation type were recorded on the proposed SCPX route, at Transects AZT11 (KP153) and AZT12 (KP154). It is a species-poor habitat, with an average of 6.5 species per quadrat in the examples recorded. Vegetation cover is approximately 75%, mostly comprising the salt-tolerant species *Climacoptera crassa* and *Eremopyrum orientale*. The characteristic shrubs *are Halocnemtum strobilaceum* (see Photograph 7-53) and *Kalidium capsicum*, which are widely scattered but frequent.

Suaedetum microphylla solonchak desert

Suaedetum microphylla solonchak desert was recorded in three transects on the proposed SCPX route at AZT15 (KP205), AZT39 (KP3) and AZT40 (KP4). It mainly occurs towards the eastern end of the Kur-Araz lowlands section. It is characterised by scattered shrubs of *Suaeda microphylla* (see Photograph 7-54) in a matrix of annual species. Characteristic annual species include *Plantago loeflingii* and *Medicago minima*. It is not especially species-rich and vegetation cover is between 67% and 89%. This habitat is intensively grazed, mainly by sheep.

Photograph 7-53: Halocnemtum Strobilaceum Solonchak Desert at KP154

Photograph 7-54: Suaedetum Microphylla Solonchak Desert at KP5

7.7.6.4 Clayey deserts

Clayey desert vegetation mostly occurs in the eastern part of the proposed route. It is generally more species-rich than the solonchak deserts. It is characterised by the presence of *Artemisia lerchiana*, with a matrix of small annual species accounting for most of the actual vegetation cover. It occurs in various forms along the pipeline route, see Table 7-32, differentiated by the presence of associated sub-shrub species including *Salsola* *dendroides*, *Salsola nodulosa* and *Peganum harmala*. The proposed new block valve at KP21 (BVR A6) is located in Artemesietum-salsolosum dendroides clayey desert. This vegetation type was recorded in the BTC transect AZ22. It is a relatively species-poor vegetation type typical of this section of the route, with a low percentage cover of sub-shrubs (mostly *Salsola dendroides*) and a matrix of annuals and summer perennials dominated by *Poa bulbosa*.

Table 7-32: Clayey Deserts

Type	Formation Class	Formation	Association	Length (km)	Transects
Desert	Clayey Deserts	Artemisia lerchiana clayey deserts	Artemesietum-salsolosum dendroides clayey desert	10	AZ22 (KP21)
Desert	Clayey Deserts	Artemisia lerchiana clayey deserts	Artemesietum-salsoletum nodulasae	2.8	AZ17 (KP0.4) AZ18 (KP0.9) AZ59 (KP1.3) AZ60 (KP1.2)
Desert	Clayey Deserts	Artemisia lerchiana clayey deserts	Artemisietum lerchiana	8.7	AZ23 (KP25) AZT19 (KP286)
Desert	Clayey Deserts	Artemisia lerchiana clayey deserts	Ephemeretum	9	AZ21 (KP13) AZT1 (KP13)
Desert	Clayey Deserts	Artemisia lerchiana clayey deserts	Peganetum	16.7	AZT16 (KP227) AZT20 (KP307)
Desert	Clayey Deserts	Artemisia lerchiana clayey deserts	Salsoletum nodulosae clayey desert	13.2	AZT18 (KP227)

The Artemesietum-salsolosum nodulasae is a typical clayey desert vegetation type with low percentage cover, characterised by scattered sub-shrubs of *Salsola nodulosa* in a matrix of small annuals and summer perennials dominated by *Poa annua*. The proposed pigging station is located in this habitat type at KP0.

The Peganetum clayey desert, see Photograph 7-55, is one of the most species-rich of the clayey desert vegetation types encountered on the proposed SCPX route. It is characterised by the constant presence of scattered small bushes of *Peganum harmala* in a species-rich matrix of annuals. Typical species include *Helianthemum salicifolium* and *Medicago minima*. Average species-diversity is between 16 and 22 species per quadrat, and vegetation cover is around 75%.

Photograph 7-55: Peganetum Clayey Desert on a Stream Bank near KP227

7.7.6.5 *Semi-desert*

Artemisetum lerchiana semi-desert is a broad definition for a range of vegetation types largely occurring at the western end of the proposed SCPX route, see Table 7-33. It is the dominant vegetation of uncultivated land in the undulating valleys around the major rivers such as the Hasansu and the Tovuzchay. *Artemisia fragrans* is the dominant species, occurring with a wide range of other species of which *Medicago minima* and the grasses *Aegilops kotschyi* and *Aegilops cylindrica* are constant. It is characterised by a diverse assemblage of annual species, with high species diversity ranging between 14 and 22 species per quadrat. Vegetation cover is quite high, ranging between 81% and 95%. Photograph 7-56 is a typical view of this vegetation type.

Table 7-33: Semi-deserts

Type	Formation Class	Formation	Association	Length (km)	SCPX Transects
Semi-desert	Steppe-like semi-desert	Artemiseta lerchiana semi-deserts	Artemisetum botriochloasum semidesert	0.7	AZ43 (KP321) AZ44 (KP322) AZ45 (KP321) AZ46 (KP321) AZT23 (KP322)
Semi-desert	Steppe-like semi-desert	Artemiseta lerchiana semi-deserts	Artemisetum lerchiana purum desert	28.9	AZ48 (KP359) AZ49 (KP367) AZ50 (KP367) AZT25 (KP343) AZT26 (KP343) AZT28 (KP346) AZT29 (KP346)
Semi-desert	Steppe-like semi-desert	Artemiseta lerchiana semi-deserts	Artemisetum steppe with arid forest in stream bed	0.3	AZT22 (KP322)

Photograph 7-56: Artemisia Lerchiana Desert at KP343

7.7.6.6 Lowland meadows

Cynodonetum alhagiosum

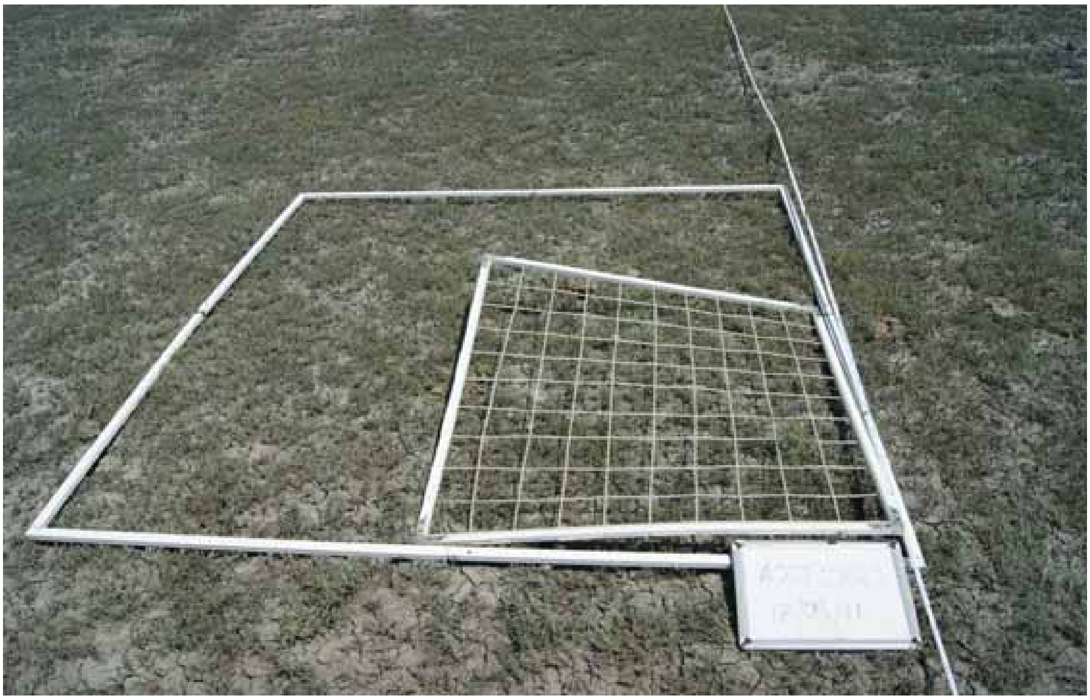
This vegetation type was recorded in four SCPX transects (AZT3 (KP89), AZT4 (KP94), AZT5 (KP94.3) and AZT6 (KP106) in the east Kur-Araz lowlands, see Table 7-34. It also occurs between KP30 and KP35.

Table 7-34: Lowland Meadows

Type	Formation Class	Formation	Association	Length (km)	Transects
Lowland Meadows	Saline meadows	Aeluropeta littoralis	Cynodonetum alhagiosum	29	AZ27 (KP86) AZ28 (KP86) AZ57 (KP89.2) AZ58 (KP89.3) AZT3 (KP89.3) AZT4 (KP94) AZT5 (KP94.3) AZT6 (KP106)

It is characterised by an open, sometimes grassy sward, which is usually grazed quite short by sheep and cattle (see Photograph 7-57). The species-composition is determined according to varying levels of soil moisture and salinity. Constant species include the small thorny shrub *Alhagi pseudoalhagi* and the grasses *Cynodon dactylon* and *Aeuluropus littoralis* with *Hordeum leporinum*. Characteristic but less frequent species include *Petrosimonia brachiata* and *Eremopyrum orientale*. The proposed BV at KP95 (BVR A7) is located in this vegetation type.

It is generally a quite species-poor vegetation type, with diversity somewhat higher on the less saline soils. Ungrazed stands of this vegetation type can transform into *Tamarixetum* or *Halocnemetum* scrub, as found on uncultivated, grazed lands in the Kurdemir region.



Photograph 7-57: Lowland Meadow Recorded at KP94

7.7.6.7 *Forest and scrub*

Table 7-35 details the forest and shrub vegetation communities found on the proposed SCPX route.

Table 7-35: Forest and Shrub Vegetation

Type	Formation Class	Formation	Association	Length (km)	Transects
Forests and Shrubs	Plantation Woodland	Plantation woodland	Plantation woodland	0.5	AZ39 (KP49) AZ40 (KP49)
Forests and Shrubs	Semi-natural Forest and Shrubs	Tamarixeta	Tamarixetum scrub	0.5	AZ33 (KP138) AZ47 (KP359) AZT10 (KP138)
Forests and Shrubs	Arid Scrub	Caraganeta	Caraganetum-Paliurosum spina-christi	0.5	AZT21 (KP322.3)

Plantation woodland

This vegetation type was not recorded during the SCPX route surveys, but a small section was recorded in the SCP/BTC biorestoration monitoring surveys at SCPX KP49 (BTC KP105). The dominant trees are *Quercus macrantha* with a scattered shrub-layer of *Tamarix ramosissima*. The field-layer vegetation is dominated by the common grasses *Alopecurus myosurouides, Hordeum leporinum* and *Lolium rigidum* with the broad-leaved herbs *Plantago lanceolata* and *Rumex crispus*. The ground in this section is prone to flooding, and there are scattered wetland plants including *Eleocharis palustris*. This is the only recorded example of plantation woodland on the route, though small amounts may occur in other locations not accessed during the surveys (e.g. forest belt at SCPX KP334).

Tamarixetum scrub

The *Tamarixeta* is found in association with river valleys (see Photograph 7-58), where it occurs on slightly saline and poorly drained soils. An example of this vegetation was recorded at Transect AZT10 (KP138). It is characterised by dense growth dominated by

Tamarix ramosissima with the scramblers *Calystegia sepium* and *Clematis orientalis*. There is a dense field-layer dominated by the grass *Hordeum leporinum* along with a range of shade-tolerant broad-leaved herbs including *Galium tenuissimum*, and *Torilis arvensis*. The example at Transect AZT10 had an average of over 18 species per quadrat and 95% cover. This vegetation type intergrades with wet meadows of the *Cynodonetum alhagiosum* (described above), generally marked by a decreasing cover of *Tamarix ramosissima* and an increased frequency of *Alhagi pseudoalhagi*.

Photograph 7-58: Tamarixetum Scrub at the Goranchay River Crossing (KP202)

Arid scrub

This is one of the most species-rich and structurally diverse vegetation types on the proposed route. It has a limited distribution, apparently being restricted to seasonally dry gullies, which are snowmelt tributaries of the rivers with braided channels such as the Asrikchay, Hasansu and Tovuzchay. It is characterised by open stands of large shrubs and species-rich, steppe-like field-layer vegetation. One SCPX transect was recorded in this vegetation type near to the Asrikchay at AZT21 at KP322. The dominant shrubs are *Caragana grandiflora* and *Paliurus spina-christi*, which are most common on the lower slopes, presumably where humidity or soil moisture are highest. Shrubs on the mid- and upper-slopes include *Atrophaxis spinosa* and *Rhamnus pallasii*. The field-layer vegetation is largely unshaded by the shrubs, and is characteristic of the surrounding *Artemisetum* semi-desert, but with a steppe element represented by species such as *Koeleria cristata*, *Nigella arvensis* and *Teucrium polium*. It becomes more grass-dominated on the upper slopes, and in the bottom of the gully it is characterised by an abundance of the carpet-forming moss *Syntrichia ruralis*.

Photograph 7-59: Arid, Shrub-dominated Vegetation in Valley-bottoms near KP322

7.7.6.8 Reedbeds and marshes

Phragmiteta australis-typhosum

Although this vegetation type occurs in wet places all along the proposed route, it is most frequent in the Kur-Araz lowlands due to the high frequency of irrigation channels. The areas of habitat are often very small – too small to map – but the two larger areas recorded in the SCPX survey are shown in Table 7-36. It ranges from species-poor vegetation dominated by one of the tall emergents such as *Phragmites australis* (common reed) (see Photograph 7-60 and *Typha angustifolia* (lesser bulrush), to species-rich vegetation with a mix of tall emergents and floating aquatics. The species-poor examples tend to occur at the water-margins of the larger irrigation channels such as the Agsu and Karabakh canals, which both have narrow stands of *Phragmites australis* (common reed) at the crossing point. These channels have a fast flow and are dredged regularly so they do not have a chance to develop extensive stands of reeds.

An example of the more species-rich vegetation in smaller channels was recorded at AZT9 (KP127). This small channel is approximately 1m wide with clear, slow-moving water less than 0.5m deep. It is dominated by an open stand of tall emergents including *Bolboschoenus maritimus* (sea club-rush), *Eleocharis palustris* (common spike-rush) and *Typha angustifolia* (lesser bulrush), along with a floating mat of *Batrachium trichophyllum* and large amounts of *Veronica anagallis-aquatica* (blue water-speedwell).

Table 7-36: Reedbed Vegetation

Type	Formation class	Formation	Association	Length (km)	Transects
Wetlands	Reedbeds	Phragmiteta	Phragmitetum australis-typhosum	0.5	AZ41 (KP238) AZ42 (KP236) AZT9 (KP127) AZT14 (KP189)

Photograph 7-60: Phragmites Reedswamp near the Korchay Reservoir at KP236

7.7.6.9 *Condition of existing BTC and SCP right of way*

Vegetation along the BTC/SCP ROW has been monitored since it was re-instated after construction, beginning in 2007 up until the most recent monitoring data available at the time of survey (2011). The results show that some sections of the route are recovering more quickly than other parts, and that vegetation cover generally recovers more quickly than species diversity. The majority of transects along the BTC/SCP ROW (89%) show an increasing trend in vegetation cover over the five years of monitoring, and over half (51%) have achieved natural levels of vegetation cover (see Table 7-37).

Table 7-37: Recovery of Vegetation Types on the BTC ROW between 2007 and 2011

Habitat Name (Association) Used in BTC Report	Average % Cover on ROW					Average % Cover Off ROW 2007–2011
	2007	2008	2009	2010	2011	
Capparisetum spinosa clayey desert	15	24	75	30	63	46
Artemisetum botriochloasum semi-desert	33	55	80	79	84	75
Plantation woodland	63	n/a	95	95	89	88
Phragmiteta-typhetum marsh	51	82	78	91	95	94
Tugay Forest	93	95	95	95	95	94
Artemisetum lerchiana purum desert	72	87	85	77	81	88
Spoil Pits	48	57	58	63	80	87
Suaedetum microphylla solonchak desert	6	5	12	21	20	22
Halocnemetum strobilaceum solonchak desert	8	13	30	27	32	36
Salsoletum dendroides clayey desert	9	19	38	33	27	31
Chal meadow	29	55	59	60	67	87
Halocnemetum strobilaceum solonchak desert	5	10	11	25	28	38
Artemisetum lerchiana clayey desert	5	30	69	60	60	85
Ephemeral desert	5	18	24	31	52	75
Salsoletum nodulosae clayey desert	10	16	34	42	51	82
Tamarixetum scrub	45	78	79	56	19	66

The lowest rates of recovery are in the habitats where growing conditions are harshest, particularly in the Sangachal region (not crossed by the SCPX route) and in habitats with highly saline soils at the eastern end of the route (the clayey and solonchak deserts between KP0 and KP169). However, there is not necessarily a correlation between recovery of vegetation cover and recovery of species diversity. A good example of this is the BTC/SCP biorestoration transects in the Artemisetum lerchiana purum desert, located towards the western end of the route (around KP341-KP346). The vegetation cover in these transects is very close to the natural off-ROW vegetation cover, but the rate of change in the percentage commonality of species is one of the lowest of all those measured. Environmental conditions here are not especially unfavourable for vegetation growth, with rainfall comparatively high in contrast to the eastern end of the route, and the soils having a significant proportion of stony material that makes them less prone to compaction. This probably explains the good recovery of vegetation cover, perhaps related to successful establishment of seeds sown during the initial biorestoration. However, this may also be a factor in retarding recovery of species commonality, as semi-ruderal species are able to colonise relatively quickly while the species typical of undisturbed vegetation colonise more slowly.

The habitat where recovery is poorest is the Tamarixetum scrub, particularly at AZ33 (KP138) (also recorded in SCPX transect AZT10). This can be caused by a combination of factors, of which probably the saline, compacted soils play the most significant role in preventing vegetation establishment.

Although Suaedetum microphylla solonchak desert and Halocnemetum strobilaceum solonchak desert are ranked low in the table above, they have actually achieved near natural levels of vegetation cover. In this case it is only the species commonality that is low. The transects are located in arid sections of the route, in the Sangachal section and in the Kur-Araz lowlands with saline soils. Soil compaction and surface salinity are likely to be limiting factors on recovery of species diversity in these habitats.

The main conclusion from the monitoring is that one of the key targets, that of re-establishing vegetation cover, has been achieved along the majority of the ROW in the four-year period since monitoring began, but that recovery of natural species composition is progressing much more slowly. The section crossed by the proposed SCPX route where recovery is slowest is in the east Kur-Araz lowlands between KP0 to 169, where climate and fragile soils combine with a naturally high salinity to militate against fast recovery.

7.7.6.10 Trends in Vegetation Growth Adjacent to BTC/SCP Right of Way (ROW)

Section 7.7.6.9 describes the condition of the existing BTC and SCP ROW based on the BTC/SCP Biorestoration monitoring results (2007-2012). The objective of this Section is to review any vegetation growth trends off the BTC/SCP ROW, and understand any potential influences or underlying trends that may require further consideration for the SCPX Project reinstatement and biorestoration programme and targets. Note that the Project does not have baseline data from the same transects from 2001, so a comparison using the same data sets is not possible. In SCPX, the baseline transect locations has followed the same 2006 BP strategy, and future monitoring will also adopt the same locations. .

Table 7-38 shows Transect, KP and habitat type. Although some of the data below is from areas that are avoided by SCPX, a few of these transects are in similar habitats and in close proximity to be worthy of consideration.

Table 7-38: BTC/SCP Vegetation Transects

Transect	Habitat No	KP	Habitat
AZ-52	0	375,500	Spoil Pit

Transect	Habitat No	KP	Habitat
AZ-53	0	343,400	Temporary soil storage
AZ-55	0	397,800	Spoil Pit
AZ-56	0	51,585	Spoil Pit
AZ-43	1	375,867	Artemisetum botriochloasum semidesert
AZ-44	1	375,694	Artemisetum botriochloasum semidesert
AZ-45	1	376,000	Artemisetum botriochloasum semidesert
AZ-46	1	376,713	Artemisetum botriochloasum semidesert
AZ-11	2	8,703	Artemisetum lerchiana clayey desert
AZ-16	2	50,558	Artemisetum lerchiana clayey desert
AZ-23	2	82,945	Artemisetum lerchiana clayey desert
AZ-29	3	151,101	Capparisetum spinosa clayey desert
AZ-30	3	151,513	Capparisetum spinosa clayey desert
AZ-31	3	151,875	Capparisetum spinosa clayey desert
AZ-19	4	60,620	Ephemeral desert
AZ-20	4	62,211	Ephemeral desert
AZ-21	4	70,965	Ephemeral desert
AZ-03	6	1,551	Halocnemetum strobilaceum solonchak desert
AZ-05	6	1,953	Halocnemetum strobilaceum solonchak desert
AZ-38	6	212,698	Halocnemetum strobilaceum solonchak desert
AZ-41	7	291,574	Phragmiteta - typhetum marsh
AZ-42	7	291,841	Phragmiteta - typhetum marsh
AZ-39	8	105,635	Plantation Woodland
AZ-40	8	105,535	Plantation Woodland
AZ-35	9	223,059	Tugay forest (East)
AZ-36	9	223,235	Tugay forest (East)
AZ-08	10	3,049	Salsoletum dendroides clayey desert
AZ-09	10	3,113	Salsoletum dendroides clayey desert
AZ-10	10	3,182	Salsoletum dendroides clayey desert
AZ-22	10	79,015	Salsoletum dendroides clayey desert
AZ-02	11	1,534	Halocnemetum strobilaceum solonchak desert
AZ-04	11	1,626	Halocnemetum strobilaceum solonchak desert
AZ-32	11	209,021	Halocnemetum strobilaceum solonchak desert
AZ-34	11	208,271	Halocnemetum strobilaceum solonchak desert
AZ-37	11	209,678	Halocnemetum strobilaceum solonchak desert
AZ-12	12	23,444	Salsoletum nodulosae clayey desert
AZ-13	12	24,988	Salsoletum nodulosae clayey desert
AZ-14	12	26,351	Salsoletum nodulosae clayey desert
AZ-15	12	27,796	Salsoletum nodulosae clayey desert
AZ-17	12	57,629	Salsoletum nodulosae clayey desert
AZ-18	12	58,041	Salsoletum nodulosae clayey desert
AZ-59	12	58,428	Salsoletum nodulosae clayey desert
AZ-60	12	58,305	Salsoletum nodulosae clayey desert
AZ-01	13	1,495	Suaedetum microphylla solonchak desert
AZ-06	13	2,566	Suaedetum microphylla solonchak desert
AZ-07	13	2,630	Suaedetum microphylla solonchak desert
AZ-33	14	193,452	Tamarixetum scrub
AZ-47	14	411,796	Tamarixetum scrub
AZ-27	15	143,015	Chal meadow

Transect	Habitat No	KP	Habitat
AZ-28	15	147,237	Chal meadow
AZ-57	15	146,534	Chal meadow
AZ-58	15	146,723	Chal meadow
AZ-48	16	411,831	Artemisetum lerchiana purum desert
AZ-49	16	419,615	Artemisetum lerchiana purum desert
AZ-50	16	419,805	Artemisetum lerchiana purum desert

Many of the off-RoW transects in the monitoring programme show a percentage of vegetation cover that is fairly stable as seen below in Figure 7-27. Transect numbers AZ9, AZ10 (BTC KP03) (Salsoletum dendroides clayey desert habitat) and AZ11 (BTC KP08) (Halocnemetum strobilaceum solonchak habitat) are located in the Sangachal desert area where the soils are prone to compaction and the climate is very arid, with little precipitation, high evaporation and high wind speeds. The low percentage of cover at AZ9 and AZ10 reflect the difficulties of colonisation in this area even though these are fairly drought tolerant species. Transect AZ11 is located in west Gobustan where the soils are less compacted and free draining, hence a better percentage of cover was recorded. Transects AZ12 and 13 are also fairly stable and these are located in the semi desert region of Gobustan in similar conditions to AZ11 and reflects the higher level of vegetative cover is seen in Figure 7-27.

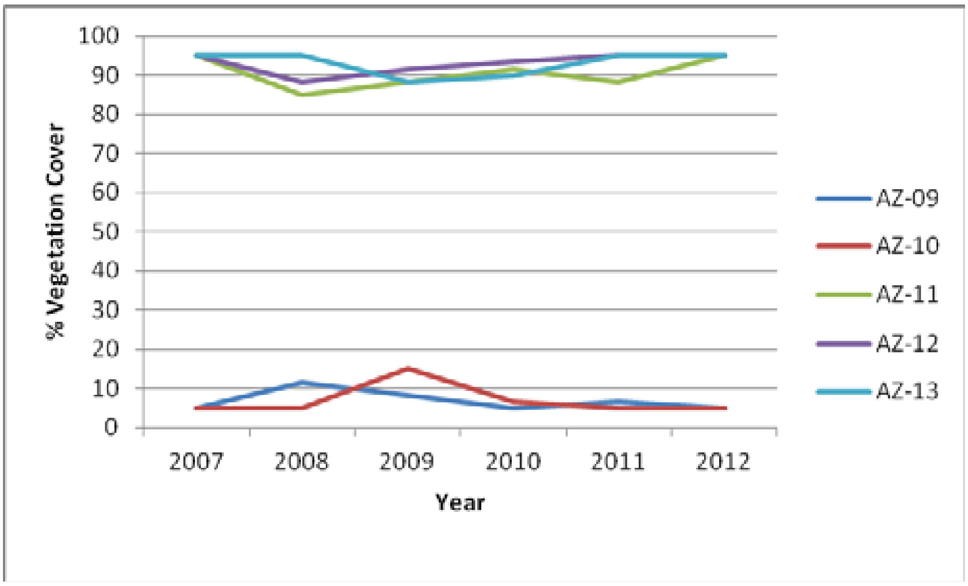


Figure 7-27: Percentage Cover Vegetation on Off-ROW Transects in areas of Arid Soils (Gobustan)

The Salsoletum nodulosae clayey desert transects below in Figure 7-28 AZ14 (BTC KP26) and AZ18 (BTC KP58, SCPX KP0.9) show periods of decline in 2008. All three transects are located in areas of arid soils. Without detailed monitoring of environmental variables and land use history, it is difficult to identify the reasons for this decline for these underlying trends. Transects 15 and 18 are showing fairly stable levels of cover and signs of increasing growth. The monitoring report has noted a slow rate of recovery on the on-ROW cover transects and that unfavourable growth could be attributable to a number of factors, such as vehicle movements and/or overgrazing.

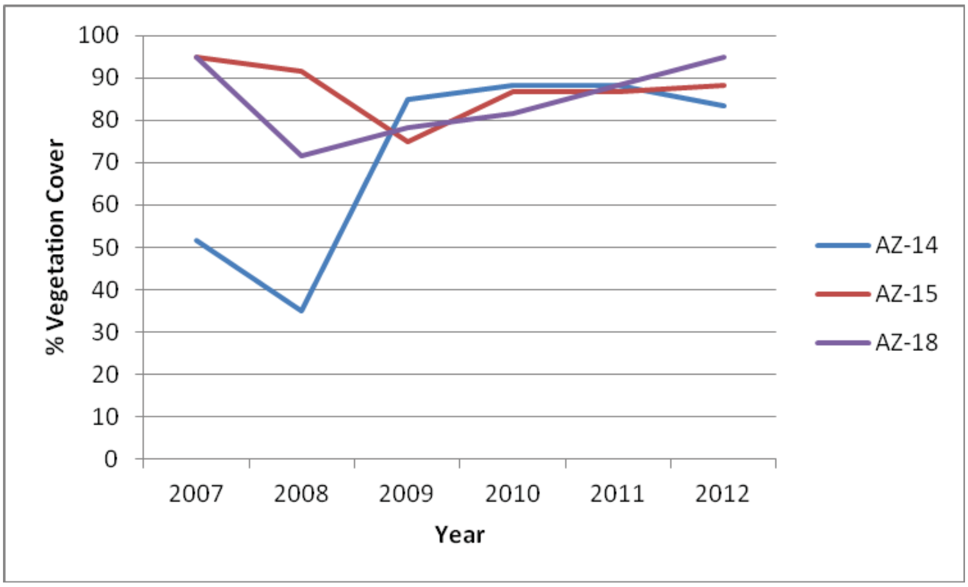


Figure 7-28: Percentage Cover of Salsoletum nodulosae clayey Desert Vegetation on Off-ROW Transects in Areas of Arid Soils (Gobustan, Hajigabul Area)

Other transects (all in the area of KP321) show a percentage of cover that is stable to increasing until recently, with a decline in 2012. An example of 2012 decline in one habitat type (Artemisetum botriochloasum semi-desert) is seen below in Figure 7-29. No observations were made during the biorestoration monitoring on potential causes for the decline in off-ROW vegetation for these transects AZ43, AZ45, AZ46. Research in different countries has shown that high temperatures can adversely affect different species and various aspects of seed germination, photosynthesis, respiration, nutrient absorption etc which has been seen in various species, and any one of these aspects or a combination of, could result in decline.

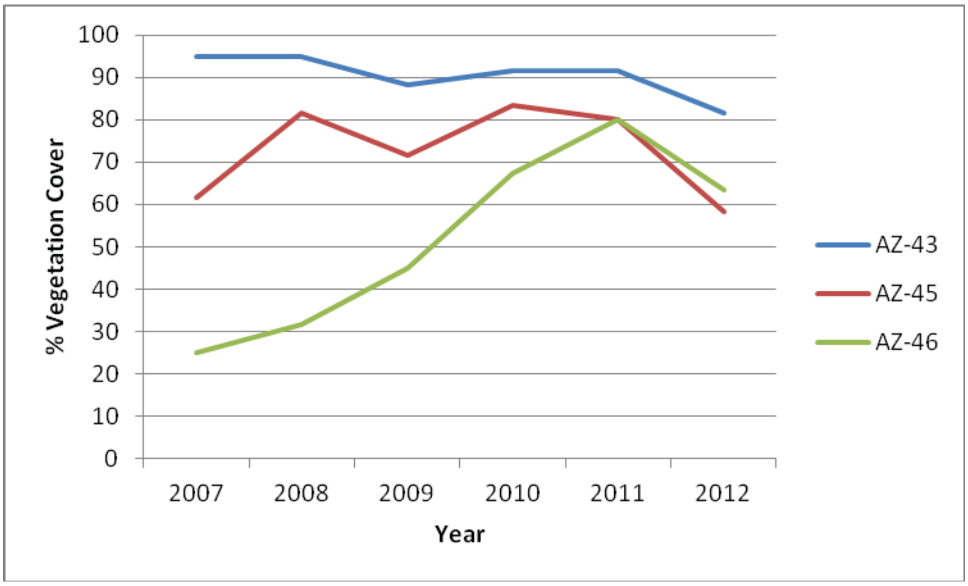


Figure 7-29: Percentage Cover of Vegetation on Off ROW Artemisetum botriochloasum semi-desert Transects

Figure 7-30 shows a steep decline at the off-ROW site at AZ19 (KP02) in Ephemeral desert habitat. The drop in % cover in 2009 off-ROW site transects was observed as being most likely due to disturbance from driving.

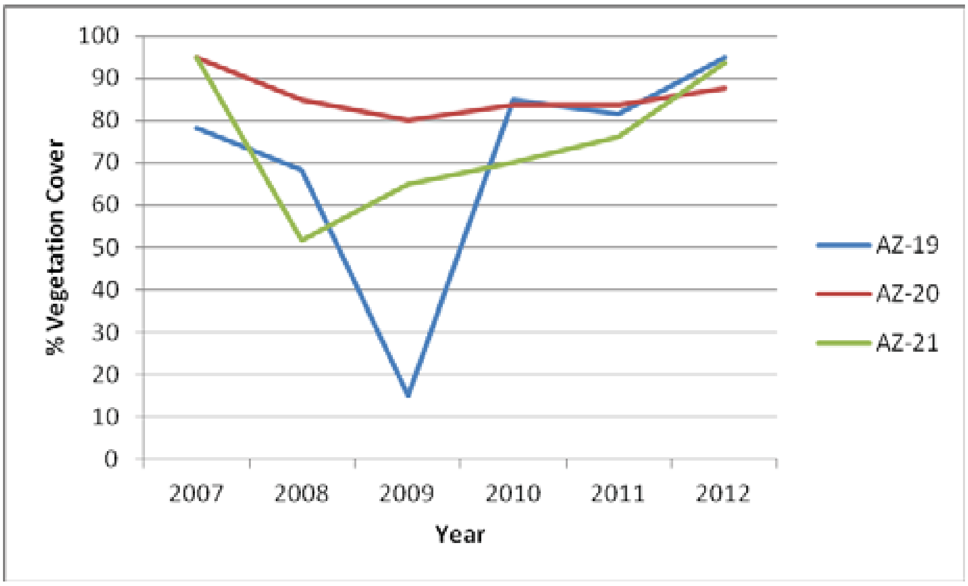


Figure 7-30: Percentage Cover of Vegetation on Off ROW Ephemeral desert transect locations

The off-ROW trend in vegetation growth can be seen to be generally increasing in the Halocnemetum strobilaceum solonchak transects (Figure 7-31) in the area around KP153 and KP157, however, no possible explanations are provided on the reasons for decline and increase. It was also noted there was a corresponding decline with the on-ROW transects in 2009. The Halocnemetum strobilaceum solonchak habitat has naturally harsh growing conditions with high salinity, and the vegetation cover is expected to be naturally low. These transects AZ32 (KP153), AZ34 (KP153), AZ37 (KP154), AZ38 (KP157) are in areas of highly saline soils and the SCP/BTC ROW has a salt crust on the soil surface, on which very few plants can survive, therefore in this area and with respect to this particular habitat, it is expected that the recovery would trend towards a slower growth rate. This area however, has a much higher growth rate than expected.

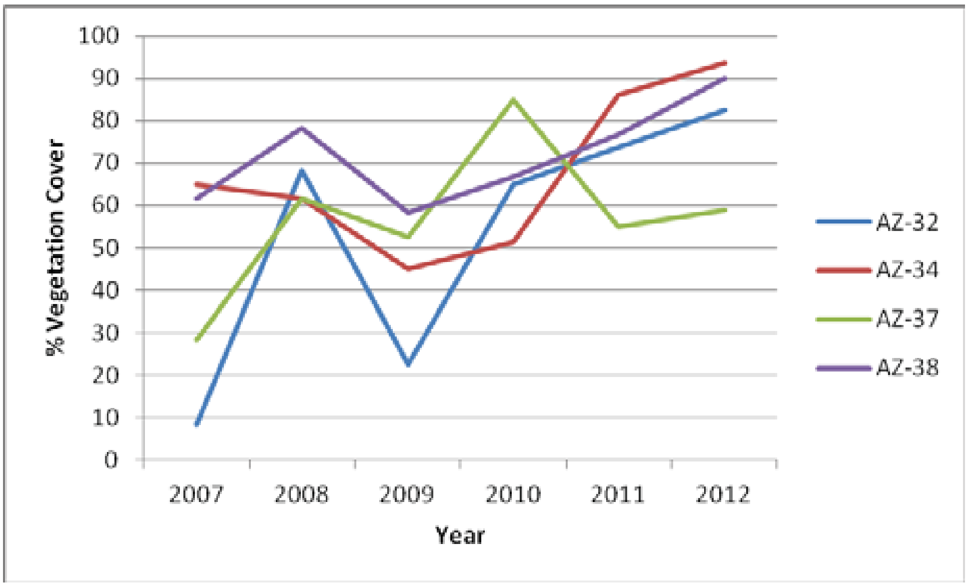


Figure 7-31: Percentage Cover of Vegetation on Off ROW Halocnemetum strobilaceum solonchak transects

Transects from AZ47 (KP359) (Tamarixetum scrub), AZ49 and AZ50 (KP367) (Artemisetum lerchiana purum desert) recorded no data from the on ROW transects in 2011 as the land had been cultivated and the vegetation cover had been lost. Although the off-ROW transects were mainly not affected, it illustrates how land management practices are a causal factor in the loss of vegetation.

In summary, the results of six years of on and off-ROW vegetation cover monitoring on the Azerbaijan section of the BTC/SCP pipeline route has shown:

- Off-ROW vegetation cover shows differing trends across the pipeline route and within areas of the same habitat type;
- Incidental observations allowed for potential causes to be attributed to change at some transects where there was a slow rate of recovery on the on-ROW cover transects and a corresponding decline of the off-ROW cover due to vehicle movements and/or overgrazing;
- Evidence of land use pattern change have been noted where transects have been affected by land use change to agriculture;
- High temperatures can adversely affect different species and various aspects of seed germination, photosynthesis, respiration, nutrient absorption etc which has been seen in various species;
- A comparison of rainfall data at 'Hajigabul' and 'Agstafa' stations revealed a reduction in mean annual rainfall of 4mm and 8.9mm, respectively. Climate variations as well as human activities could account for periods of decline in the vegetation cover at these locations;
- The time period for monitoring of vegetation is too short to identify long term climatic impact.

7.7.6.11 Overall assessment of terrestrial habitats

The table below summarises the likely relative ecological importance and sensitivity of the habitat types crossed by the proposed route. The ecological importance is assessed according to the criteria referred to in Section 7.7.2.7. Each habitat type is considered in the context of its rarity and extent on the pipeline route and in the wider landscape. The sensitivity of the habitats is assessed according to their ability to recover from disturbance as shown in Table 7-39 following disturbance (both with and without assistance). For each habitat type (where available) the average species diversity and percentage cover is given in brackets, e.g. (18.4/65) equals an average species diversity of 18.5 species per quadrat and an average of 65% vegetation cover.

Table 7-39: Likely Ecological Importance and Sensitivity of the Habitat Types Crossed by the Proposed Pipeline Route

Type	Association	Ecological Importance	Sensitivity	Overall Importance/ Sensitivity
Agriculture	n/a	Very low	Very low – can easily be re-instated following disturbance	Very low
Desert	Artemesietum-salsolosum dendroides clayey desert	Low – typically a species-poor habitat that is not uncommon on the route or the surrounding landscape	High – prone to soil compaction and slow recovery of vegetation cover and diversity	Medium
Desert	Artemesietum-salsoletum nodulasae	Low – typically a species-poor habitat that is not uncommon on the route or the surrounding landscape	High – prone to soil compaction and slow recovery of vegetation cover and diversity	Medium
Desert	Artemisietum lerchiana	Low – (8.4/85) typically a species-poor habitat that is not uncommon on the route or the surrounding landscape	High – prone to soil compaction and slow recovery of vegetation cover and diversity	Medium
Desert	Ephemeretum	Medium – a species-rich habitat with limited occurrence on the route	High – prone to soil compaction and slow recovery of vegetation cover and diversity	High
Desert	Peganetum	Medium – (19.5/66) a species-rich habitat with limited occurrence on the route	Medium – capable of unassisted recovery following disturbance	Medium
Desert	Salsoletum nodulosae clayey desert	Medium – (11.8/65) a moderately species-rich habitat of limited distribution on the route	High – slow to recover after biorestoration	High
Desert	Kalidetum & Capparisetum spinosa solonchak desert	Low – (4.9/68) typically a species-poor habitat that is not uncommon in the surrounding landscape (although it has a limited distribution on the route)	High – prone to soil capping and compaction following disturbance resulting in poor recovery rates	Medium
Desert	Halocnemetum strobilaceum solonchak desert	Low – (6.5/64) typically a species-poor habitat that is not uncommon on the route or the surrounding landscape	High – prone to soil capping and compaction following disturbance resulting in poor recovery rates	Medium
Desert	Suaedetum microphylla solonchak desert	Low – (6.8/67) species-poor habitat that is not uncommon in the surrounding landscape	Medium – capable of return to natural conditions relatively quickly following biorestoration	Medium

Type	Association	Ecological Importance	Sensitivity	Overall Importance/ Sensitivity
Semi-desert	Artemisetum botriochloasum semidesert	Medium – (16.2/83) a species-rich habitat with limited occurrence on the route	High - capable of return to natural conditions through assisted recovery (biorestoration)	High
Semi-desert	Artemisetum lerchiana purum desert	Medium – (15.6/85) a species-rich habitat with limited occurrence on the route	High - capable of return to natural conditions through assisted recovery (biorestoration)	High
Semi-desert	Artemisetum steppe with arid forest in stream bed	High – (20.6/95) very species-rich habitat potentially supporting National RDB plant species, which has a very limited extent on the route	High – capable of return to natural conditions through assisted recovery (biorestoration) over a long period	High
Lowland meadows	Cynodonetum alhagiosum	Low – (5.6/83) a very widespread and typically species-poor habitat	Medium – capable of unassisted recovery	Medium
Forests & shrubs	Plantation woodland	Very low – non-natural habitat of low ecological value	Low – can easily be re-created by re-planting	Low
Forests & shrubs	Tamarixetum scrub	Medium – (18.3/57) has low to moderate species-richness, but does not have a limited distribution	Low – can easily recover if re-planted with appropriate shrubs	Medium
Forests & shrubs	Caraganetum-Paliurosum spina-christi	High – (21.8/93) very species-rich habitat potentially supporting National RDB plant species, which has a very limited extent on the route	High – capable of return to natural conditions through assisted recovery (biorestoration) over a long period	High
Wetlands	Phragmitetum australis-typhosum	Medium – (7.8 / 81) not especially species-rich but a near natural habitat type of limited occurrence on the route	Low – capable of recovery without intervention	Medium

7.7.7 Riparian Habitats and Fauna

7.7.7.1 Introduction

This section describes the habitats of the main rivers crossed by the proposed route. Photographs of the rivers are included in Appendix F-3 of the ESBR.

There are three main types of rivers, classified according to their morphology:

- Straight canalised rivers are those watercourses with a more-or-less man-made channel regularly maintained by dredging and that consequently have little natural habitat structures or vegetation. These are major irrigation channels for the east Kur-Araz lowlands
- Meandering rivers are typical lowland rivers following a natural course. They generally have at least some natural habitats and vegetation. These rivers have a semi-natural channel morphology, and are typical of most of the rivers in the west Kur-Araz lowlands

- Braided channels are lowland rivers following a natural course, but which have several minor channels within a larger channel. They typically have gravel and pebble beds and have a large seasonal variation in flow, with high flows in spring snowmelts.

Table 7-40 provides a summary description of the rivers and their likely ecological importance/sensitivity. The morphology of the rivers is described in more detail in Section 7.5. Table 7-40 provides a list of animal species recorded at each river crossing during the SCPX surveys.

Table 7-40: Descriptions and Likely Ecological Importance of Rivers Crossed by the Proposed Pipeline Route

River Name	SCPX KP	Morphology[1]	Habitats	Ecological Importance/ Sensitivity
Agsu canal	54	C	Very little aquatic or riparian vegetation	Low
Geokchay	115	M	Water-margin stands of *Phragmites australis* with dense scrub on the banks	Medium
Turianchay	137	C	Very little aquatic or riparian vegetation but dense Tamarixetum scrub on the banks	Low
Kura East	167	M	No aquatic vegetation visible, and the bank vegetation is highly modified by man. There are scattered *Populus hybrida* trees, and stands of semi-natural scrub, but no tugay forest at the proposed crossing point	High
Karabakh canal	189	C	Very little aquatic or riparian vegetation, with semi-ruderal vegetation on the banks dominated by salt-tolerant herbs and sub-shrubs	Low
Goranchay	202	M	The channel and banks are entirely dominated by Tamarixetum scrub with a semi-ruderal field-layer	Medium
Kurekchay	221	B	There was no aquatic vegetation and only scattered stands of water-margin vegetation comprising *Phragmites australis*. The grassy floodplain is a moderately species-rich meadow dominated by *Aeluropus littoralis*, *Agrostis tenuis*, *Lolium rigidum* with scattered broad-leaved herbs such as *Centaurea calcyptera*.	Medium
Korchay	237	M	Dominated by dense reedswamp with species-rich aquatic and water-margin vegetation	Medium
Ganjachay	240	M	There was no aquatic or water-margin vegetation visible in the water channel. The floodplain has an open stand of cattle-grazed *Tamarix* scrub with a ruderal field-layer. The soft earth banks have little vegetation but are used by hole-nesting birds including *Merops apiaster* (bee-eater).	Medium

River Name	SCPX KP	Morphology[1]	Habitats	Ecological Importance/ Sensitivity
Sarisu	261	M	The channel has some dense stands of tall emergents including *Arundo donax*, *Lycopus europaeus*, *Phragmites australis*, *Sparganium erectum* and *Typha angustifolia*. There are scattered *Tamarix* bushes and stands of bramble scrub on the banks. The valley sides are dominated by species-rich *Artemisetum* semi-desert.	Medium
Goshgarachay	261	M	There are scattered stands of water-margin vegetation including *Phragmites australis* and *Typha angustifolia*. The floodplain vegetation comprises scattered scrub and meadow. The scattered shrubs include *Crataegus pentagyna*, *Eleagnus angustifolia*, *Tamarix ramosissima* and the RDB species *Punica granatum*. The meadow is dominated by grasses including *Aeluropus littoralis* and *Alopecurus myosuroides* with *Aegilops kotshii* forming a closed, short-grazed sward.	Medium
Shamkirchay	277	B	There is a small floodplain area with scattered ruderals such as *Anisantha rubens* and *Papaver hybridum*. The banks have a disturbed form of shrub-desert vegetation, which is very open and comprises a range of species including *Filago pyramidalis*, *Medicago minima* and *Parapholis incurva*.	Medium
Zeyamchay	303	B	The dry sections of the riverbed have scattered semi-ruderals such as *Anisantha rubens*, *Lolium rigidum* and *Papaver hybridum*. The ground above the banks is cultivated for arable crops.	Medium
Tovuzchay	324	B	The shallow pools and minor channels of the floodplain have a diverse aquatic flora including species such as *Batrachium trichophillum*, *Ranunculus sceleratus*, *Rorippa nastursium-aquatica* and *Rumex hydroplapathum*.	Medium
Hasansu	345	M	There are some stands of water-margin vegetation comprising narrow strips of *Phragmites australis*. The banks are dominated by dense bramble scrub dominated by *Rubus iberica*. The upper slopes and top of the banks has species-rich *Artemisetum* semi-desert.	Medium
Kura West	358	M	The floodplain comprises a grassy meadow dominated by *Lolium rigidum* and *Hordeum leporinum* with large amounts of *Trifolium campestre*. It is moderately species-rich. Adjacent to the meadow there is a dense stand of *Tamarix* scrub. The eastern bank beyond the floodplain has been cultivated for arable crops. The west bank slopes up from the *Tamarix* scrub to become dominated by species-rich *Artemisetum* semi-desert.	High

[1] C = canalised rivers; M = meandering rivers; B = braided channels.

Table 7-41: Fauna recorded from river crossings during the riparian habitat surveys for SCPX

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
Agsu	*Alcedo atthis*	Kingfisher	Bird	LC	-	Foraging	1
	Apus apus	Swift	Bird	LC	-	Foraging	8
	Arvicola amphibius	Water Vole	Mammal	LC	-	Foraging	1
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	10
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	4
	Corvus frugilegus	Rook	Bird	LC	-	Foraging	5
	Cuculus canorus	Common Cuckoo	Bird	LC	-	Calling	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	50
	Merops superciliosus	Olive Bee-eater	Bird	LC	-	Foraging	5
	Microtus species	a Vole	Mammal	n/a	-	Burrows	3
	Oenanthe deserti	Desert Wheatear	Bird	LC	-	Foraging	3
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	2
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	15
	Sturnus vulgaris	Starling	Bird	LC	-	Foraging	12
Zegemcay	*Corvus cornix*	Hooded Crow	Bird	LC	-	Foraging	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	3
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	6
	Lacerta saxicola	Rock Lizard	Reptile	LC	-	Basking	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	2
	Larus ridibundus	Black-headed Gull	Bird	LC	-	Foraging	1
	Lepus europaeus	Hare	Mammal	LC	-	Foraging	1
	Melanocorypha calandra	Calandra Lark	Bird	LC	-	Foraging	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	2
	Microtus species	a Vole	Mammal	n/a	-	Burrows	100
	Oenanthe finschii	Finsch's Wheatear	Bird	LC	-	Foraging	1
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	5
	Sterna hirundo	Common Tern	Bird	LC	-	Foraging	1
	Testudo graeca	Spur-thighed Tortoise	Reptile	VU	RDB	Foraging	1

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Vulpes vulpes	Red Fox	Mammal	LC	-	Foraging	1
Ganjachay	*Columba livia*	Rock Pigeon	Bird	LC	-	Foraging	6
	Emberiza melanocephala	Black-headed Bunting	Bird	LC	-	Foraging	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	1
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	2
	Lacerta raddei	Radde's Lizard	Reptile	LC	-	Foraging	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Foraging	1
	Lepus europaeus	Hare	Mammal	LC	-	Foraging	3
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	9
	Motacilla flava	Yellow Wagtail	Bird	LC	-	Foraging	1
	Oenanthe finschii	Finsch's Wheatear	Bird	LC	-	Foraging	2
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	3
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	1
	Upupa eupops	Eurasian Hoopoe	Bird	LC	-	Foraging	2
	Vulpes vulpes	Red Fox	Mammal	LC	-	Anecdotal	-
Goshgarachay	*Canis lupus*	Gray Wolf	Mammal	LC	-	Faeces	1
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	9
	Corvus cornix	Hooded Crow	Bird	n/l	-	Foraging	1
	Emberiza calandra	Corn Bunting	Bird	LC	-	Foraging	2
	Emberiza melanocephala	Black-headed Bunting	Bird	LC	-	Foraging	1
	Emys orbicularis	European Pond Turtle	Reptile	NT	-	Basking	3
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	2
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	2
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Foraging	10
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	3
	Microtus species	a Vole	Mammal	LC	-	Burrows	15
	Motacilla flava	Yellow Wagtail	Bird	LC	-	Foraging	2
	Natrix tessellata	Tessellated Water Snake	Reptile	LC	-	Basking	1
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	1
	Oenanthe oenanthe	Northern Wheatear	Bird	LC	-	Foraging	2

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	3
	Pica pica	Magpie	Bird	LC	-	Foraging	3
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Basking	1
	Streptopelia turtur	European Turtle-dove	Bird	LC	-	Foraging	1
	Turdus merula	Eurasian Blackbird	Bird	LC	-	Foraging	2
Geokchay	*Acrocephalus palustris*	Marsh Warbler	Bird	LC	-	Foraging	1
	Acrocephalus scirpaceus	Reed Warbler	Bird	LC	-	Foraging	1
	Arvicola amphibius	Water Vole	Mammal	LC	-	Foraging	1
	Cercotrichas galactotes	Rufous-tailed Scrub-robin	Bird	LC	-	Singing	2
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	2
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1
	Corvus monedula	Jackdaw	Bird	LC	-	Foraging	1
	Emys orbicularis	European Pond Turtle	Reptile	NT	-	Basking	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	5
	Motacilla alba	White Wagtail	Bird	LC	-	Foraging	2
	Natrix tessellata	Tessellated Water Snake	Reptile	LC	-	Basking	1
	Pica pica	Magpie	Bird	LC	-	Foraging	2
	Alauda arvensis	Skylark	Bird	LC	-	Foraging	1
Goranchay	*Buteo rufinus*	Long-legged Buzzard	Bird	LC	pRDB	Foraging	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	2
	Glareola pratincola	Collared Pratincole	Bird	LC	-	Foraging	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	1
	Microtus species	a Vole	Mammal	n/a	-	Burrows	15
	Oenanthe finschii	Finsch's Wheatear	Bird	LC	-	Foraging	1
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	1
	Oenanthe oenanthe	Northern Wheatear	Bird	LC	-	Foraging	2
	Ophisaurus apodus	European Legless Lizard	Reptile	n/l	-	Basking	1
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	3
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Foraging	1

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Streptopelia turtur	European Turtle-dove	Bird	LC	-	Foraging	1
Hasansu	*Galerida cristata*	Crested Lark	Bird	LC	-	Foraging	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	1
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	1
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Calling	
Karabakh Canal	*Alcedo atthis*	Kingfisher	Bird	LC	-	Foraging	1
	Buteo rufinus	Long-legged Buzzard	Bird	LC	pRDB	Foraging	1
	Egretta alba	Great Egret	Bird	LC	-	Foraging	1
	Himantopus himantopus	Black-winged Stilt	Bird	LC	-	Foraging	2
	Motacilla alba	White Wagtail	Bird	LC	-	Foraging	3
	Natrix tessellata	Tessellated Water Snake	Reptile	LC	-	Basking	1
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	3
	Oenanthe oenanthe	Northern Wheatear	Bird	LC	-	Foraging	3
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	5
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Calling	
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	30
	Vanellus vanellus	Lapwing	Bird	LC	-	Foraging	4
Korchay	*Buteo rufinus*	Long-legged Buzzard	Bird	LC	pRDB	Foraging	1
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	4
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	1
	Motacilla flava	Yellow Wagtail	Bird	LC	-	Foraging	1
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	4
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	5
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Calling	
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	3
	Sterna hirundo	Common Tern	Bird	LC	-	Foraging	7
Korchay Reservoir	*Acrocephalus scirpaceus*	Reed Warbler	Bird	LC	-	Foraging	1
	Anas platyrhynchos	Mallard	Bird	LC	-	Foraging	6
	Astacus leptodactylus	Crayfish	Crustacean	LC	-	Dead remains	1

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Aythya nyroca	Ferruginous Duck	Bird	NT	pRDB	Foraging	7
	Chlidonias leucopterus	White-winged Tern	Bird	n/a	-	Foraging	5
	Clemmys caspica	Caspian Pond Turtle	Reptile	n/l	-	Foraging	1
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	5
	Fulica atra	Coot	Bird	LC	-	Foraging	5
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	10
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	20
	Podiceps cristatus	Great Crested Grebe	Bird	LC	-	Foraging	4
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	30
	Sterna hirundo	Common Tern	Bird	LC	-	Foraging	33
	Vanellus vanellus	Lapwing	Bird	LC	-	Foraging	1
Kura East	*Alcedo atthis*	Kingfisher	Bird	LC	-	Foraging	1
	Anas acuta	Northern Pintail	Bird	LC	-	Foraging	4
	Anas penelope	Wigeon	Bird	LC	-	Foraging	1
	Arvicola amphibius	Water Vole	Mammal	LC	-	Foraging	1
	Aythya nyroca	Ferruginous Duck	Bird	NT	pRDB	Foraging	2
	Cercotrichas galactotes	Rufous-tailed Scrub-robin	Bird	LC	-	Foraging	3
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	5
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	3
	Cuculus canorus	Common Cuckoo	Bird	LC	-	Foraging	2
	Egretta alba	Great Egret	Bird	LC	-	Foraging	4
	Emys orbicularis	European Pond Turtle	Reptile	NT	-	Basking	3
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	3
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	1
	Lepus europaeus	Hare	Mammal	LC	-	Foraging	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	2
	Motacilla alba	White Wagtail	Bird	LC	-	Foraging	1
	Natrix tessellata	Tessellated Water Snake	Reptile	LC	-	Basking	1
	Oenanthe oenanthe	Northern Wheatear	Bird	LC	-	Foraging	1
	Pica pica	Magpie	Bird	LC	-	Foraging	5

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Basking	6
	Streptopelia turtur	European Turtle-dove	Bird	LC	-	Foraging	2
	Upupa eupops	Eurasian Hoopoe	Bird	LC	-	Foraging	1
Kura West	*Alauda arvensis*	Skylark	Bird	LC	-	Foraging	2
	Anas platyrhynchos	Mallard	Bird	LC	-	Foraging	1
	Chlidonias leucopterus	White-winged Tern	Bird	LC	-	Foraging	2
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	4
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	2
	Coturnix coturnix	Quail	Bird	LC	-	Foraging	1
	Cuculus canorus	Common Cuckoo	Bird	LC	-	Calling	1
	Egretta alba	Great Egret	Bird	LC	-	Foraging	1
	Emberiza calandra	Calandra Lark	Bird	LC	-	Foraging	1
	Fulica atra	Coot	Bird	LC	-	Foraging	2
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	2
	Himantopus himantopus	Black-winged Stilt	Bird	LC	-	Foraging	3
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	2
	Larus ridibundus	Black-headed Gull	Bird	LC	-	Foraging	1
	Oenanthe oenanthe	Northern Wheatear	Bird	LC	-	Foraging	1
	Oenanthe pleschanka	Pied Wheatear	Bird	LC	-	Foraging	1
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	4
	Phalacrocorax pygmaeus	Pygmy Cormorant	Bird	LC	-	Foraging	1
	Pica pica	Magpie	Bird	LC	-	Foraging	2
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	4
	Sterna albifrons	Little Tern	Bird	LC	-	Foraging	4
	Sterna hirundo	Common Tern	Bird	LC	-	Foraging	3
	Sterna sandvicensis	Sandwich Tern	Bird	LC	-	Foraging	6
	Turdus merula	Eurasian Blackbird	Bird	LC	-	Foraging	2
Kurekchay	*Alcedo atthis*	Kingfisher	Bird	LC	-	Foraging	1
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	4

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Lacerta saxicola	Rock Lizard	Reptile	LC	-	Basking	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	2
	Merops superciliosus	Olive Bee-eater	Bird	LC	-	Foraging	1
	Microtus species	a Vole	Mammal	n/a	-	Burrows	30
	Motacilla flava	Yellow Wagtail	Bird	LC	-	Foraging	1
	Oenanthe finschii	Finsch's Wheatear	Bird	LC	-	Foraging	3
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	2
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	5
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	3
	Turdus merula	Eurasian Blackbird	Bird	LC	-	Foraging	1
Sarisu	*Acrocephalus scirpaceus*	Reed Warbler	Bird	LC	-	Foraging	1
	Alauda arvensis	Skylark	Bird	LC	-	Foraging	1
	Buteo rufinus	Long-legged Buzzard	Bird	LC	pRDB	Foraging	1
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1
	Emys orbicularis	European Pond Turtle	Reptile	NT	-	Basking	10
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	1
	Lacerta raddei	Radde's Lizard	Reptile	LC	-	Foraging	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	4
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	1
	Microtus species	a Vole	Mammal	n/a	-	Burrows	10
	Oenanthe isabellina	Isabelline Wheatear	Bird	LC	-	Foraging	2
	Ophisaurus apodus	European Legless Lizard	Reptile	n/l	-	Basking	1
	Ophisops elegans	Snake-eyed Lizard	Reptile	n/l	-	Basking	1
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	20
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Calling	
	Streptopelia turtur	European Turtle-dove	Bird	LC	-	Foraging	1
Shamkirchay	*Alcedo atthis*	Kingfisher	Bird	LC	-	Foraging	1
	Chlidonias leucopterus	White-winged Tern	Bird	LC	-	Foraging	1
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Emys orbicularis	European Pond Turtle	Reptile	NT	-	Basking	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	3
	Hirundo rustica	Barn Swallow	Bird	LC	-	Foraging	2
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	9
	Microtus species	a Vole	Mammal	-	-	Burrows	10
	Motacilla flava	Yellow Wagtail	Bird	LC	-	Foraging	2
	Oenanthe deserti	Desert Wheatear	Bird	LC	-	Foraging	1
	Pica pica	Magpie	Bird	LC	-	Foraging	1
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	3
	Streptopelia turtur	European Turtle-dove	Bird	LC	-	Foraging	3
	Upupa eupops	Eurasian Hoopoe	Bird	LC	-	Foraging	1
	Vulpes vulpes	Red Fox	Mammal	LC	-	Passage	1
Tovuzchay	*Ardea cinerea*	Grey Heron	Bird	LC	-	Foraging	1
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1
	Galerida cristata	Crested Lark	Bird	LC	-	Foraging	3
	Hyla arborea	European Tree Frog	Amphibian	LC	-	Foraging	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Foraging	1
	Larus argentatus	Herring Gull	Bird	LC	-	Foraging	20
	Larus minutus	Little Gull	Bird	LC	-	Foraging	2
	Larus ridibundus	Black-headed Gull	Bird	LC	-	Foraging	10
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Calling	
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	2
	Sterna hirundo	Common Tern	Bird	LC	-	Foraging	2
Turianchay	*Alcedo atthis*	Kingfisher	Bird	LC	-	Foraging	1
	Cercotrichas galactotes	Rufous-tailed Scrub-robin	Bird	LC	-	Foraging	2
	Columba livia	Rock Pigeon	Bird	LC	-	Foraging	1
	Coracias garrulus	European Roller	Bird	NT	-	Foraging	1
	Corvus cornix	Hooded Crow	Bird	LC	-	Foraging	1
	Corvus monedula	Jackdaw	Bird	LC	-	Foraging	1
	Cuculus canorus	Common Cuckoo	Bird	LC	-	Foraging	4

River Name	Species	English Name	Group	IUCN Category	Az RDB Category	Sighting / Activity	Number of Individuals
	Dendrocopos medius	Middle Spotted Woodpecker	Bird	LC	-	Foraging	1
	Elaphe hohenackeri	Transcaucasian Rat Snake	Reptile	LC	pRDB	Basking	1
	Emys orbicularis	European Pond Turtle	Reptile	NT	-	Basking	2
	Hyla arborea	European Tree Frog	Amphibian	LC	-	Foraging	1
	Ixobrychus minutus	Little Bittern	Bird	LC	-	Singing	1
	Lacerta strigata	Caspian Green Lizard	Reptile	LC	-	Basking	1
	Merops apiaster	European Bee-eater	Bird	LC	-	Foraging	1
	Passer montanus	Eurasian Tree Sparrow	Bird	LC	-	Foraging	5
	Pica pica	Magpie	Bird	LC	-	Foraging	1
	Rana ridibunda	Eurasian Marsh Frog	Amphibian	LC	-	Foraging	1
	Riparia riparia	Sand Martin	Bird	LC	-	Foraging	2

7.7.8 Temporary Construction Camp, Pipe Storage Areas, Rail spurs and Offloading Areas

Many of the temporary construction camps and pipe storage areas were not visited for the dedicated RSK ecology surveys (as they were not decided on at the time of the survey), so the descriptions below are taken from photographs and site descriptions produced during the soil, contamination and preliminary appraisal surveys of the sites.

Table 7-42: Descriptions of the Temporary Construction Camp, Pipe Storage, Rail spur and Offloading Areas

Location	Site Name	Habitat Type	Description
Mugan	Camp Option 3*	Desert, Ephemeretum	This site is located in relatively undisturbed clayey desert of the Ephemeretum type. This is a fairly species-poor vegetation type with low percentage cover. Although not common on the pipeline route, this vegetation type is widespread in the Sangachal area of Azerbaijan.
Mugan	Mugan Pipe Storage, Offloading and Rail Spur	Disturbed Ground and grassland	This pipe storage area is located close to a road and rail track, and the ground has been heavily disturbed by vehicle movement such that there is very little natural vegetation left.
Mugan	Mugan Rail Spur and Offloading	Disturbed Ground	This site is located on the site of a previous camp for BTC / SCP. IT consists of brownfield land of very low ecological value.
Kurdemir	Kurdemir Camp Option 4*	Phragmites Swamp, Desert and Agriculture	This site includes both ploughed agricultural land and semi-natural desert vegetation typical of the Kurdemir lowland plains. The vegetation type is unknown at this stage, although it is likely to be a widespread type that is nevertheless vulnerable to slow recovery if subject to soil compaction and loss of vegetation. The irrigation canals on the western and southern boundaries may be used by reptiles and amphibians as well as nesting birds.
Kurdemir	Kurdemir Rail Spur and Offloading	Disturbed Ground	This site is located between a road and railway on disturbed ground with very little natural vegetation.
Kurdemir	Pipe Storage Area Option 1 (Mususlu)	Lowland Meadow, Cynodonetum alhagiosum	This site is located in flat area of meadow vegetation. Vegetation on the nearest section of the SCPX route is classed as Cynodonetum alhagiosum, and the photos appear to show that this site has similar vegetation.
Kurdemir	Pipe Storage Area Option 2 (Mususlu)	Lowland Meadow and Agriculture	The site is split into parcels mainly used for Agriculture (wheat) with some areas of more natural habitat. It may be used by mammals, reptiles and amphibians as well as nesting birds.
Kurdemir	Access road - Pipe Storage Areas (Mususlu)	Phragmiteta-Typhetum wetland and Agriculture	There is a Phragmiteta-Typhetum wetland that is crossed by the access road that will be used if either option is used. This is of Medium importance / sensitivity as it is not a common habitat type but it can recover quickly following disturbance. It may be used by reptiles and amphibians as well as nesting birds.

Location	Site Name	Habitat Type	Description
Kurdemir	Kurdemir Camp Option 5	Lowland Meadow	This site is located in flat irrigated land that is used for grazing. The habitats are very common along this section of the route and not of high value.
Ujar	Ujar Camp Option 5	Disturbed Ground and Tamarixetum scrub	This site appears to consist of disturbed ground and scrub (likely to be dominated by *Tamarix meyeri*). This is a relatively common vegetation type but it is very vulnerable to slow recovery if subject to soil compaction and loss of vegetation. Irrigation canals around the site may be used by reptiles and amphibians as well as nesting birds.
Yevlakh	Camp Option 1*	Disturbed Ground	This site is located in disturbed ground with very little natural vegetation left. There is a nearby watercourse.
Yevlakh	Yevlakh Pipe Storage Area	Disturbed Ground, Lowland Meadow and Tamarixetum scrub	This site appears to comprise a mosaic of semi-natural and secondary habitats, dominated by grazing land with some open Tamarixetum scrub grading into Cynodonetum alhagiosum.
Yevlakh	Yevlakh Rail Spur and Offloading	Disturbed Ground	This site consists of disturbed ground of low ecological value along the old rail spur.
Gazanchi	Gazanchi Pipe Storage Area Option A	Lowland Meadow and Disturbed Ground	This site is located partially in lowland meadow and partially in disturbed land. It is not apparently of high ecological value.
Gazanchi	Gazanchi Pipe Storage Area Option B	Cultivated land	This site is located in cultivated land of low ecological value.
Gazanchi	Gazanchi Rail Spur and Offloading	Disturbed Ground	This site consists of disturbed ground of low ecological value along the old rail spur.
Goranboy	Goranboy Camp Option 3	Halcnemetum desert and Agricultural land	This site comprises mostly semi-natural desert apparently dominated by *Halocnemtum strobilaceum*. This widespread vegetation type is nevertheless vulnerable to slow recovery if subject to soil compaction and loss of vegetation.
Ganja	Camp and Pipe Storage Goranboy 1 & 2*	Agricultural land	This appears to be cultivated agricultural land, though there may be small areas of semi-natural vegetation.
Ganja	Zazali rail spur*	Disturbed Ground	This site appears to consist entirely of disturbed ground of very low ecological value.
Dallar	Dallar Pipe Storage and Dallar Rail Spur and Offloading	Disturbed Ground	This site consists of man-made ground and disturbed land. There is a shallow watercourse on the southern boundary.
Dallar	Pipe Storage Area, Option 1B (Bayramli)	Agricultural land	This site consists of land cultivated and planted for pasture and is of low importance/sensitivity.
Samukh	Samukh Camp Option 3	Agricultural land	This site consists of cultivated land and is therefore of low importance/sensitivity.
Tovuz	Camp Option 5*	Agricultural land	This site is located in cultivated fields.

Location	Site Name	Habitat Type	Description
Agstafa	Pipe Storage and Offloading Areas*	Disturbed Ground	These sites are located in disturbed and man-made habitats.
Agstafa	Agstafa Camp Option 3	Agriculture	This site consists of cultivated land and is therefore of low importance/sensitivity.
Poylu	Poylu Pipe Storage Area	Lowland meadow	This site consists of pasture land with shallow (mostly dry) drainage ditches. It is not of high ecological importance / sensitivity.
Poylu	Poylu Rail Spur and Offloading	Disturbed ground	This site is used for Gypsum storage and is of low ecological importance / sensitivity.
Saloghlu	Saloghlu Rail Spur and Offloading	Disturbed ground	The habitats at the site are not of high ecological importance / sensitivity.
Saloghlu	Saloghlu Camp	Lowland meadow	The habitats at the site are not of high ecological importance / sensitivity. It is adjacent to the Garayazi protected area, which is designated for Tugay Forest, but it does not contain any of the habitats for which the protected area is designated. The potential for indirect effects on the protected area depends on the distance between the site and any important habitats, and the land use and topography in between.
Saloghlu	Saloghlu Pipe Storage Area	Lowland meadow	The habitats at the site are not of high ecological importance / sensitivity. It is adjacent to the Garayazi protected area, which is designated for Tugay Forest, but it does not contain any of the habitats for which the protected area is designated. The potential for indirect effects on the protected area depends on the distance between the site and any important habitats, migratory species that utilise the meadow area and the land use and topography in between.

* Temporary facilities that have subsequently been rejected and are no longer being considered

7.7.9 Fauna

7.7.9.1 Amphibians

Only two amphibian species were recorded during the field surveys in 2011: *Hyla arborea* (European tree frog) and *Rana ridibunda* (marsh frog). In addition, *Bufo viridis* (green toad), *Bufo bufo*[7] (common toad) and *Pelobates syriacus* (eastern spadefoot toad) were recorded during surveys for BTC/SCP in 1996 and may occur in wetlands along the proposed SCPX route. *Bufo bufo* and *Pelobates syriacus are* included in the Azerbaijan RDB.

Rana ridibunda (marsh frog) is a very common frog found in most wetland habitats along the proposed route. It was recorded at nine of the surveyed rivers, and is considered to be present at most, if not all, of the river crossings.

Amphibian species that may be encountered on the proposed route are listed in Table 7-43.

[7] *Bufo verucosissimus* also occurs in Azerbiajan, in the area crossed by the pipeline, although it has only recently been separated from *Bufo bufo*.

Table 7-43: Amphibian Species that Occur in Habitats Crossed by the Proposed Pipeline Route

Common Name	Scientific Name	Az Status	IUCN Status[1]	Habitat
Common toad	*Bufo bufo*	RDB	LC	Riparian forests and meadows
European tree frog	*Hyla arborea*	-	LC	Riparian forests and meadows
Green toad	*Bufo viridis*	-	LC	Rivers, streams and pools
Marsh frog	*Rana ridibunda*	-	LC	Rivers, streams and pools
Eastern spadefoot toad	*Pelobates syriacus*	RDB	LC	Rivers and semi-desert

1 See Table 7-26 for IUCN status categories

7.7.9.2 Birds

Fifty-two species of bird were recorded during the 2011 SCPX surveys. Widespread species that can be encountered almost anywhere on the proposed pipeline route include *Passer montanus* (tree sparrow), *Corvus cornix* (hooded crow) and *Galerida cristata* (crested lark).

Deserts and semi-deserts generally have a low diversity of birds, although some species are quite abundant. The low species-diversity of birds in semi-deserts is probably linked to the homogenous structure of the vegetation (Ward, 2009). There are two main groups of birds in these habitats: the passerines (which typically nest on the ground or in shrubs, typified by *Galerida cristata* (crested lark)); and birds of prey (which typically nest elsewhere and forage for prey in the desert and semi-desert).

The most common passerines in deserts and semi-deserts are the larks, particularly *Galerida cristata* (crested lark) and *Alauda arvensis* (skylark) along with species such as wheatears, e.g. *Oenanthe deserti* (desert wheatear). Birds of prey recorded from the desert and semi-desert habitats include *Buteo fufinous* (long-legged buzzard) and *Falco tinunculus* (kestrel). The birds of prey typically forage for food (small mammals, reptiles and carrion) in the desert, but nest elsewhere in tall trees or upland crags.

River crossings tend to have a fairly characteristic bird fauna, associated with the aquatic habitats and the adjacent riparian habitats (i.e. reedbeds and shrubs). Waders recorded during the SCPX riparian surveys include *Ardea cinerea* (grey heron), *Egretta alba* (great white egret), *Ixobrychus minutus* (little bittern), *Nycticorax nycticorax* (black-crowned night heron), *Podiceps cristatus* (great crested grebe) and *Vanellus vanellus* (lapwing). Waterfowl recorded in the 2011 SCPX surveys include the ducks *Anas platyrhynchos* (mallard) and *Aythya nyroca* (ferruginous duck) as well as *Fulica atra* (coot). Gulls such as *Sterna hirundo* (common tern) and *Larus ridibundus* (black-headed gull) are also commonly found feeding at many of the rivers.

Many of the rivers with steep earth banks are used by hole-nesting birds including *Alcedo atthis* (kingfisher), *Merops apiaster* (bee-eater) and *Riparia riparia* (sand martin). Birds commonly found in riparian scrub and reedbeds include *Acrocephalus scirpaceus* (reed warbler), *Coracias garrulus* (European roller) and *Cuculus canorus* (common cuckoo).

Many migratory birds pass through Azerbaijan on their route between breeding grounds in the north (*e.g.* Europe and Eurasia) and wintering grounds to the south (*e.g.* the Middle East, Asia and Africa). These migrations include many species of raptor and wetland birds. Raptors tend to soar at height and may forage or perch in suitable locations during migration. Wetland birds may congregate in large numbers in wetlands. The route corridor does not pass through any wetlands that are likely to be of high importance for migratory wetland birds (the closest sites are the reservoirs at Korchay and Mingechevi). Table 7-44 presents a list of rare or notable bird species that have either been recorded during field surveys of the proposed pipeline route or have been noted in desktop data as likely to be present.

Table 7-44: Notable Birds Potentially Occurring along the Proposed Pipeline Route

Common Name	Scientific Name	Az status[1]	IUCN Status[2]	Residency[3]	Habitat
Birds of Prey					
Golden eagle	*Aquila chrysaetos*	RDB	LC	R	Semi-desert
Lesser kestrel	*Falco naumanni*	pRDB	LC	R	Semi-desert
Long-legged buzzard	*Buteo rufinus*	pRDB	LC	R/M	Semi-desert
Osprey	*Pandion haliaetus*	RDB	LC	S	Rivers
Tawny eagle	*Aquila rapax*	RDB	LC	M/W	Semi-desert
White-tailed eagle	*Haliaeetus albicilla*	RDB	LC	R	Rivers
Waders					
Black-winged pratincole	*Glareola nordmanni*	RDB	NT	S	Rivers
Purple gallinule	*Porphyrio porphyrio*	RDB	LC	W	Rivers
Sociable lapwing	*Vanellus (Chettusia) gregaria*	RDB	CR	M	Rivers
White-tailed lapwing	*Vanellus (Chettusia) leucurus*	RDB	LC	S	Rivers
Water Fowl					
Ferruginous duck	*Aythya nyroca*	pRDB	NT	R	Rivers
Game Birds and Other Species					
Black francolin	*Francolinus francolinus*	RDB	LC	R	Semi-desert
European roller	*Coracias garrulous*	-	NT	R	Semi-desert
Little bustard	*Tetrax tetrax*	RDB	NT	W	Semi-desert

[1] RDB – Azerbaijan Red Data Book; p - proposed Red Data Book (RDB) species
[2] See Table 7-26 for IUCN status categories
[3] R = resident; M = migrant; W = wintering; S =Summer

7.7.9.3 Mammals

Only three mammal species were recorded during the 2011 SCPX surveys. *Arvicola amhipibius* (water vole) was recorded at two rivers, the Agsu canal and the Geokchay. However, almost all of the rivers and drainage channels have habitat suitable for this species and it is possible that burrows could be found on the pipeline route wherever the river crossings have steep earth banks with continuous riparian vegetation. The other two mammals recorded, *Lepus europaeus* (brown hare) and *Vulpes vulpes* (red fox), are widespread species associated with terrestrial habitats along the pipeline route.

Table 7-45 presents a list of rare or notable mammals that have been recorded during this and previous field surveys of the proposed pipeline route or have been noted in desktop data as likely to be present.

Table 7-45: Notable Mammals Potentially Occurring along the Proposed Pipeline Route

Common Name	Scientific Name	Az status	IUCN status	Habitat
Bats				
Eastern barbastelle bat	*Barbastella leucomelas*	pRDB	LC	Summer roosts in old woodlands
Lesser horseshoe bat	*Rhinolophus hipposideros*	pRDB	LC	Forages around woodland and riparian vegetation. Roosts in caves, tunnels etc
Botta's serotine bat	*Eptesicus battoae*	pRDB	LC	Forages over semi-desert and roosts in rock crevices
Felines and Canines				
Wild field cat	*Felis silvestris (lybica)*	RDB	LC	Semi-desert
Striped hyena	*Hyaena hyaena*	RDB	NT	Semi-desert
Jungle cat	*Felis chaus*	pRDB	LC	Reedswamp
Mustelids				
Marbled polecat	*Vormela peregusna*	RDB	VU	Semi-desert
Eurasian otter	*Lutra lutra*	RDB	NT	Rivers, streams etc
Ungulates				
Goitered gazelle	*Gazella subgutturosa*	RDB	VU	Semi-desert

7.7.9.4 *Reptiles*

Nine reptile species were recorded during the 2011 SCPX surveys. Lizards and snakes are generally quite abundant in semi-desert habitats, where they typically live in burrows and under rocks.

Two species of reptile were recorded from wetland habitats. *Mauremys caspica* (Caspian pond turtle) was recorded from the Korchay and Goshgarachay. *Emys orbicularis* (European pond turtle) was recorded from six rivers between KP172 and KP335. It is probably widespread and may be found in most of the river crossings; it was often observed in large numbers basking on riverbanks.

Two species of snake were recorded during the 2011 SCPX surveys. *Elaphe hohenackeri* (transcaucasian rat snake) was recorded once at the Turianchay crossing in dense Tamarix scrub. *Natrix tessellata* (tessellated water snake) was recorded at four different river crossings, and is probably quite widespread along the proposed route.

Testudo graeca (spur-thighed tortoise) was recorded at many locations, in terrestrial and riparian habitats. It is widespread along the proposed route, although probably more abundant towards the west.

Table 7-46 presents a list of all reptiles that have been recorded during field surveys of the proposed pipeline route or have been noted in desktop data as likely to be present.

Table 7-46: Reptiles Recorded along the Proposed Pipeline Route

Common Name	Scientific Name	Az Status	IUCN Status	Habitat	Occurrence1
Caspian green lizard	*Lacerta strigata*	-	LC	Semi-desert	C
European pond turtle	*Emys orbicularis*	-	NT	Rivers, streams etc	C
Radde's lizard	*Lacerta raddei*	-	LC	Semi-desert	C
Tessellated water snake	*Natrix tessellata*	-	LC	Rivers, streams etc	C

Common Name	Scientific Name	Az Status	IUCN Status	Habitat	Occurrence1
European legless lizard	*Ophisaurus apodus*	-	-	Semi-desert	C
Caspian pond turtle	*Mauremys caspica*	-	-	Rivers, streams etc	C
Transcaucasian rat snake	*Elaphe hohenackeri*	pRDB	-	Rivers, streams etc	C
Snake-eyed lizard	*Ophisops elegans*	-	-	Semi-desert	C
Spur-thighed tortoise	*Testudo graeca*	RDB	VU	All	C
Long-legged skink	*Eumeces schneideri*	-	-	Semi-desert	Po

[1] C = confirmed presence; Po = possibly present

7.7.9.5 Terrestrial invertebrates

Surveys were not carried out for invertebrates in the 2011 surveys. Previous reports indicate that there may be some nationally designated species occurring on the route, but no species listed on the IUCN Red List. As the proposed route passes through habitats that are widespread in the surrounding landscape, impacts on individuals or populations are likely to be small, and long-term impacts will be avoided by post-construction habitat restoration. Therefore, this section uses desktop data, compiled in the BTC EIA report, to provide baseline information for invertebrates.

A wide diversity of species is known to occur in the habitats along the proposed route. Notable species likely to occur on the route are presented in Table 7-47.

Table 7-47: Notable Terrestrial Invertebrates Likely to Occur on the Proposed Pipeline Route

Common Name	Scientific Name	Az Status	IUCN Status	Occurrence
Beetle species	*Anchylocheria salmoni*	RDB	-	Po
Crayfish	*Astacus pyzolwi*	USSR RDB	-	Po
Daghestan bumble-bee	*Bombus daghestanicus*	RDB	-	Po
Bumble-bee species	*Bombus persicus*	RDB	-	Po
Clouded yellow butterfly	*Colias aurorina*	RDB	-	Po
Oleander hawkmoth	*Daphnis nerii*	RDB	-	Po
Death's-head hawkmoth	*Manduca atropos*	RDB	-	C(ERM, 2000)
Beetle species	*Megacephalus euphraticus*	RDB	-	Po
Hairstreak butterfly	*Tomares romanovi*	RDB	-	Po

7.7.9.6 Fish

Fish were recorded from all the watercourses surveyed. A total of 29 different fish species were caught from all rivers visited during the surveys (see Table 7-48). This section of the chapter presents a summary of the findings from the fish surveys; more comprehensive information, including information on species abundance and population age structure, can be found in the SCPX Project ESBR (2011). The Caspian Lamprey (*Caspiomyzon wagneri*) is an Azerbaijan RDB species at present, although it may lose this status in the forthcoming new edition of the RDB.

Table 7-48: Species Presence/Absence for Each of the Watercourses Surveyed during 2011

Species Name[1]	River													
	Agsu	Kura East	Karabakh	Kurekchay (Kyorakchay)	Korchay	Ganjachay	Goshgarachay (Kushkarchay)	Sarisu	Zeyamchay	Tovuzchay	Hasansu	Total Fish Caught	Mean Size (mm)	Range Size (mm)
Abramis brama (common bream)		Y	Y									46	135	42 - 280
Alburnoides bipunctatus (schneider)		Y				Y	Y	Y	Y	Y	Y	91	57	32 - 88
Alburnus alburnus (*A. charusini*) (bleak)	Y	Y		Y	Y	Y	Y	Y		Y	Y	588	46	14 - 97
Alburnus chalcoides (Caspian shemaya)		Y	Y							Y	Y	36	47	15 - 143
Alburnus filippii (Kura bleak)		Y		Y		Y				Y	Y	74	60	28 - 94
Barbatula (*Orthrias*) *brandti* (Kura loach)							Y				Y			
Barbus lacerta (Kura barbel)				Y		Y	Y	Y	Y	Y		115	46	26 - 125
Blicca bjoerkna (white bream)		Y										4	80	62 - 90
Capoeta capoeta capoeta (seven khramulya)		Y		Y		Y	Y	Y		Y		453	43	15 - 85
Carassius auratus auratus (goldfish)	Y		Y		Y							5	46	20 - 86
Carassius gibelio (Prussian carp)		Y			Y		Y					32	44	20 - 170
Caspiomyzon wagneri (Caspian lamprey)		Y										2	73	65 - 80
Cobitis taenia (spined loach)					Y							3	86	81 - 90
Cyprinus carpio (common carp)								Y				30	82	73 - 90
Esox lucius (northern pike)		Y										2	255	255
Gambusia affinis (Mosquitofish)		Y	Y		Y							148	30	15 - 66
Luciobarbus mursa (mursa)											Y	2	66	42 - 90
Neogobius fluviatilis (monkey goby)					Y					Y		3	34	28 - 40
Neogobius melanostomus (round goby)		Y										6	77	65 - 86

Species Name[1]	River													
	Agsu	Kura East	Karabakh	Kurekchay (Kyorakchay)	Korchay	Ganjachay	Goshgarachay (Kushkarchay)	Sarisu	Zeyamchay	Tovuzchay	Hasansu	Total Fish Caught	Mean Size (mm)	Range Size (mm)
Neogobius cephalarges (ginger goby)		Y		Y		Y	Y		Y	Y		3	79	64 - 107
Oxynemacheilus angorae (angora loach)									Y	Y	Y	57	48	28 - 70
Oxynoemacheilus merga (stone loach)		Y										9	51	35 - 87
Ponticola gorlap (Caspian bighead goby)		Y										2	80	40 - 120
Rhodeus sericeus (bitterling)								Y				20	69	44 - 103
Rutilus rutilus (roach)		Y	Y				Y					61	59	21 - 110
Sabanejewia aurata aurata (Aral spined loach)				Y		Y				Y	Y	15	54	35 - 100
Sander lucioperca (pike-perch)		Y	Y									6	114	79 - 155
Squalius cephalus (European chub)			Y	Y		Y	Y			Y	Y	190	81	45 - 107
Total no. of fish species	2	17	7	7	6	8	9	6	4	11	9	2002	-	-

Of additional interest was the presence of two non-native fish species. *Carassius gibelio* (Prussian carp) was observed at three locations including the Kura East River, the reservoir downstream of the Korchay and the Goshgarachay. *Gambusia affinis* (mosquitofish) was observed in the reservoir downstream of the Korchay only. Neither of these species directly predates upon native fish species but there are concerns that non-native fish species can introduce and spread pathogens and compete with native species for resources.

The fish surveys provide a snapshot of the species that were present at the time of the survey and which could be caught using the available methods. Previous reports have indicated that perhaps more than 50 species might be found in rivers and lakes in Azerbaijan. When the fish species-lists from the various desktop reports are combined and cross-referenced with each other, there are 15 additional species that may occur in freshwaters in Azerbaijan, but which were not caught during the SCPX surveys (giving a total of 44 species). This means that the SCPX surveys recorded approximately two thirds of the species that might be expected to occur, which is a good sample of the fish fauna in the rivers crossed by the proposed route.

Of the 15 'additional species', one – *Acipenser nudiventris* (ship sturgeon) – is almost certainly extinct from the Kura, the only river crossed by the route from where it had previously been recorded. Based on their known distributions and ecology, the remaining 14 species are quite likely to occur in some or all of the rivers crossed by the proposed route. These species belong to the same functional groups as species already known to occur, if they were present, this would not affect the assessment of the ecological sensitivity of the rivers crossed for fish. The IUCN and Azerbaijan RDB status of these species is shown in Table 7-49. The remaining eight species are widespread and common species with no nature conservation designations.

Table 7-49: Fish Species Not Recorded During SCPX Surveys but are Likely to Occur in Rivers Crossed by the Proposed Pipeline Route

Common Name	Scientific Name	Az Status	IUCN Status
White-eye bream	*Abramis sapa*	RDB	Not Assessed
Blackbrow bleak	*Acanthalburnus microlepis*	-	Not Assessed
Aral barbel	*Luciobarbus brachycephalus*	pRDB	VU
Bulatmai barbel	*Barbus capito*	pRDB	VU
Sichel	*Pelecus cultratus*	RDB	LC
Kura nase	*Chondrostoma cyri*	-	-
Kura gudgeon	*Romanogobio persus*	-	-
North Caspian roach	*Rutilus rutilus caspius*	-	LC
Sea trout	*Salmo trutta trutta*	-	-
Brook trout	*Salmo fario*	RDB	-
Sea trout	*Salmo trutta caspius*	pRDB	-
Wels catfish	*Silurus glanis*	-	-
Tench	*Tinca tinca*	-	-
Zahrte	*Vimba vimba persa*	-	-

7.7.10 *Sensitivities*

This section considers the likely overall ecological importance/value of the habitats, flora and fauna crossed by the proposed pipeline route and their potential sensitivity to change.

7.7.10.1 Vegetation types

Table 7-50 identifies the location of sensitive habitats on the route, including sections of the route where vegetation recovery has been very slow on the parallel section of the BTC route.

Table 7-50: Sections of the ROW with Habitats of High Sensitivity/Importance

Start KP	End KP	Sensitive Receptor	Sensitivity
KP0	KP3.2	*Salsoletum nodulosae* clayey desert	A moderately species-rich habitat of limited distribution on the route, which is prone to soil compaction and slow recovery of vegetation cover and diversity
KP5.4	KP24.4	Desert habitats including Ephemeretum desert	This section has been slow to recover on the BTC ROW and there is potential for a cumulative impact from the SCPX ROW. It includes a section of Ephemeretum desert (KP5 to KP14) – a species-rich habitat of limited distribution on the route, which is prone to soil compaction and slow recovery of vegetation cover and diversity
KP84.8	KP95.8	Desert habitats	This section has been slow to recover on the BTC ROW and there is potential for a cumulative impact from the SCPX ROW
KP137.6	KP158.1	Desert habitats	This section has been slow to recover on the BTC ROW and there is potential for a cumulative impact from the SCPX ROW
KP321.4	KP322.9	*Artemisetum botriochloasum* semi-desert and *Caraganetum-Paliurosum spina-christi* arid scrub	Very species-rich habitat potentially supporting RDB plant species, with a very limited extent on the route. Capable of return to natural conditions through assisted recovery (biorestoration)
KP335.4	KP336.4	*Artemisetum lerchiana purum* Semi-desert	A species-rich habitat with limited occurrence on the route, potentially supporting RDB plant species. Capable of return to natural conditions through assisted recovery (biorestoration)
KP341.6	KP345.6		
KP346.1	KP351		
KP358.8	KP369.8		
KP382.8	KP390		

7.7.10.2 Rivers

The riparian habitats at the majority of river crossings are suitable for a range of rare and notable animal species, many of which have either been recorded at the crossings or are likely to occur there. In particular, this includes reptiles and amphibians (see Section 7.7.10.4 below).

The sensitivity of the fish fauna at river crossings to construction activities is dependent upon a range of factors including the physical nature of the water bodies concerned, the life history/ecological characteristics of the fish community residing in them and the time of year. In particular, when water levels are at their lowest, habitats are typically more sensitive. The likely ecological importance and sensitivity of the rivers surveyed, based on the evidence gained from the fish surveys, is presented in Table 7-51, below. The variation in importance and sensitivity reflects timing, as noted above.

Table 7-51: Likely Ecological Importance and Sensitivity of Rivers for Fish

River Name	KP	Ecological Importance	Sensitivity	Overall Importance /Sensitivity
Agsu canal	54	Very low	Very low–low	Low
Kura East	167	Medium	Medium	Medium
Karabakh canal	189	Very low	Very low	Very low
Kurekchay	221	Low	Low–medium	Medium
Korchay	237	Very low	Very low	Very low
Ganjachay	240	Very low–low	Very low–low	Low
Sarisu	261	Low-medium	High	Medium
Goshgarachay	261	Low	Low–medium	Medium
Zeyamchay	303	Low	Low–high	Medium
Tovuzchay	324	Medium	Low–high	Medium
Hasansu	345	Low–medium	Low–medium	Medium

The overall importance/sensitivity of the rivers is assessed in Table 7-52 as a combination of their habitats, fauna and fish species. Some of the rivers will have an increased sensitivity during the breeding season for the species of fauna that use the aquatic and riparian habitats. This includes animals nesting in holes in the banks (e.g. water voles or hole-nesting birds such as *Alcedo atthis* (kingfisher)), amphibians breeding in shallow water, reptiles breeding in riparian habitats and fish spawning on gravels or in shallow slack-waters (N.B. although fish typically spawn within the river channel, in periods of flooding, some fish species may spawn in temporarily inundated habitats adjacent to the rivers). The spawning period generally runs from March to July depending on the species concerned. Some animal species also have increased sensitivity during periods of low activity in winter (e.g. the hibernating reptiles, amphibians or mammals), which are less able to move away from disturbance at this time of year.

Table 7-52: Overall Likely Ecological Importance/Sensitivity of Rivers Crossed by the Proposed Pipeline Route

River Name	SCPX KP	Habitat Importance/ Sensitivity	Fish Importance/ Sensitivity	Overall Ecological Importance/ Sensitivity	Seasonality
Agsu canal	54	Low	Low	Low	No significant seasonal variation in importance/ sensitivity
Geokchay	115	Medium	n/a	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Turianchay	137	Low	n/a	Low	No significant seasonal variation in importance/ sensitivity
Kura East	167	High	Medium	High	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Karabakh canal	189	Low	Very low	Low	No significant seasonal variation in importance/ sensitivity
Goranchay	202	Medium	n/a	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)

River Name	SCPX KP	Habitat Importance/ Sensitivity	Fish Importance/ Sensitivity	Overall Ecological Importance/ Sensitivity	Seasonality
Kurekchay	221	Medium	Medium	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Korchay	237	Medium	Very low	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Ganjachay	240	Medium	Low	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Sarisu	261	Medium	Medium	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Goshgarachay	261	Medium	Medium	High	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Shamkirchay	277	Medium	n/a	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Zeyamchay	303	Medium	Medium	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Tovuzchay	324	Medium	Medium	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March).
Hasansu	345	Medium	Medium	Medium	Increased sensitivity during breeding season (March–July) and winter period (October–March)
Kura West	358	High	n/a	High	Increased sensitivity during breeding season (March–July) and winter period (October–March)

7.7.10.3 Notable flora

Three notable plant species were recorded during the surveys in 2011.

Punica granatum (Pomegranate) (see Photograph 7-61) was recorded at the Goshgarachay crossing and the Shamkirchay crossing. This shrub species is listed in the Azerbaijan RDB. It is quite common in semi-natural landscapes north of Ganja, growing in open scrub vegetation among the river valleys. It is also extremely common in cultivation throughout the country. It is therefore considered of medium importance, but of low sensitivity.

Photograph 7-61: *Punica granatum* (Pomegranate)

Vitis sylvestris (wild grape) (see Photograph 7-62) was recorded in one location, near the Kura East River crossing near KP167. This species is very rare in the wild, and only three plants were recorded, growing on a large mature *Populus hybrida* tree. Both the tree and the vine are probably relicts of tugay forest. Estimates of the abundance of this species at a national level are not available, but it is likely to be uncommon given its association with tugay forest (which is a nationally rare habitat type). It is therefore considered of medium importance and high sensitivity.

Photograph 7-62: *Vitis sylvestris* (Wild Grape)

Iris camillae (a dwarf Iris) is listed in the Az RDB. It was recorded in one area, near to the Hasansu crossing on the western side at KP345–KP346. It grows in a scattered population in this area, both on the proposed route and adjacent to it. Estimates of the national population of this species are not available, but as it is restricted to species-rich natural vegetation (of a type that is uncommon) the national population is likely to be small, and the population on and near the proposed route is very small. It is therefore considered to be of medium importance and high sensitivity.

In addition to these three species, *Iris acutiloba* has been recorded from the BTC and SCP ROWs between BTC KP0 and KP57, but not beyond that point. It is therefore unlikely to be found on the proposed SCPX route. However, there is habitat suitable for this species between SCPX KP0 and KP35. A further survey should be undertaken of this area to confirm presence on the SCPX route. This species is considered of medium importance and high sensitivity.

7.7.10.4 Notable fauna (including fish)

Appendix F-1 of the ESBR comprises a table of species that are potentially most important in relation to the proposed pipeline. They are ranked in descending order of importance according to the following criteria:

1. Species listed on the IUCN Red List or the Azerbaijan RDB that have either been recorded during surveys or are likely to be present based on known distribution and habitat availability
2. Species listed on the IUCN Red List or the Azerbaijan RDB that occur on the proposed route but have large populations that are unlikely to be affected by it
3. Species listed on the IUCN Red List of the Azerbaijan RDB that are unlikely to be present on the pipeline route or which are unlikely to be affected by it (e.g. raptors that may forage over the route but which are very unlikely to nest there, or migratory birds that do not nest in the region).

Table 7-53 lists those species included in Category 1, i.e. rare species that are known to occur on the route (or are quite likely to occur there) and, because of their behaviour or habitat requirements could be affected by the proposed pipeline construction. They are presented in alphabetical order of the main habitat type in which they occur. The following sections discuss the species, or groups of species, and their relative likely importance and sensitivity.

Table 7-53: Notable Fauna

Common Name	Scientific Name	Habitat	IUCN Status	National Status
White-eye bream	*Abramis sapa*	Aquatic	-	RDB
Caspian lamprey	*Caspiomyzon wagneri*	Aquatic	NT	RDB
Aral barbel	*Luciobarbus brachycephalus*	Aquatic	Not Assessed	pRDB
Bulatmai barbel	*Barbus capito*	Aquatic	Not Assessed	pRDB
Sichel	*Pelecus cultratus*	Aquatic	LC	RDB
Brook trout	*Salmo fario*	Aquatic	-	RDB
Sea trout	*Salmo trutta caspius*	Aquatic	-	pRDB
Eastern spadefoot toad	*Pelobates syriacus*	Riparian	LC	RDB
Ladder snake	*Elaphe hohenackeri*	Riparian	LC	pRDB
European pond terrapin	*Emys orbicularis*	Riparian	NT	-
Reed cat	*Felis chaus*	Semi-desert and riparian	LC	pRDB
Wild field cat	*Felis lybica*	Semi-desert and riparian	LC	RDB
Black francolin	*Francolinus francolinus*	Scrub and semi-desert	LC	RDB
Little bustard	*Tetrax tetrax*	Semi-desert (winter)	NT	RDB
Eurasian otter	*Lutra lutra*	Semi-desert	NT	RDB
European marbled polecat	*Vormela peregusna*	Semi-desert	VU	RDB
Spur-thighed tortoise	*Testudo graeca*	Semi-desert	VU	RDB
Eastern barbastelle bat	*Barbastella leucomelas*	Trees, buildings, semi-desert	LC	pRDB

Ground-nesting birds

Ground-nesting birds in desert and semi-desert habitats are particularly vulnerable to disturbance associated with pipeline construction. The actual abundance of these species, and therefore the risk of disturbance, is likely to be low as they naturally occur at low densities in this kind of habitat. Although *Tetrax tetrax* (little bustard) is vulnerable to disturbance during breeding, Azerbaijan is most notable for wintering populations of this species (Gauger, 2007). It is mostly associated with large areas of semi-desert under winter pasture and avoids areas of intensive agricultural production. The main breeding period for ground-nesting bird species likely to occur on the route (i.e. when they are most vulnerable to disturbance) is between late March and early June. As a group, the ground-nesting birds occurring on the route are considered of low ecological importance and their populations are of low sensitivity (although individually, nesting birds are of high sensitivity during the breeding season). The only ground-nesting bird species listed in Table 7-53 is *Francolinus francolinus* (black francolin). Globally this species has a large range and its population appears to be stable[8]. In the context of the route, it is considered to be of medium importance and high sensitivity during the breeding season (which is between late March and early June).

Vanellus gregarius (sociable lapwing; IUCN CR) is a ground-nesting bird that breeds in northern Kazakhstan and south-Central Russia. It was recorded from the pipeline route in the 2002 BTC baseline, at KP83.5. As a migratory species that does not breed in Azerbaijan, it is not vulnerable to potential impacts from the pipeline (hence it was not included in Table 7-53). It is considered of medium ecological importance and sensitivity.

Reptiles and amphibians

The reptile and amphibian species of importance that are known or are likely to occur on the proposed route are found in association with water, i.e. irrigation ditches, canals and rivers and the adjacent riparian habitats, with the exception of *Testudo graeca* (spur-thighed tortoise; VU, RDB. The relative sensitivity of the species varies according to their differing life cycles and biology, although their shared habitat preferences mean they are vulnerable to similar factors. In particular, individual reptiles and amphibians are vulnerable to killing or injury during construction, particularly during winter when they are in hibernation and less able to move away from disturbance, and in the spring while moving from terrestrial habitat to breeding sites. However, because these species are widespread along the route, their populations are unlikely to be sensitive to short term, small, temporary impacts such as might be experienced during construction. Following reinstatement, the reduced vegetation cover on the ROW may make individual animals more vulnerable to predation, particularly if the route intersects with a regular migration route between terrestrial habitat and breeding sites.

Bufo bufo (common toad; LC, RDB) breeds in still or slow-moving freshwater in spring and summer, and young toadlets emerge from the water in autumn. Adults and juveniles generally hibernate on land in winter, beneath dense vegetation, under rocks or in holes. They can be found some distance from water, as they are relatively tolerant to dry conditions. Although this species is listed on the national RDB (which suggests it should be classed as high importance), it is not uncommon along the pipeline route and the populations that occur at watercourse crossings are very unlikely to be significantly affected by the proposed pipeline construction. It is therefore considered of medium importance and sensitivity.

Elaphe hohenackeri (ladder snake; LC, pRDB) prefers scrub and tall riparian habitat but is less common away from wetland habitats. This species is considered of medium importance and sensitivity.

Emys orbicularis (European pond turtle; NT) is found in or near slow-moving and stagnant waters. It was recorded in a range of watercourses, from concrete irrigation channels to large rivers, and was sometimes seen in large numbers basking on the banks. It lays eggs in a nest in the ground or in vegetation, and may return to the same nest site year after year. The species is considered of medium importance and sensitivity.

[8] BirdLife International (2012) Species factsheet: *Francolinus francolinus*. Downloaded from http://www.birdlife.org on 15/05/2012.

Testudo graeca (spur-thighed tortoise; VU, RDB) inhabits dry open areas and can be found in most habitats crossed by the proposed route, except for cultivated agricultural land where it is likely to be found only occasionally. Mating begins shortly after the animals emerge from hibernation, and females may lay several clutches of eggs in a year from spring to summer. Individual animals are vulnerable to vehicles and machinery, both during the active season (as they move very slowly) and in winter when they may be found hibernating beneath dense vegetation such as at the bases of trees and shrubs. Egg clutches would also be vulnerable to ground clearance works. Overall, the species is widespread in the region crossed by the proposed pipeline and therefore population levels are unlikely to be at risk from construction. It is therefore considered of medium importance and sensitivity.

Mammals

Arvicola amphibius (water vole; LC) inhabits riverbanks, with a preference for semi-natural watercourses with dense vegetation for foraging and to provide cover while they move along the banks. It lives in burrows in riverbanks, so needs steep banks into which it can burrow and which will not flood. It feeds on water-margin vegetation such as reeds and grasses. Water voles breed in spring and summer and have just one litter of pups. They are active throughout the year, but are much less active in winter. They need more or less continuous water-margin vegetation for commuting and providing cover, and are therefore vulnerable to habitat fragmentation. They would also be vulnerable to habitat loss or mortality if their burrows were destroyed by construction. They are therefore considered of high importance and sensitivity.

Lutra lutra (Eurasian otter; NT, RDB) inhabits rivers and adjacent vegetation. Otters feed largely on fish and other aquatic animals. They breed in holts, typically in overhanging tree roots or fallen dead wood, and prefer watercourses with dense riparian vegetation. Otters were common in Azerbaijan up to at least the 1980s, although there is no up-to-date data on their populations[9]. Owing to their dependence on aquatic food, particularly fish, they are vulnerable to water pollution and to habitat loss if their holts are destroyed or if there is a loss or fragmentation of riparian habitat. They are therefore considered of high importance and sensitivity.

Vormela peregusna (European marbled polecat; VU, RDB) is a terrestrial carnivore found in desert and semi-desert habitats. It is most active in the mornings and evenings, and it rests and breeds in underground burrows. This species is naturally rare throughout its range and is unlikely to be present in large numbers in Azerbaijan. Individual animals would be vulnerable to mortality from vehicles and construction activities if they were present. If they are only present in low numbers then local populations could be at risk if small numbers of animals were affected. Overall, it is considered of high importance and sensitivity.

Barbastella leucomelas (eastern barbastelle bat; LC, pRDB) is a widespread insectivorous bat species that roosts in caves, tunnels, buildings and trees. Several bat species could be encountered along the proposed pipeline route. The semi-desert habitats provide good foraging habitat and the watercourses provide good foraging and commuting habitat. There are very few buildings or trees on the proposed route.

7.7.10.5 Pigging station, block valve stations, temporary construction camp and pipe storage areas

The proposed temporay construction camps and pipe storage areas are all located in habitats considered of low ecological value. Most of them are located in cultivated agricultural land or on previously disturbed ground that are of low ecological value and could be reinstated to a better ecological condition following completion of works. Based on photographs and current knowledge of habitats along the proposed pipeline route, the proposed temporary pipe storage area at Kurdemir has been identified as being located in lowland meadow habitat. This vegetation type is considered of low ecological value and

[9] The Eurasian Otter in the South Caucasus, Gorgadze, G., 2004 IUCN Otter Spec. Group Bull. 21(1): 19–23.

medium sensitivity to disturbance. Mugan Camp Option 3 is located in relatively undisturbed Ephemeretum desert, although this facility is no longer being considered as part of the project. Parts of Kurdemir Camp Option 4 and Goranboy Camp Option 3 areas consist of desert habitats that are widespread and of low ecological value but medium sensitivity to disturbance. However, Kurdemir Camp Option 4 is no longer being considered as part of the project. Ujar Camp Option 5 area partly consists of Tamarixetum scrub, which is common but slow to recover when disturbed. Several of the Alternative 1 and Alternative 2 camp and pipe storage areas are also near to watercourses that may be used by reptiles and amphibians as well as nesting birds; many of these sites are no longer being considered by the project.

The proposed new pigging station at KP0 is located in semi-natural desert (Artemisetum salsolosum-nodulosae), a habitat that is considered of low ecological value but high sensitivity to disturbance. Three of the five new block valves (BVR A8-A10) are located in agricultural land of low ecological value and sensitivity. The proposed BVR A6 (KP21) is located in Artemisetum salsola-dendroides clayey desert, a habitat of low ecological value and high sensitivity to disturbance. The proposed new BVR A7 (KP95) is located in lowland meadow, a habitat of low value and medium sensitivity to disturbance.

7.7.10.6 Protected areas

The SCPX route does not cross any areas that are protected for nature conservation. One protected area, the Barda State Nature Sanctuary (SNS), is approximately 4km downstream of the Kura East River crossing, so it could theoretically be vulnerable to impacts such as sediment release or accidental spills into the river. However, Barda SNS is designated because it is an area of tugay forest supporting birds and mammals (in particular Pheasants, Black Francolin and Hares), which although a very rare habitat type is not vulnerable to the likely impacts of pipeline construction. The SCPX route does not affect any tugay forest either within or outside of the protected area. Any short-term spills or releases into the river would be very unlikely to have even a negligible effect on the tugay forest, except in the unlikely event that a major release occurred during a flood, when water from the river could flood onto the land occupied by the tugay forest. It is not known whether such floods occur in the Barda SNS. The animals in the Barda SNS are unlikely to be sensitive to direct effects from the pipline construction, as the reserve is 4km away and at this distance any noise, light or dust (typically the most important indirect effects on animals) are unlikely to be significant. At the Kura East crossing it passes through agricultural land which, given the distance and isolation from the Barda SNS, is unlikely to support large numbers of nesting Francolins or Pheasants but could be used by individuals or small numbers of birds. The temporary effects of pipeline construction are highly unlikely to affect the population of the species for which the reserve is designated.

The route passes within 2.2km of the Korchay SNR, which is designated for the conservation of Goitered Gazelle (*Gazella subgutturosa*). There is no up to date information available on the population of this species in the reserve, and whether they are resident here or whether they migrate to and from the reserve annually. The route does not cross any habitats that are likely to be of critical importance to this species, being mostly located in arable land. It would be possible that, in the absence of mitigation, the construction phase could present a temporary barrier to movement of this species. However, this effect will be temporary and the mitigation measures described later in Chapter 10 should ensure there is no significant effect on this species.

The route passes within 1.3km of the Shamkir SNS, which is designated for the conservation of Black Francolin, Pheasants, Partridge and Waterfowl. As with the Barda SNS, the pipeline route is unlikely to support large numbers of these species, and therefore the temporary effects of pipeline construction are highly unlikely to affect the population of the species for which the reserve is designated.

The route also passes very close to the Garayazi-Agstafa protected area (IUCN Management Category IV and State Nature Sanctuary, which is contiguous with the

Garayazi protected area (IUCN Management Category Ia and State Nature Reserve), which is upstream of the SCPX crossing point on the Kura West River. This protected area is also designated for its Tugay forest. However, as noted above, the SCPX route does not cross any Tugay forest, and it is extremely unlikely that any spills or releases into the river would affect the SNS, which is upstream of the crossing point. West of the crossing point, the riparian and floodplain habitats form a fairly wide corridor of semi-natural habitats up to 2.5km wide. This narrows up to and beyond (eastwards from) the crossing point. The crossing point does not pass through any semi-natural habitats, so it is unlikely to be important for the animal species that use the SNS. It crosses through land already cleared for the BTC crossing point and therefore will not have an additional effect on habitat connectivity. Biorestoration of this section will mitigate effects on habitat connectivity along the river corridor.

To conclude therefore, only temporary and minor effects are anticipated on small numbers of individuals (i.e. not a significant effect) either due to indirect effects on the protected area (from noise, light or dust) or direct effects on species crossing the pipeline route during movements into or out of the protected area.

7.8 Climate and Air Quality

7.8.1 Introduction

This section describes the climatic environment and air quality along the proposed SCPX route through Azerbaijan and includes information on thermal conditions, humidity, precipitation, wind speed, air quality including dust and climate change.

7.8.2 Methodology

7.8.2.1 Data sources

As the proposed SCPX route follows the existing WREP, BTC and SCP pipelines for much of its length, existing baseline information on climate and air quality for the WREP and BTC/SCP projects has been used to compile this review.

The baseline information in the EIA for the WREP (1996) and the ESIAs for BTC and SCP (2002) was based on a desktop study and literature review prepared by Professor Eyubov, Head of the Climatology Department at the Institute of Geography (Eyubov, 1996). Much of the information here is based on this study, including long-term data from seven meteorological stations near the proposed pipeline route (at Hajigabul, Kurdemir, Yevlakh, Ganja, Shamkir, Gazakh and Agstafa). Other publications by him are also referred to, including one on bioclimate resources (Eyubov, 1993b) and the detailed maps contained within the Agroclimate Atlas of Azerbaijan (Eyubov, 1993a).

In addition to the above, further information has been made available by BP, and through online searches, as detailed below:

- Analyses of Azerbaijan Strategic Performance Unit (AzSPU) air emission performance in comparison with Oil and Gas Producers (OGP) 2006–2009 report, 2011
- Norwegian Meteorological Institute, Transboundary air pollution by main pollutants (Sulphur, Nitrogen, Ozone and Particulate Matter), Azerbaijan, July 2011
- BP in Azerbaijan Sustainability Report, 2010
- Initial National Communication of Azerbaijan Republic on Climate Change, Phase 2, Capacity Improvement Activities on Climate Change in the Priority Sectors of Economy of Azerbaijan, 2001
- Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007 – The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC, 2007

- Climate-charts, Climate, Global Warming and Daylight Charts and Data, Azerbaijan, http://www.climate-charts.com/Locations/a/AJ37735.php, accessed April 2012
- BTC Project Lender Group, Report of the Post-Financial Close IEC – BTC Pipeline Project Twelfth Site Visit, July 2010
- SCPX Georgia, Environmental and Social Baseline Report, unpublished, May 2012
- Azerbaijan Export Pipelines Asset, Emissions Monitoring Database, March 2012
- World Meteorological Office (WMO) Statement on the Status of the Global Climate in 2011, 2012
- The World Bank Climate Change Knowledge Portal, Average Monthly Rainfall and Temperature for Azerbaijan, http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisRegion=Asia&ThisCcode=AZE#, accessed May 2012.

7.8.2.2 Assessment of importance and sensitivity of climate and air quality

An assessment has been made of the importance of climate and air quality along the proposed pipeline route and the potential sensitivity to change. As a result, the importance and sensitivity of climate and air quality has been classified into categories that range from very low to very high. Information on this process is given in Chapter 3 and the assessment table, defining the categories used, is also included in Appendix B of the ESBR.

7.8.2.3 Technical difficulties or uncertainties

Information drawn from several sources has been used to produce this section, a number of which may not have been independently verified or peer reviewed (e.g. websites).

Much of the desktop information used was produced approximately 20 years ago for the WREP EIA. To assess how closely the data used here reflects current conditions, a desktop search was conducted for comparable data from the same weather station regions used. Comparison data was obtained for Ganja for 2011 from Climate-charts.com (see Section 7.8.2.1) and allowed for a comparison of temperature and precipitation.

For both temperature and precipitation, the Ganja-based data used here were found to be consistent with the 2011 data. The 2011 data found the mean annual temperature to be 0.23°C lower, and the mean annual precipitation to be 50mm higher. These differences indicate that baseline conditions, for these parameters, have not changed considerably. However, this was a limited comparison of only a small percentage of the data and caution should be exercised regarding any possible discrepancies that may exist owing to the age of the data used here.

7.8.3 Temperature

7.8.3.1 Sunshine and solar radiation

The number of sunshine hours experienced along the proposed route is high by global standards. Most regions receive approximately 2200 hours of sunshine per annum (Eyubov, 1993), decreasing to around 2100 hours for Kurdemir in the Shirvan Plain and rising to 2320 hours in Ganja. Around 60% of this total occurs between June and August when up to eleven hours of sunshine per day can be expected, declining to an average of only three hours per day in winter.

Mean annual solar radiation fluxes alter little along the proposed pipeline route. They vary between 128 and 132kcal cm^{-2} at the eastern end, and decline to a little less than 124kcal cm^{-2} at the slightly cloudier western end, a region with one of the lowest annual solar radiation levels in Azerbaijan. In the winter period, between October and March, the whole route receives a solar radiation flux of only 36 to 40kcal cm^{-2}.

7.8.3.2 Air temperature

The large inputs of solar energy noted above, combined with limited thermal moderation by cooling vegetation (especially around the eastern semi-desert part of the route), means that air and soil temperatures are high, particularly in the peak of summer. Mean annual air temperature increases steadily eastwards from approximately 12°C at the Georgian border to 13.2°C at Ganja and 14.3°C at Kurdemir.

Seasonal changes can be identified from the monthly averages given in Table 7-54. The coldest month is usually January and the warmest are July and August. The hottest parts of the proposed pipeline route in July are normally in the centre of the Republic, around Kurdemir and Yevlakh (both 27.3°C). These locations are far enough inland to be isolated from the moderating effects of the Caspian, yet not at a sufficiently high elevation to be affected by altitudinal cooling (see Table 7-54).

As regards temperature extremes, mean monthly minimum air temperature in January varies from -2.1°C at Kurdemir to -4.0°C at Gazakh. The lowest temperatures ever recorded at these two meteorological sites, however, are -24°C and -25°C respectively. Mean monthly maximum air temperature in July varies from 30.3 at Gazakh to 34.6°C at Kurdemir. The highest air temperatures ever recorded at Gazakh and Kurdemir are 39°C and 43°C respectively.

Table 7-54: Air Temperature Statistics for Meteorological Stations along the Proposed Pipeline Route (°C) (Eyubov, 1996)

Station	Mean	Average Max	Average Min	Absolute Max	Absolute Min	Mean	Average Max	Average Min	Absolute Max	Absolute Min
	January					April				
Kurdemir	1.4	6.2	-2.1	20	-24	12.6	19.2	7.1	34	-2
Yevlakh	1.7	6.9	-2.2	20	-18	13.5	20.2	7.4	35	-3
Ganja	1.1	5.5	-2.4	19	-18	12.0	18.2	6.7	33	-4
Gazakh	0.0	5.0	-4.0	18	-25	11.1	17.5	5.7	31	-5
	July					October				
Kurdemir	27.3	34.6	20.6	43	14	15.9	22.3	11.2	35	-4
Yevlakh	27.3	34.0	20.4	42	11	15.6	21.9	10.2	36	-5
Ganja	25.4	31.8	19.0	40	10	14.3	19.9	9.6	34	-5
Gazakh	24.0	30.3	17.9	39	7	13.2	19.0	8.1	33	-6

7.8.3.3 Soil temperature

Long term data analysis of temperatures conducted by Gerayzade et al, (2010) over three different regions of Azerbaijan: dry, average and damp subtropical zone observed both an increase and reduction of soil-atmosphere system temperatures, and noted as a whole the increase of temperature of investigated soil-climatic zones particularly for the period from 1990 to 2008.

The mean annual soil surface temperature map for central Azerbaijan is presented in Figure 7-32. Mean daily soil surface temperatures are around 2–3°C higher than air temperatures. This is due to the following factors:

- Very strong heating of the soil surface as a result of incident solar radiation (especially in summer)
- The lack of a shading/transpiring vegetation cover
- A limited soil moisture supply that could be evaporated and therefore cause cooling.

Mean annual soil surface temperatures are relatively constant along the proposed pipeline route, varying between 16°C and 18°C. The highest temperatures, above 18°C, are reached in the Shirvan Plain and towards the east of the route (see Figure 7-32). In summer, soil surface temperatures can be extreme, and maxima have exceeded 70°C at Agstafa in the west and at Sabirabad in the Shirvan Plain. Mean July temperatures along the whole route vary between 30°C and 35°C. In January, mean soil surface temperatures along the entirety of the proposed pipeline route lie between 0°C and 3°C.

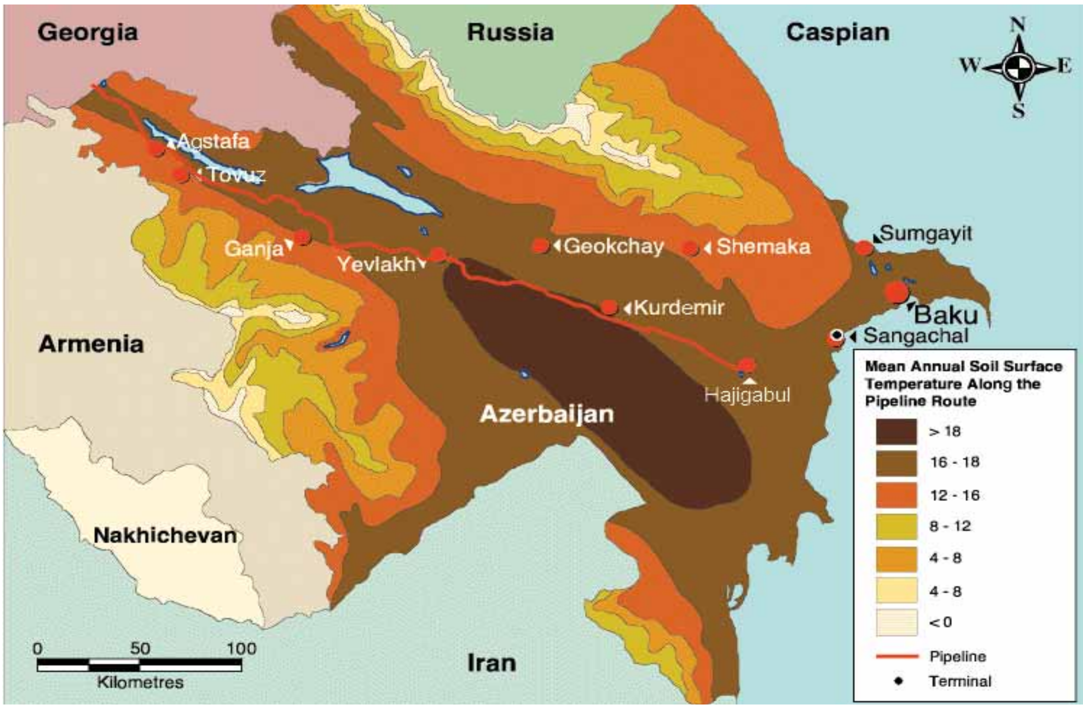


Figure 7-32: Mean Annual Soil Surface Temperature along the Proposed Pipeline (Source: Agroclimatic Atlas of Azerbaijan, 1993)

7.8.4 Atmospheric Moisture

7.8.4.1 Evapotranspiration

Potential evapotranspiration (PE) is the maximum amount of evaporation and transpiration that can take place if an unlimited moisture supply is available. PE rates, at more than 800mm in eastern Azerbaijan and 600mm in the west in the April to October period, are very high owing to a combination of large solar radiation receipts, long hours of sunshine, high air temperatures, high wind speeds and low atmospheric humidity.

PE losses therefore exceed precipitation inputs by a significant margin, which is largely responsible (along with soil salinity and overgrazing problems) for the sparse vegetation cover in the eastern part of the route. Irrigation systems are used extensively in the central parts of the proposed route to replenish soil moisture.

7.8.4.2 Humidity

Mean annual absolute humidity increases from around 11gcm^{-3} in the west to around 13gcm^{-3} in the east. Strong seasonality exists, however, and in the Shirvan Plain lowlands, values range from 4.0 to 7.2gcm^{-3} in January to 14.3 to 22.2gcm^{-3} in August. Mean annual relative humidity displays little spatial variability, increasing from 67% at Shamkir to 72% at Kurdemir. Summers are hot and dry, and peak relative humidities are achieved in winter. The highest average humidity recorded is 87% in Kurdemir during the winter, a value that declines to 72% in July.

7.8.5 Precipitation

7.8.5.1 Annual and seasonal precipitation

Rainfall is the most strongly varying climatic parameter in the proposed route (see Figure 7-33). An analysis of recent rainfall data for Azerbaijan was undertaken using information available on the World Bank Climate Change Knowledge Portal (2012). This provided data for different weather stations within Azerbaijan, although it should be noted that details were not available regarding the specific location of the stations. The mean annual rainfall data for the period 1990 to 2009 for four different stations was reviewed. The following settlements were within the 'catchment area' of the individual stations (see Figure A7-1 Appendix A for locations):

- Hajigabul
- Ujar
- Ganja
- Agstafa.

The station closest to Ganja recorded the highest mean annual rainfall, at 39.64mm, while the lowest was recorded at Hajigabul, at 25.1. Hajigabul is at the most eastern end of the pipeline route and the arid desert plain in the east of the pipeline route is one of the driest areas in Azerbaijan. Variability from year to year is high, as is common with semi-arid and arid environments, and Kurdemir has received as much as 551mm in one year (1963) and as little as 195mm in another (1947) (see Table 7-55). Similarly, annual totals at Agstafa have ranged from 567 to 253mm (as shown in Table 7-54). It should be stressed, however, that it is the much greater precipitation (and snowmelt processes) in the vicinity of stations like Sheki in the Caucasus ranges (greater than 1000mm in many areas) that controls the magnitude and seasonal variation of flows in the rivers crossed by the proposed pipeline route, rather than rainfall over the proposed pipeline route itself (see Figure 7-33).

Table 7-55: Precipitation Statistics for Meteorological Stations along the Proposed (mm) (Year Given in Brackets)

Station	January			April		
	Mean	Ave. Max.	Ave. Min.	Mean	Ave. Max.	Ave. Min.
Kurdemir	22	68 (1937)	1 (1912)	32	88 (1923)	2 (1950)
Ganja	10	34 (1893)	0 (6 yrs)	27	64 (1895)	0 (1950)
Agstafa	13	43 (1957)	0 (6 yrs)	38	92 (1912)	0 (1943)
Kurdemir	17	121 (1926)	0 (9 yrs)	33	134 (1951)	0 (1954)
Ganja	23	92 (1922)	0 (2 yrs)	22	95 (1951)	0 (1952)
Agstafa	32	139 (1906)	0 (4 yrs)	30	120 (1951)	2 (1932)
Station	Total for Year					
	Mean	Ave. Max.	Ave. Min.			
Kurdemir	325	551 (1963)	195 (1947)			
Ganja	248	397 (1948)	150 (1932)			
Agstafa	359	567 (1915)	253 (1925)			

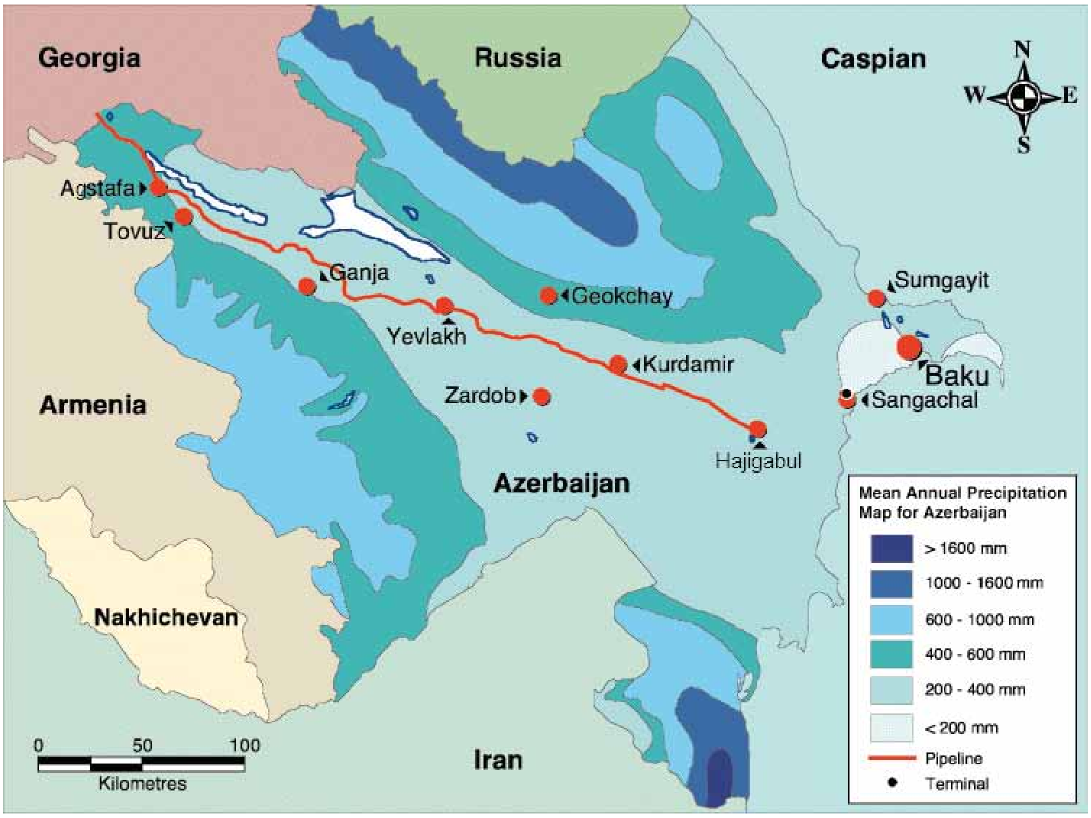


Figure 7-33: Mean Annual Precipitation Map for Azerbaijan (Source: Agroclimatic Atlas of Azerbaijan, 1993)

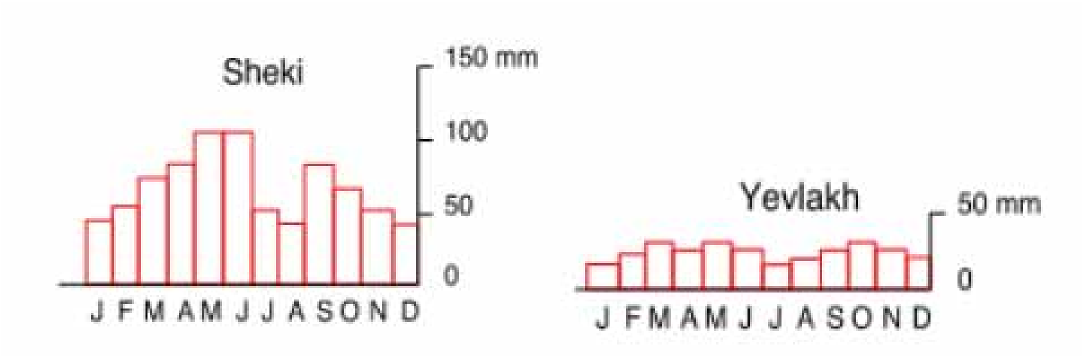


Figure 7-34: Monthly Precipitation Distribution for Yevlakh and Sheki

Seasonal distribution of precipitation is not especially pronounced in the region, although there are subtle differences along the proposed pipeline route (see Table 7-55). Most of the precipitation falls between September and April. Figure 7-34 demonstrates that two seasonal peaks are evident, one in the March to May period, and a second in autumn/winter. The driest month is July throughout the proposed pipeline route, when the average rainfall is just 32mm in Agstafa, although year-to-year variability is high. For summer rainfall probabilities (June–August), there is a clear east/west gradient, west of Mingechevir, there is an 80% probability of receiving between 50 and 100mm precipitation, but this figure falls to less than 10mm in the Hajigabul area (Figure 7-35). This relative security of summer rainfall supplies helps to ensure the maintenance of the Garayazi wetland at the western end of the proposed pipeline route.

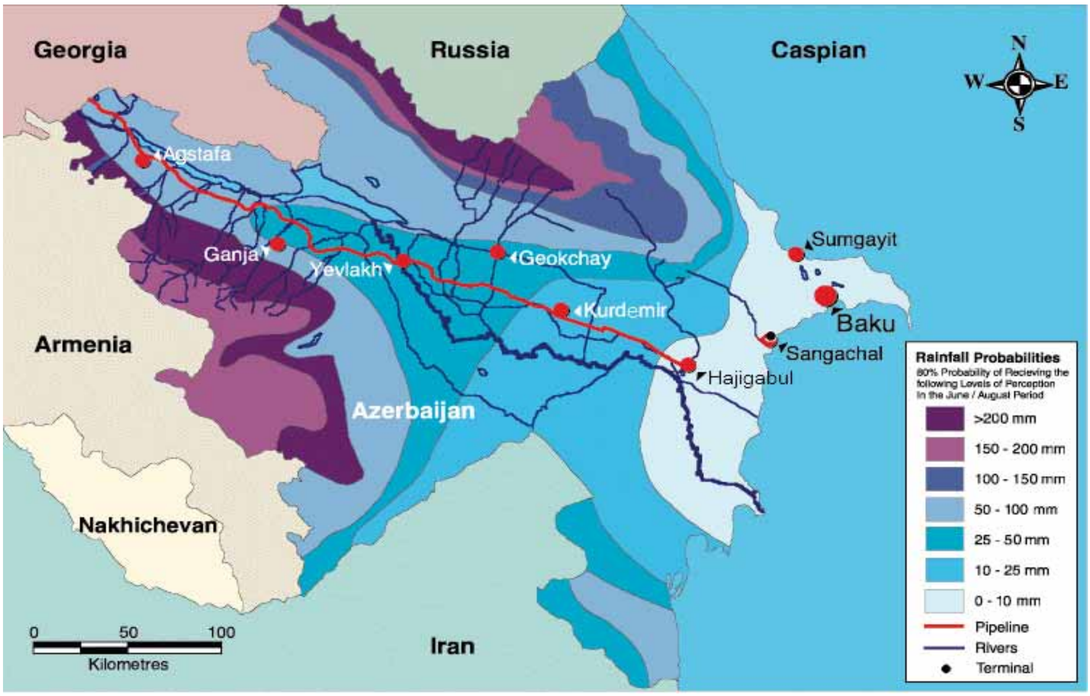


Figure 7-35: Rainfall Probabilities in Azerbaijan Between June-August (Source: Agroclimatic Atlas of Azerbaijan, 1993)

7.8.5.2 Rainfall event magnitudes and frequencies

On average, rain falls on approximately 71 days a year in Kurdemir. The absolute maximum daily precipitation amounts received along the route vary from 77mm in Ganja to 100mm in Hajigabul, 97mm in Kurdemir and 95mm in Agstafa. These extreme events occur mostly in summer, but they can also arrive in winter, especially near the coast.

Precipitation is very often convective or frontal, when high-intensity rainfall results. While the local annual average numbers of daily rainfall events in excess of 30mm are not high, they are probably more common in the mountains where flash floods are generated and transmitted downstream. Despite low annual precipitation receipts, intense rainstorms in such semi-arid environments have occurred, on average, every 2–4 years. Because of the relatively large, steeply sloping and poorly vegetated river basins in the region, these events can lead to significant floods, associated with erosion and substantial sediment loads in the channel networks, which may be dry or at low flow for most of the year. This is especially true at the eastern end of the line (see Section 7.5).

In order to design the Project for future events and change, the Project team analysed daily rainfall for the Caucasus from 10 global climate models and historical change in rainfall using data from ECA, the European Climate Assessment and Dataset program (http://eca.knmi.nl/dailydata) . This is the state of the art data set of high-resolution gridded (25 km) rainfall and temperature in the European area including the Caucasus between 1950 and 2010.

The report noted that all of the climate models project a warming and most projected a decrease in annual mean precipitation. The 100 year daily rainfall was calculated using a Gumbel extreme value distribution for two periods: 1980-2000 and 2040-2060. There is projected to be an overall average drying in the region with the largest decline in mean rainfall of over -10% near the Black Sea Coast. Despite the decline in average precipitation the extreme rainfall is projected to increase.

As a result of the work undertaken, the daily extreme rainfall design criteria for the proposed Project was increased by +10%.

7.8.5.3 Snowfall and snowmelt

Precipitation occurs almost entirely as rain with only six days of snow per annum on average recorded at Kurdemir, increasing to 15–18 near the Georgian border. In Agstafa, for example, there is an 8% chance each winter of snow depth of between 60 and 200mm. However, heavy snow accumulations do occur in the Greater and Lesser Caucasus mountains every winter, which significantly affect the rivers crossed by the proposed pipeline route. The snows melt under strong, thermally driven ablation conditions each spring, and snowmelt can be augmented by rainstorms. Considerable quantities of meltwater can generate significant flooding downstream in the proposed pipeline route in spring (see Section 7.5).

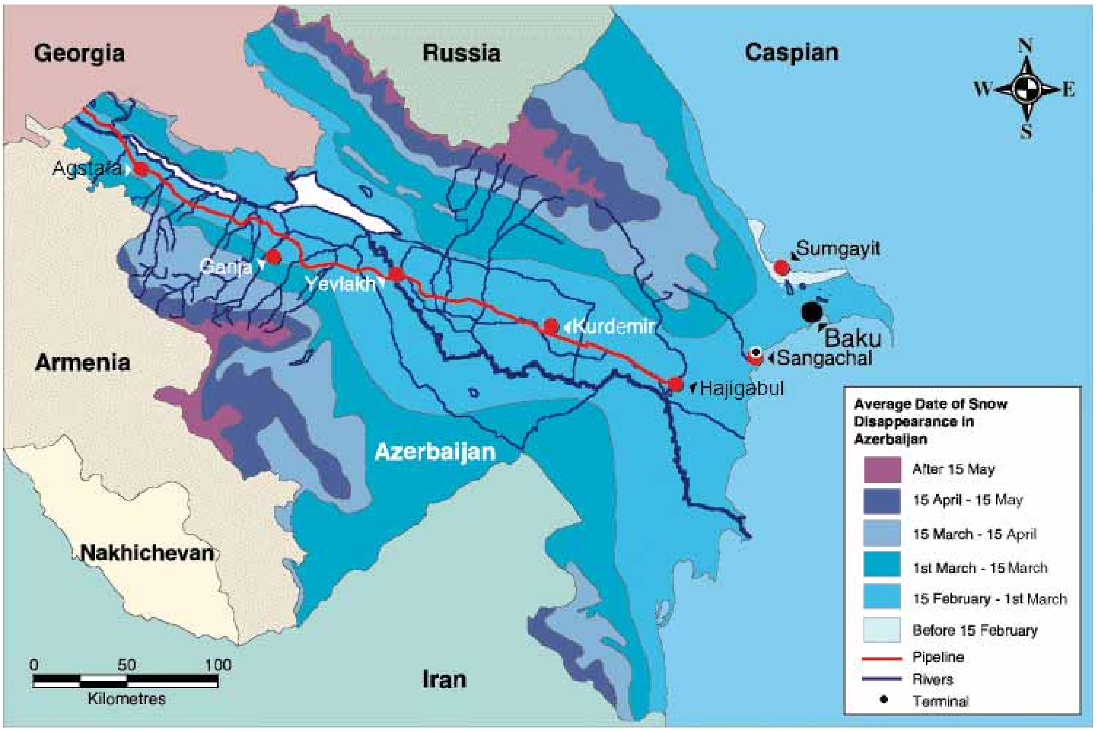


Figure 7-36: Average Date of Snow Disappearance along the Proposed Pipeline (Source: Agroclimatic Atlas of Azerbaijan, 1993)

Figure 7-36 shows that snow has generally melted along the proposed pipeline route by the end of March. However, the isochrone map shows that snow usually persists in the mountain river source areas until the end of May/early June, and a risk of flooding downstream at proposed pipeline river crossings usually remains until late June (see Section 7.5).

7.8.6 Wind Speed and Direction

Mean annual wind speeds are relatively low near the eastern end of the proposed pipeline and rise as the route passes through higher ground towards the western end of the route (see Figure 7-37).

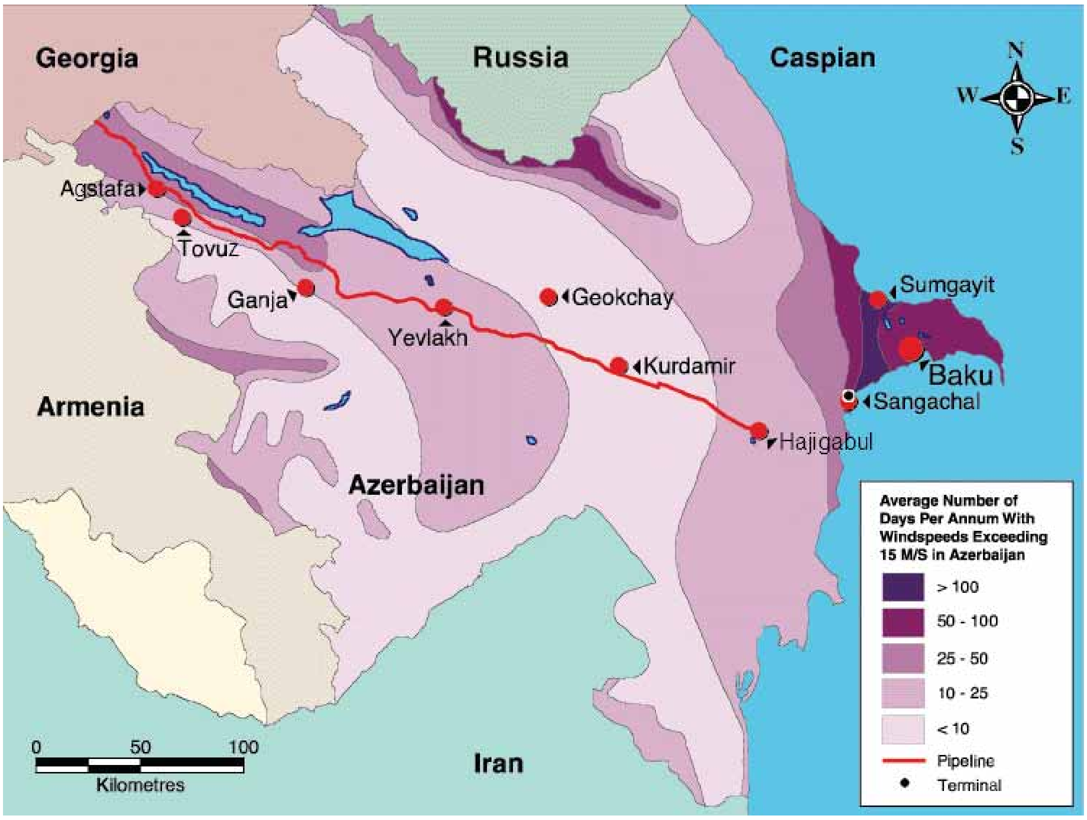


Figure 7-37: Average Number of Days Per Annum when Wind Speeds Exceed 15m/s^{-1} in Azerbaijan (Source: Agroclimatic Atlas of Azerbaijan, 1993)

Data for wind speed and direction at PSA2 (see Figure 7-38), which is located close to Yevlakh, for July and August 2010, was made available. The annual average wind speed was recorded as 1.78m/s (see Figure 7-38), with the winds mostly come from the quadrant east through north, and the predominant wind direction is easterly.

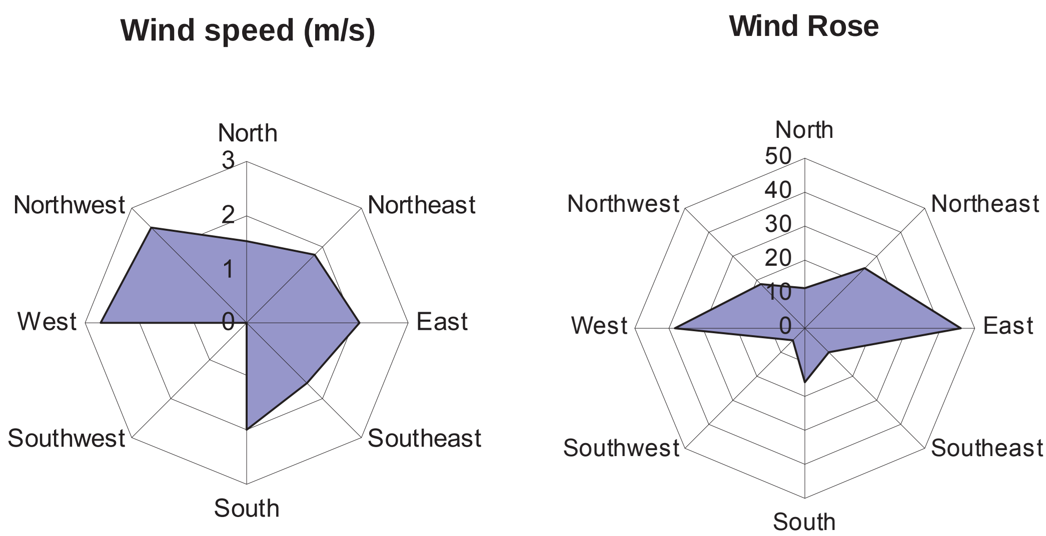


Figure 7-38: Average Wind Speed and Wind Rose for PSA2 for July and August 2010

CSG1 is a site located within Georgia upon which a new compressor station is due to be constructed as part of the SCPX Project and is approximately 3km from where the pipeline route traverses the Azerbaijan border. In this location the winds mostly come from the quadrant west through north, and the predominant wind direction is north-westerly. The average wind speed is slightly higher than the recordings at PSA2.

7.8.7 *Air Quality*

7.8.7.1 Existing air quality information

Azerbaijan

The Norwegian Meteorological Institute (2011) reviewed emissions of NO_x, SO_x, NH_3, CO, ground level ozone and particulate matter (PM) in Azerbaijan for 2000–2009, see Table 7-56. This data was in turn derived from data submitted to the United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution (UNECE CLRTAP) in May 2011.

Table 7-56: Emissions from Azerbaijan (in Gigagrams)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SO_x	162	154	146	138	130	129	105	99	91	85
NO_x	104	91	100	80	118	97	81	80	91	91
NH_3	37	36	35	41	48	48	50	53	53	53
CO	306	419	422	361	463	361	401	447	496	530
$PM_{2.5}$	6	6	5	5	5	5	4	4	4	4
PM_{10}	7	6	6	6	5	5	5	4	4	4

Source: Norwegian Meteorological Institute (2011)

The data above indicates that, within Azerbaijan as a whole, there has been an overall decrease in SOx, $PM_{2.5}$ and PM_{10} emissions and an increase in NH_3 and CO emissions over the past decade, while NO_x emissions have remained relatively constant. While this data is not specific to the proposed pipeline route, it is able to provide an indication of emission levels and likely trends.

Pump Station Azerbaijan (PSA) 2

A programme of ambient air quality monitoring is carried out by BP Operations at the existing PSA2 Facility (see Figure A7-1, Appendix A): Nitrogen dioxide, sulphur dioxide and benzene are measured approximately quarterly using diffusion tubes at locations around the existing pipeline plant.

Table 7-57, Table 7-58 and Table 7-59 summarise the mean concentrations of nitrogen dioxide, sulphur dioxide and benzene, respectively, at eight monitoring locations from 2005 to 2011.

The measured NO_2 concentrations are all below the EU and WHO annual mean standard, are consistent with semi-rural background concentrations and likely to be representative of conditions along most of the pipeline route, which passes through rural areas.

The measured SO_2 concentrations are in the main below the EU and WHO annual mean standards. Elevated SO_2 results of 31 and 37µg/m^3 were reported at locations AQ1 and AQ4 respectively in 2008. However, this is based upon single measurements and is likely to reflect atypical conditions or may be erroneous.

The measured benzene concentrations are all below the EU and WHO annual mean standard.

Table 7-57: Mean Concentrations of Nitrogen Dioxide at Eight Monitoring Points Close to PSA2, 2005–2011

	Mean NO_2 (u/m^3)							Mean 2005–2011
BP Point ID	2005	2006	2007	2008	2009	2010	2011	
AQ1	1.5	19	7.95	9	-	-	-	9.36
AQ2	0.8	3	3.3	31	-	-	-	9.53
AQ3	-	20	12.4	21.5	7.33	5.5	5.4	12.02
AQ4	-	17	13	17	-	-	-	15.67
AQ5	-	-	-	5.23	7.33	7.4	5.9	6.47
AQ6	-	-	-	8.15	10.33	7.8	5.7	8.00
AQ7	-	-	-	7.55	8.83	4.5	5.3	6.55
AQ8	-	-	-	0.82	1.54	8.5	7.8	4.67

Table 7-58: Mean Concentrations of Sulphur Dioxide at Eight Monitoring Points Close to PSA2, 2005–2011

	Mean SO_2 (u/m^3)							Mean 2005–2011
BP Point ID	2005	2006	2007	2008	2009	2010	2011	
AQ1	$<$0.8	3	6.6	31	-	-	-	10.15
AQ2	$<$0.8	1.1	3.10	-	-	-	-	1.40
AQ3	-	7.3	28.5	8.58	3	5.7	15.8	11.48
AQ4	-	1.9	12.5	37	-	-	-	17.13
AQ5	-	-	-	2.85	4.67	37.4	10.3	13.81
AQ6	-	-	-	1.1	4.33	7	7.7	5.03
AQ7	-	-	-	2.56	10.5	32.5	9.3	13.72
AQ8	-	-	-	19.69	4.3	6.3	13.8	11.02

Table 7-59: Mean Concentrations of Benzene at Eight Monitoring Points Close to PSA2, 2005–2011

	Mean Benzene (u/m3)							Mean 2005–2011
BP Point ID	2005	2006	2007	2008	2009	2010	2011	
AQ1	0.78	0.94	1.26	1.3	-	-	-	1.07
AQ2	0.79	1.2	1.3	1.3	-	-	-	1.15
AQ3	-	1.1	1.32	0.89	2	1.7	-	1.40
AQ4	-	-	1.31	1.2	-	-	-	1.26
AQ5	-	-	-	2.87	1.92	1.62	-	2.14
AQ6	-	-	-	0.81	1.75	1.7	-	1.42
AQ7	-	-	-	0.67	1.93	1.34	-	1.31
AQ8	-	-	-	0.61	1.54	1.55	-	1.23

7.8.7.2 Air quality sensitivity

The areas relevant to the Project are predominantly rural or semi-rural in nature, and air quality in these areas of Azerbaijan is generally likely to be good.

Small communities are sited within proximity along the length of the proposed pipeline route. Existing ambient air quality may be affected by domestic emissions of volatile organic compounds (VOC) from kerosene-fuelled domestic heating and lighting, and oxides of nitrogen, carbon monoxide, sulphur dioxide and particulate matter from domestic and agricultural activities such as burning of materials as waste or for fuel and operation of plant.

7.8.8 Dust

Dust is predominantly generated in arid and dry regions, where high velocity winds are able to remove mostly silt-sized material, eroding susceptible surfaces. Throughout Azerbaijan the particle size of the soils is predominantly very small, primarily fine silts and clays (see Section 7.3) that will be more susceptible to being disturbed.

The Gobustan region in the east of Azerbaijan is prone to much higher wind speeds than at the western end, resulting in a high concentration of dust storms. However, where the proposed pipeline route starts, close to Hajigabul, average wind speeds are significantly reduced and dust storms are both less frequent and intense, which is the case throughout the proposed route.

7.8.9 Climate Change

Climate change can be defined as a significant and lasting statistical change in weather over an extended period of time, which in turn may influence regional wind, temperature and precipitation patterns. Change may be caused by natural factors (e.g. oceanic processes, solar radiation intensity, plate tectonics and volcanic eruptions), and/or anthropogenic factors (e.g. industrial emissions and changes in land use).

Research published by the Intergovernmental Panel on Climate Change (2007) indicates that observed change in climate is most likely a result of increased emission of human associated greenhouse gases (GHGs). Within Azerbaijan, GHG emissions are primarily attributable to the industrial/manufacturing, utility, transportation, residential and agricultural sectors (Initial National Communication of Azerbaijan Republic on Climate Change, 2001).

With regards to observed changes in weather patterns within Azerbaijan, Hadiyev (1996) indicated that over the last 100 years, at selected sites in Trans-Caucasia, mean air temperatures have risen significantly. In 2011 maximum air temperatures recorded within several stations throughout Azerbaijan were higher than all previous years (WMO, 2012), which remains consistent with Hadiyev’s observations.

Hadiyev (1996) also observed that over the last 100 years annual rainfall totals have decreased, except over large cities. However, in a simple analysis of patterns over the 60 years preceding 1996, done specifically for the WREP EIA (WREP Azerbaijan EIA, 1996), it emerged that there has been a significant increase in annual rainfall. The number of annual totals greater than 300mm tripled at both Baku and Ganja over the 28-year period between 1963 and 1990 compared with the previous 28 years.

An analysis of more recent rainfall data for Azerbaijan was undertaken using information available on the World Bank Climate Change Knowledge Portal (2012) (see Section 7.8.5.1). A comparison of data was made between mean annual rainfall for 1960 to 1990 and 1990 to 2009. The data from both the ‘Ujar’ and ‘Ganja’ stations showed that there has been an increase in mean annual rainfall, of 0.7mm and 7.6mm respectively. Data from the ’Hajigabul’ and ‘Agstafa’ stations revealed a reduction in mean annual rainfall of 4mm and 8.9mm respectively.

Gerayzade et al, (2010) discusses increasing temperatures and changes in soil profiles and attributes historic activity over the last few decades in Azerbaijan i.e deforestation in a number of areas of Azerbaijan and also growth of forest parks around cities (Imanov, et al 2002), as some of the contributing factors which appear to have changed the heat and moisture regimes in their vicinities.

Studies in the Aral and Caspian region discuss increasing concerns related to desertification. It cannot be said that desertification is anthropogenic or natural (climate driven). It is a complex field of interactions which includes climatic influences and meteorological conditions. The Project has considered climate change in the design criteria of the proposed SCPX route and this is discussed in Section 7.8.5.2.

H. J. Geist and E. F. Lambin (2004), discussed and analysed the causes and underlying driving forces of desertification, including their interactions and their feedbacks on land use. There are examples of desertification resulting from irrigation schemes in the Aral and

Caspian Sea regions. The recurring main underlying variables are climatic factors, economic factors, institutions, national policies, population growth, and remote influences.
It is these factors that have been seen in Asia, Africa and Australia to drive the expansion of cropland (at the expense of grazing land and natural grassland, thus leading to overstocking) and the expansion of infrastructure. It is discussed further in H. J. Geist and E. F. Lambin (2004), that desertification is most often linked to the development of water-related infrastructure for cropland irrigation and pasture development (reservoirs, dams, canals, boreholes, and pump stations), leading to a decrease in livestock mobility (Niamir-Fuller 1999). The expansion and improvement of irrigation infrastructure is associated with expanding human settlements, following an increase in food production and food security. Other infrastructure components, such as road extension, mining, and quarrying, are far less frequently reported. The extraction of wood (fuel wood, pole wood, charcoal) from forests and woodlands is reported to influence desertification in less than half of the cases. It was found in the review of the Asian cases that the development of water management infrastructure ultimately results in high water losses due to poor maintenance of the infrastructure.

7.8.10 Sensitivities

Key air quality and climate issues in relation to the proposed SCPX route are as follows:

- Under dry conditions, the soil types present along the pipeline route may be prone to generate dust when disturbed and wind speed can be relatively high along certain sections of the pipeline route, particularly in the west
- The proposed SCPX route passes in close proximity to dwellings at the following four locations: Chiyny village (KP104-108), Garaberk village (KP116-120), Alpout village (KP121-125) and Dallyar Dashbulak village (KP287-289), where there will potentially be sensitivity to increased levels of dust generated by the movement of project vehicles along the ROW
- The pipeline route primarily passes through agricultural land used for grazing and production of cereal crops, which will have a low sensitivity to air quality.

7.9 Noise

7.9.1 Introduction

The purpose of this section is to provide a description of the baseline noise environment of the South Caucasus Pipeline expansion (SCPX) route. It is based primarily on a desktop review of existing information, which will allow for a consideration of the potential impacts associated with the Project on different receptors. Additional baseline noise surveys have not been undertaken for the SCPX Project as noise will be limited to the construction phase; the pipeline, block valves (BV) or pigging station will not generate any significant noise during operation.

7.9.2 Methodology

7.9.2.1 Desk-based review

This section was compiled from a review of the following sources of information:

- Noise Baseline (Part 13 of the Baseline Appendices presented in the ESIA report - Baku-Tbilisi-Ceyhan (BTC) Pipeline Azerbaijan) dated May 2002
- Complaints log from BTC/SCP operations in Azerbaijan
- Results of recent noise monitoring of a selection of existing BTC/SCP/WREP facilities conducted by BP in Azerbaijan.

7.9.2.2 *Assessment of importance and sensitivity of noise*

An assessment has been made of the importance of noise along the proposed pipeline route and the potential sensitivity to change. As a result, the importance and sensitivity of noise has been classified into categories that range from very low to very high. Information on this process is given in Chapter 3 and also the assessment table, defining the categories used, is included in Chapter 3.

7.9.2.3 *Technical difficulties or uncertainties*

The original information presented was acquired for the SCP/BTC projects over ten years ago and may therefore have become outdated. However, ongoing noise monitoring conducted by BP gives a good indication of current noise levels around facilities including those that do not generate any significant noise, such as block valve sites, where the results can be regarded as representing ambient noise levels.

7.9.3 Noise Environment and Receptors

A background, pre-construction noise survey was undertaken around BTC Pump Station PSA2, which is close to KP189, in November 2001. The survey was conducted in accordance with British Standard BS 4142: ‘Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas’, 1997. The location is considered typical of rural conditions in the central area of Azerbaijan, comprising a featureless plain with occasional trees and irrigation channels. A medium-sized village (Yardili) is close by and the Karabakh Canal runs to the west.

During the daytime, measured minimum (L_{A90}, 15min[10]) background levels at the monitoring locations ranged between 29 and 39dB(A). The noise environment was dominated by local activity, agricultural machinery and at positions close to roads, by individual traffic movements. Measured night-time background noise levels during the survey period were in the range 22 to 35dB(A). These background noise levels are considered typical of a rural/agricultural area during the night.

BP is currently undertaking a programme of ongoing noise monitoring of BTC/SCP facilities. The results from the latest round of monitoring are shown in Table 7-60. The data for the BV sites are likely to represent ambient noise levels as no significant noise is generated by BVs. The results for other sites may be higher than ambient depending on the equipment being operated on site at the time of monitoring. The locations of the sites are shown relative to the nearest SCPX KP and from that it can be seen that the sites are spread along the entire SCPX route and are therefore likely to represent either ambient or slightly higher than ambient noise levels in the rural areas crossed by the pipeline.

The results shows that the noise environment is relatively consistent across the length of the pipeline route, with day-time noise levels ($L_A$eq[11]) varying between 35.3 dB(A) (KP269) and 40.7 dB(A) (KP165). This corresponds fairly well with the day-time pre-construction survey at PSA2. Background noise levels may be significantly higher during periods of strong winds, typically 45-55dB(A) during the day. Night-time noise levels were not measured but can be expected to be low or very low (sometimes less than 20dB(A) at night).

The BP grievance log shows that a single verbal complaint has been made during the operation of the BTC/SCP/Western Route Expansion Project (WREP) in Azerbaijan relating to a security generator near Goranboy.

[10] L_{90} is the level exceeded for 90% of the time, i.e. for 90% of the time the noise level is above this level for the measurement period (in this case 15 minutes). It is generally considered to represent the background or ambient level of a noise environment.

[11] LAeq can be regarded as approximately the mean sound level.

Table 7-60: Recent Data from Ongoing BP Noise Monitoring of BTC/SCP/WREP Facilities (2011)

Facility	AB-4[1]	IPA-1[2]	PS-5[3] (WREP)	AB-7	PSA2[4]	AB-10	AB-11	PS-8 (WREP)	AB-13	AB-14
Approx. SCPX KP	55	69	133	165	188	234	243	269	270	279
Date & Time	25 Oct 2011 11:05	25 Oct 2011 13:24	31 Oct 2011 14:45	24 Oct 2011 11:01	24 Oct 2011 10:08	02 Nov 2011 10:02	02 Nov 2011 11:17	27 Oct 2011 17:05	27 Oct 2011 17:26	02 Nov 2011 15:55
Duration (minutes)	5	5	5	5	5	5	5	5	5	5
Distance from source (Facility) (metres)	196	1129	500	200	1085	146	283	625	165	280
LAeq[5] dB(A)	38.3	36.4	36.2	40.7	38.1	39.1	37.8	35.3	39.0	38.5

[1]= Azerbaijan Block Valve No.4; [2] = Intermediate Pigging Station Azerbaijan No.1; [3]= Pump Station No.5 (WREP); [4] =Pump Station Azerbaijan No.2; [5] = The L_{Aeq} can be seen as approximately the mean sound level

The location of human settlements should be taken into consideration when describing the baseline due to their importance as potential noise receptors. As part of the SCPX Project, temporary camp and pipe storage areas will be significant when considering the impacts of noise on baseline conditions. Table 7-61 details the approximate distance of the Alternative 1 camp and pipe storage options to the nearest house or settlement. Several of the locations are within 100m of the nearest house or settlement, which are therefore likely to be more sensitive to changes in noise levels. None of the Alternative 2 sites appear to be close to houses, but further survey work and measurements will be undertaken to confirm this.

Table 7-61: Distance of Temporary Construction Camps and Pipe Storage Areas to the Nearest House or Settlement

Camp or Pipe Storage Area	Distance to nearest house or settlement (m)
Mugan Camp Option 3*	1000
Mugan Pipe Storage Area	80
Mugan Rail Spur and Offloading	200
Kurdemir Pipe Storage Area Option 1 (Mususlu)	50
Kurdemir Pipe Storage Area Option 2 (Mususlu)	50
Kurdemir Rail Spur and Offloading Area	50
Kurdemir Camp Option 5*	500
Ujar Camp Option 5	150
Yevlakh Camp Option 1*	100
Yevlakh Pipe Storage Area	50
Yevalkh Rail Spur and Offloading	50
Gazanchi Pipe Storage Area	50
Gazanchi Rail Spur and Offloading	100
Camp and Pipe Storage Area Goranboy 1*	500
Goranboy Camp Option 3	>1000
Dallar Pipe Storage	50
Dallar Rail Spur and Offloading	100
Dallar Pipe Storage Area, Option 1B (Bayramli)	50
Samukh Camp Option 3	200

Camp or Pipe Storage Area	Distance to nearest house or settlement (m)
Tovuz Camp Option 5*	150
Agstafa Pipe Storage and Offloading Areas*	1000
Agstafa Camp Option 3	800
Poylu Pipe Storage Area	100
Poylu Rail Spur and Offloading	100
Saloghlu Rail Spur and Offloading	50
Saloghlu Camp	200
Saloghlu Pipe Storage Area	50

* Temporary facilities that have subsequently been rejected and are no longer being considered

7.9.4 *Sensitivities*

Key noise sensitivities in the context of the SCPX Project are as follow:

- There are communities located along the proposed pipeline route that are potentially sensitive to increased noise
- Proposed access roads are likely to use what are currently quiet rural roads, several of which pass potentially sensitive receptors (e.g. houses or settlements)
- Some of the temporary construction camp, pipe storage and rail spur and offloading areas are situated within close proximity of sensitive receptors (e.g. houses or settlements)
- The proposed SCPX route passes through rural areas where ambient noise levels, particularly at night, can be expected to be low or very low (sometimes less than 20 db(A) at night). This may lead to complaint when construction activities need to be carried out overnight (e.g. pipeline testing or horizontal directional drilling)
- The proposed SCPX route passes in close proximity to dwellings at the following four locations: Chiyny village (KP104-108), Garaberk village (KP116-120), Alpout village (KP121-125) and Dallyar Dashbulak village (KP287-289), where there will potentially be sensitivity to increased noise.

7.10 Archaeology and Cultural Heritage

7.10.1 *Introduction*

The aim of this section is to establish an accurate archaeological and cultural heritage baseline as a key input to the Project design. With careful management and planning, linear projects such as the proposed SCPX Project can be completed with a minimal impact on the heritage resources of the area that they cross. At the same time, the overall significance of the heritage resources can be increased through the enhanced availability, accessibility and dissemination of archaeological information and by adding to the interpretation and understanding of that information through an appropriate and proportionate programme of research.

This section provides an overview of the context of cultural heritage and archaeological resources in Azerbaijan. It describes the results of the baseline surveys undertaken and provides a list of heritage sites within the vicinity of the proposed pipeline corridor. Sites requiring further study are discussed and areas requiring preliminary trial trenching presented. There is an intangible cultural heritage interest in such features as cemeteries, religious buildings and offering sites.

The focus of the study relates to the impact of the Project on archaeological materials. Aspects of the wider cultural heritage, including those of an intangible nature, are covered in the study. Sites of cultural heritage value can be identified or predicted accurately in advance and their impact mitigated by design or control of construction activity. The same does not apply to archaeological features, which frequently cannot be positively identified in advance of construction activity. Assets of cultural heritage value also tend to be concentrated in villages and larger settlements, all of which are avoided by the Project. A wider search corridor would have identified many more sites of value such as religious structures and civic memorials.

Cultural heritage assets in the vicinity of the proposed SCPX Project have been identified for an area approximately 500m wide around the Project activities and potential areas of concern highlighted. In addition, sites of greater significance within a wider area have been identified to show their proximity to the Project corridor. Figure 7-39 illustrates potential and known sites along the proposed SCPX Project corridor.

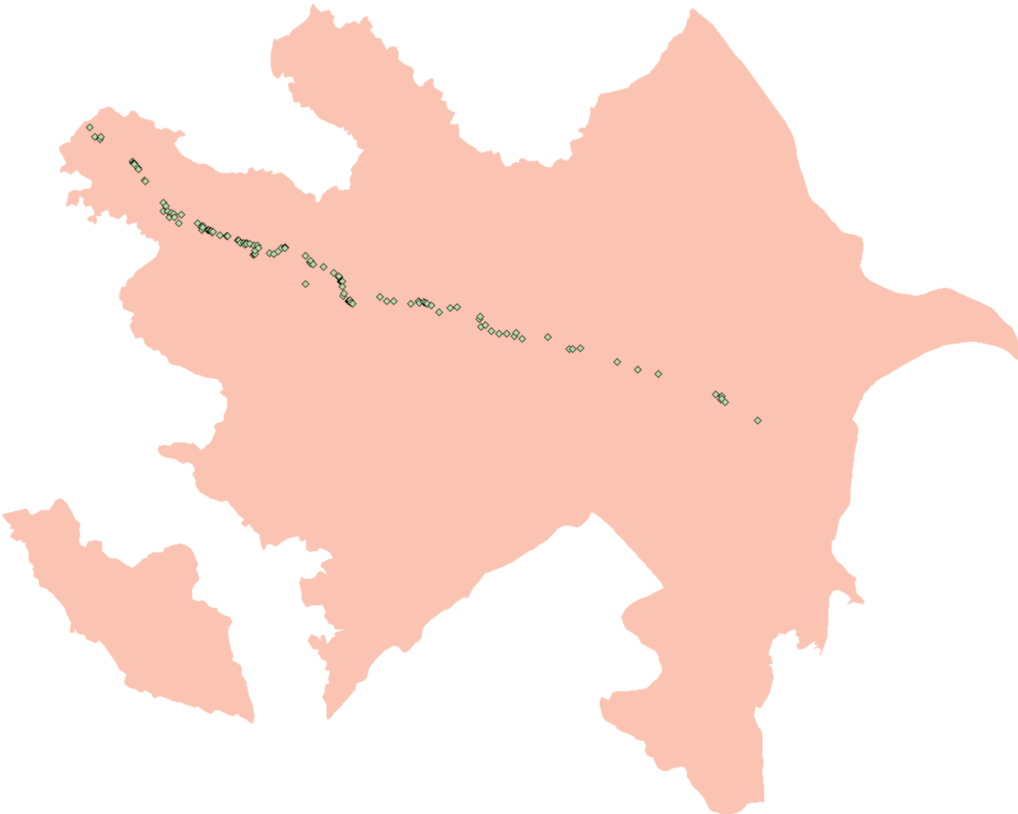


Figure 7-39: Potential and Known Cultural Heritage Sites in the vicinity of the Proposed SCPX Project Route

7.10.2 Desktop Literature Survey

There is extensive archaeological literature for Azerbaijan and on the wider Caucasus region but until recently the focus of archaeological study has been research driven and has concentrated on well-characterised and easily visible sites. The value of much of the earlier work for accurate desktop assessment is compromised to some extent by a general lack of good cartographic or positional information. Nevertheless, the Monuments Record collated by the Ministry of Culture provides a general view of the broad regional distribution of known sites within Azerbaijan.

Recent development-led investigations provide a better view of the distribution of archaeological remains across the landscape with good positional accuracy. As the proposed SCPX route follows very closely that of BTC and SCP, completed in 2006, the results of the archaeological investigations carried out for these projects provides an excellent resource for assessing the potential cultural heritage implications of the SCPX route.

It should be borne in mind, however, that the presence or absence of archaeological remains discovered at a particular location on the BTC and SCP route does not imply that similar remains will be present or absent in the corresponding location on the proposed SCPX route. Many of the significant remains uncovered on the earlier project were limited in their physical extent and did not necessarily cross the full width of the combined easement. There were quite extensive remains of the significant chalcolithic site at Boyuk Kasik (site number CH130), for instance, on the BTC ROW but these did not extend as far at the SCP centreline. Similarly, many of the isolated Antique period burials were very limited in their extent and their occurrence could not have been predicted from the results from the working width of the adjacent pipeline.

7.10.3 Overview and Context of the Cultural Heritage Resources of Azerbaijan

Archaeology in Azerbaijan has a long and distinguished history dating back to the second half of the nineteenth century. Extensive excavations and surveys by Russian scientists in the Mingechevir area were instigated in the 1870s and French researchers were excavating Bronze Age cemetery sites in various parts of the region in the 1880s, the start of a long and continuing involvement of French academic interest in the country. The establishment of the Museum of the History of Azerbaijan in 1920 gave a considerable boost to archaeological studies, as did the foundation of the Academy of Sciences in 1945. The Institute of Archaeology and Ethnography of the Academy of Sciences now has responsibility for the conduct of archaeological investigations in the country as well as curatorial authority with the Ministry of Culture over the archaeological resource.

Archaeological methods have been heavily influenced by Russian practice and the subject has had a heavy academic bias, with a concentration of cultural and artefactual typologies. Landscape and environmental studies have been relatively limited and there is considerable scope for capacity building in these areas. The Law on the Protection of Historical and Cultural Monuments 1998 provides a strong regulatory framework and requires that archaeological studies be conducted prior to construction works in areas with archaeological significance. The encouragement of clearly defined and applied standards and consistency of excavation and recording techniques between different researchers is a long-term aim of all cultural heritage work in Azerbaijan. Table 7-622 outlines the various periods and ages that will be discussed further in this section.

Table 7-62: Archaeological Periods and Ages

Period or Culture	Age
Palaeolithic	35,000 BC
Mesolithic	8000 BC
Neolithic/Chalcolithic	6000–2500 BC
Bronze Age	2500–1000 BC
Iron Age	1000–500 BC
Antique Period	500 BC–AD 400
Albanian Period	AD 400–700
Sassanids	AD 700–1000
Shirvanshah/Seljuk	AD 1000–1235
Saffavid	AD 1550
Ottoman	AD 1550–1813
Modern era	AD 1813–

7.10.3.1 Palaeolithic and Mesolithic periods

Much of the land surface of present day Azerbaijan was profoundly affected by the various episodes of glaciation during the Palaeolithic period and in situ evidence of human activity has been recovered only from cave sites. The most significant finds have been made in Azikh cave in the Karabakh region, where sequences of deposits could date back as far as two million years ago. Finds include a fragment of human mandible, believed to be 350,000 to 400,000 years old, while a fire site discovered within the cave system is thought to be up to 700,000 years old.

Both the Azikh cave and neighbouring Taghlar cave have produced rich assemblages of stone tools from the Middle Palaeolithic period, dating from approximately 150,000 to 35,000 years ago. This was the period during which modern humans evolved and replaced the earlier Neanderthal types. In the Upper (or late) Palaeolithic period, corresponding to the last major glaciation from around 35,000 years ago to the fourteenth millennium BC, technology continued to develop with the production of more varied and complex stone tools.

The gradual climatic amelioration at the end of the Ice Age is marked in the archaeological record by the slow emergence, during the Epi-palaeolithic period, of the distinct Mesolithic culture. The areas available for exploitation by the hunter-gatherer communities increased as the ice retreated to progressively higher altitudes. Changes in lifestyle were brought about by changes in the range of resources available for exploitation, reflected in the range of highly specialised stone tools typical of the Mesolithic period.

It is in the Upper Palaeolithic period that the earliest examples of artefacts seemingly of aesthetic rather than purely functional significance appear: what would now be considered as works of art rather than tools. Rock art sites are scattered throughout the Caucasus region, the most notable being the Gobustan Reserve overlooking the Caspian shore just to the south of the Sangachal terminal. Over 600 petroglyphs provide graphic depictions of the people the Upper Palaeolithic and Mesolithic and their activities: hunting aurochs, deer and ibex, and fishing from high-prowed boats. Archaeological investigations at Gobustan have identified Mesolithic burials allowing anthropological comparisons with modern populations. The international importance of this site was recognised in 2007 by its inclusion on the UNESCO list of World Heritage Sites.

7.10.3.2 Neolithic and Chalcolithic periods, and Early Bronze Age

The transition from the hunter-gatherer lifestyle, depicted on the Gobustan petroglyphs, to one of stock herding and settled agriculture is marked in the archaeological record by the change from Mesolithic to Neolithic cultures. A new suite of stone implements was needed for these new activities and a new proprietorial relationship of communities with the land that they farmed would have developed alongside the more sedentary way of life.

Agriculture probably originated in western Asia and Mesopotamia, from where it spread to the territory of Azerbaijan relatively quickly: the transition from the Mesolithic to Neolithic perhaps occurring as early as the eighth millennium BC. In the Kura basin of western Azerbaijan and south-eastern Georgia a distinct Neolithic culture, the Shumatapa culture, can be distinguished. Characteristic stone tools of the period, in flint, volcanic tuff and obsidian, were recovered during the investigations carried out on the route of the BTC and SCP pipelines. Pottery also came into use during this period.

The first use of copper in the Caucasus region probably dates to the early part of the fourth millennium BC. Most of the locally available copper ores produce a fairly pure metal, too soft to be used for edge tools, and traditional stone tools would have continued to be of prime importance during this period, known as the Eneolithic or Chalcolithic Age. There would have been trade in stone suitable for working and in ceramics in earlier periods but the increasing use of copper from more limited and widely dispersed sources of ores would have led to a regional expansion of trade routes throughout the Caucasus. Occasional ore bodies containing a relatively high proportion of arsenic produce a natural bronze when smelted and demand for this harder metal would have been a further driver of regional trade. Apart from any functional uses, possession of metal objects would have served as markers of social stratification in increasingly complex communities.

The Eneolithic period saw an expansion of the settled areas of Azerbaijan from the light and easily cultivated soils of the Kura basin into the higher regions on the valley sides. Farming regimes may have included transhumance: the regular seasonal movements to exploit the different resources of valley bottoms and upland pasture. In addition to the use of metal technology, the Eneolithic period saw considerable advances in techniques of ceramic production. Wheel-thrown pottery made its first appearance in this period and a range of characteristic hard-fired pottery types were in use.

Affinities with the Ubeid and Uruk cultures suggest that the Eneolithic culture of the Kura valley spread from Northern Mesopotamia. The sites of this period investigated during construction of the course of the BTC and SCP pipelines, including the settlement sites at Boyuk Kasik (Site CH130), Poylu II (Site CH123) and Agılı Dere (Site CH97) and the Soyuqbulaq burial mounds (Site CH128) also indicated affinities with the sites of the Maykop culture in the North Caucasus region, emphasising the importance of the Kura Basin as a route for trade and cultural exchange. These sites are described further in Table 7-63.

The use of bronze made from tin alloyed with copper, rather than arsenical bronzes, provides a marker for the start of the Bronze Age. In the Kura Valley, this occurred around the middle of the fourth millennium BC. There are no known sources of tin in the Caucasus, so this development was dependent on the establishment of long-distance trade routes from Anatolia, Syria or Central Asia. In the Early Bronze Age, western Azerbaijan was at the centre of a highly developed culture spreading along the valleys of the Kura and the Araxes to the south, reaching, at its furthest extent, from what is now Dagestan to Iranian Azerbaijan in the east and through much of Anatolia to the west. As well as the use of bronze, the Kura-Araxes culture is characterised by finely made black and dark grey pottery vessels with hemispherical handles, burial in kurgan mounds and the development of a cattle-rearing economy. It was a long-lived culture, surviving until the third quarter of the third millennium BC. Three kurgans from the Kura-Araxes culture were discovered and excavated on the western side of Shamkirchay (Sites CH73, 76) on the SCP route.

7.10.3.3 Middle and Late Bronze Age and Iron Age

The material culture of the Middle Bronze Age indicates strengthening economic and cultural contacts with the wider region, with the appearance in Azerbaijan of glazed pottery. Incipient urbanisation has been dated to this period in sites excavated in the Nahchivan and Karabakh regions. Artefacts of the Uzarlik and Tazakand cultures have a wide distribution throughout Azerbaijan, with the most notable assemblages recovered from burial contexts. In the western Kura region, graves have been excavated at Babadervish in the Gazakh region and near the Garajamirli village in the Shamkir region.

In the second half of the second millennium BC, spanning the Late Bronze Age and Early Iron Age, the Khojali-Gadabay culture flourished in a region encompassing the present day Ganja, Gazakh and Karabakh regions along with south-eastern Georgia and north-eastern Armenia. Few settlement sites of this period have been excavated but burial sites are widely distributed and well known. This was reflected in the results from the archaeological excavations on the BTC and SCP pipelines route. The excavated burial mound at Borsunlu (Site CH41) in the Goranboy region, and the cemeteries at Zayamchay (Site CH92) in the Shamkir region, Tovuzchay (Site CH111) in the Tovuz region, and Hasansu (Site CH117) in the Agstafa region all have affinities with the Khojali-Gedabey culture.

More than two hundred graves were excavated at these four cemetery sites, the bodies generally laid on their sides in a flexed position. The graves were typically rich in grave goods, including knives and body adornments as well as suites of different kinds of pottery vessels.

For the first time, in the Iron Age, documentary sources are available. The kingdoms of Manna, in what is now Azerbaijan and Urartu in eastern Anatolia, were contemporaries of the Khojali-Gadabay culture.

7.10.3.4 Antique and Early Medieval periods

The Antique Period in Azerbaijan corresponds to the age of classical antiquity in the Mediterranean. Although peripheral to the empires of the Graeco-Roman world, Azerbaijan had close economic, trading and cultural contacts and was profoundly influenced by the political and social changes occurring in the wider region. In classical sources, the regions of present-day Azerbaijan and Georgia are generally referred to as Albania and Iberia, respectively. Scythia lay to the west with Sarmatia and Colchis to the north. The empires of the Medes, Assyrians, and Babylonians to the south and south-west were eventually replaced by the Persian Achaemenid Empire, established by Cyrus the Great in the sixth century BC and eventually encompassing an area from Afghanistan to Thrace, in what is today Bulgaria and northern Greece. This empire had a lasting influence in the history and culture of the whole Caucasus region. Following the conquests of Alexander in the fourth century BC, the influence of Greek culture also spread to the region, which continued under the Seleucid dynasty after the break-up of the Macedonian Empire.

Roman power extended into the region during the first century BC, with campaigns against the Parthians from south and east of the Caspian Sea. Over the next four centuries, Roman influence extended through much of the region, the relative stability provided by Roman authority helping to strengthen economic and social ties. A tangible reminder of the occasional Roman military presence is provided by a Latin inscription or graffito by a member of the 12th legion on a rock at the base of Boyukdash hill in Gobustan. This and a similar example at Derbend, are claimed as the easternmost occurrences of contemporary Latin inscriptions and may be a relic of an abortive attempt in the first century AD to control the trade routes along the western Caspian seaboard.

Strabo, Ptolemy, Pliny, Cassius and Plutarch have all left accounts of Caucasian Albania, which had an administrative capital in Gabala and extended to include the towns of Barda, Derbend, Shamaxi, Shabran and Baylagan. Diverse religious traditions, including Zoroastrianism were practised, but Christianity became a major influence, especially among the political elites, in the fourth century AD. The variety of religious practices is reflected in the range of Albanian burial rites including interments in large jars or in wooden coffins, in catacombs or in simple earth-fast graves.

The later Antique Period corresponds with early centuries of the Byzantine Empire, extending into south-west Asia. Caucasian Albania was subjugated and assimilated into the Persian Sassanid Empire. The imposing remains of massive 120km-long defensive earthworks around Derbend, near the current border with Dagestan, date from this period, a response to the frequent incursions from the peoples of the southern Russian steppes. The rise of Islam in the seventh century is generally taken to mark the end of the Antique Period in Azerbaijan.

Caucasian Albanian graves from the Antique Period are fairly commonly encountered in Azerbaijan and examples were discovered and excavated at a number of locations along the BTC and SCP pipeline routes (Sites CH21, 23, 33, 66, 79, 122, 123, 124, as listed in Table 7-63). In some instances, these were buried with rich assemblages of grave goods providing evidence of trade links with the wider region. A settlement area dating from the fifth to third centuries BC, along with a number of burials was excavated near Girag Kasaman village in the Agstafa region (Site CH122). It included a feature interpreted as the remains of a metal-working kiln and numerous spindle whorls indicating that metal-working and weaving were among the activities carried out at this small domestic rural site.

Early Medieval sites excavated on the BTC and SCP routes included a settlement area, Seyidlar II in the Samux district (Site CH66), and a settlement and graveyard near the Chaparli village in the Shamkir district (Site CH79). The Chaparli site was particularly noteworthy as it contained architectural remains surrounded by Early Medieval graves. The structural remains were interpreted as the foundations of an early Christian chapel, belonging to a local Albanian community.

7.10.3.5 Medieval period

By the middle of the seventh century, the Mihranid Dynasty dominated Caucasian Albania as a client stage of the Sassanids, but following the overthrow of the Sassanids by the Arabian advance, the Mihranids formed an alliance with the Arab Islamic Caliphate. The arrival and growth of Islamic culture and the exposure to its flourishing intellectual environment allowed great advances in the sciences and arts and in continuing economic development. Many of the local Christian and Zoroastrian population converted to Islam, although Christian communities are thought to have survived well into the Medieval Period. There was also continuing political ferment and in the ninth century Azerbaijan, under the leadership of Babek, broke free of Arab rule, although Arabs who had settled in the territory and become integrated into the ruling elite continued to have strong cultural influence.

The distinct political and cultural identity of Azerbaijan began to emerge more strongly at this time, the state of Aran uniting much of the territory. By around AD 1000, the Shirvanshahs had established a powerful state in the east of the country, with its centre in Shamaxi. Other dynasties, including the Shaddadids and Ravvadids, ruled portions of what is now Azerbaijan during the tenth and eleventh centuries. The Seljuk Empire, expanding from Central Asia, gradually came to dominate much of the region from Iran to Anatolia, delegating power to atabegs governing from Shamaxi. The period of political and economic stability which occurred as a result of Seljuk rule allowed a flowering of culture and arts: this was the period of the great poets Khaghani and Nizami. Cultural and commercial centres at Ganja, Beylagan, Tabriz, Nahchivan, Shamaxi, and Shamkir developed at this time, growing into cities with populations in the tens of thousands.

This period of stability came to an end in 1235, when Mongols expanding from Central Asia destroyed many of the important cities in Azerbaijan, including Ganja and Shamkir, and Azerbaijan was incorporated into the Mongol Empire. The remains of the old cities of Ganja and Shamkir (Sites CH63, 78) still stand in both cases to the east of the present day cities. In the late fourteenth century, the territory was ravaged by the forces of Amir Timur, Tamerlane of western literature, the states of Garagoyunlu and Aghgoyunlu emerging from the ensuing disorder, and establishing hegemony over their surrounding regions. At the beginning of the sixteenth century, Shah Ismayil established the Azerbaijan Saffavid state centred on Tabriz, eventually inheriting the mantle of the Persian Emperors. It was during this period that Shiite Islam became the predominant religion of both Azerbaijan and Iran.

Study of the Medieval Period only came to prominence in the later part of the twentieth century concentrating initially on the larger urban sites. Sites discovered and investigated on the BTC and SCP pipelines partially redressed this imbalance, by including small rural settlements at Girag Kasaman in the Agstafa district, Dashbulag in Shamkir district and Fakhrali in Goranboy district. These sites provide evidence of domestic activities and burial practices, as well as the economic and trade relationships within the area. It was during the Medieval Period that long distance transport and trade routes between Europe and Eastern Asia, which became known collectively as the Silk Road, came into prominence.

7.10.3.6 Post-Medieval and modern periods

The waning of Saffavid power in the seventeenth century increasingly allowed incursions into the territory from Ottoman Turks, Tatars and, increasingly, the expanding Russian Tsarist state. Through the latter part of the seventeenth and the first half of the eighteenth centuries, the country was fragmented into regional khanates. A confederation of these khanates in the mid-eighteenth century established a degree of independence, allowing a cultural and artistic renaissance, centred particularly on Susha, in the Karabakh region. In the early years of the nineteenth century, Russia took control of much of the country, leading eventually to the division of Azerbaijan that persists today, with the southern Azeri states forming a province of Iran. There was some nineteenth-century colonisation by Russia, and colonisation by western Europeans, especially from rural areas of Germany, was also encouraged.

In the early years of the twentieth century, the oil industry rapidly expanded with Baku burgeoning from its medieval walled centre, now a UNESCO World Heritage Site, into a large cosmopolitan city supplying over half of global demand for petroleum. The country emerged from the political turmoil of the First World War as a briefly independent state, but post-revolutionary Soviet Russia re-established control within a couple of years. The oil industry remained of crucial strategic importance through the Second World War, but tended to stagnate afterwards, as production from Siberian oilfields became more important. With the dismantling of the Soviet Union in the early 1990s, the country regained independence, encouraging a resurgent oil and gas industry as a driver for economic and cultural development.

Economic expansion is particularly evident in Baku, where the cityscape has been transformed by modern multi-storey buildings, but can be seen even in rural villages, where increasing prosperity and expressions of national and cultural identity are manifest in the increasingly elaborate sheet metal roofs of vernacular buildings. These add to a rich and varied legacy of extant buildings: surviving medieval castles and mosques, the southern German style of the colonial buildings of Xanlar and Ganja, the southern European oil-boom mansion blocks of Baku, and public buildings ranging in architectural style from the richly decorated geometry of Persia to the brutal concrete functionality of post-war Soviet constructivism.

Despite recent development, the essential character of rural Azerbaijan has been largely preserved. The lowlands of the Kura valley present a largely open landscape dotted with large villages, typically of houses each set within its own walled compound, which serve as gardens, orchards and stockyards. The standard building material, in much of the region, consists of blocks of coarse limestone from local quarries, particularly in the Gobustan and Shamkir regions. Towards the east, the land is arid and settlements are sparsely distributed, but the west is fertile irrigated farmland.

For the most part, these heritage assets from recent centuries are visible and easily avoided by pipeline construction, though smaller informal structures, such as pirs and shrines, may be impacted. In addition, there is a potential for archaeologically significant sub-surface deposits dating from the earlier years of the Post-Medieval period. The heritage value of modern structures is often overlooked, and the archaeological team on the BTC and SCP pipeline project were able to draw attention to the post-war concrete bus shelters, decorated with mosaics in a lively vernacular style, that were being lost to road-improvement schemes.

7.10.4 Methodology and Data Gaps

The information used for this study comes from a number of sources principally the following:

- Information from previous studies and earlier project records
- Literature review of published sources
- Satellite and aerial imagery of the Project area
- Survey of specific areas of the Project
- Consultation with other teams working in the area.

There is good coverage of the archaeological evidence from the BTC and SCP projects as a result of monitoring of construction, and new sources of archaeological evidence are continuously being added. Since the BTC/SCP construction period, new studies have taken place adding to the knowledge of the area and to some specific points adjacent to the Project. This is demonstrated particularly in a series of recent programmes of work in the Shamkir and Tovuz regions with Japanese–Azerbaijan excavations at the Neolithic settlement of Goytepe; the French–Azerbaijan excavations at the Chalcolithic settlement at Mentesh; and the excavations at Shamkir medieval town. The earlier archaeological programme on the BTC and SCP projects prompted attention to some of these sites and provided a framework for their understanding.

The proposed SCPX Project route in Azerbaijan is mainly constructed parallel to the existing BTC and SCP ROW; therefore, evidence gained during these projects is a useful source of baseline information. There are some areas where the SCPX route diverges from the existing route and these areas, along with the supporting infrastructure locations, required further study.

High-resolution satellite imagery is a valuable resource that was not available during the BTC and SCP projects. Many additional features were added to the database using this source. These particularly included locations and extents of cemeteries and burial mounds. Sources used include Project aerial photography of a narrow width along the BTC and SCP route corridor, commercially available satellite images from the Internet and a declassified US government satellite image taken on 20 September 1971 (DS1115-2154DF093_93_a). This last image covered an area of the Shamkir valley and was especially useful in identifying elements of landscape change in this area.

The cultural heritage field surveys were undertaken between July 2011 and May 2012 to supplement existing information, and covered the following Project components:

- Locations of known archaeological sites where an impact could be predicted from the proposed SCPX Project
- Route sections that deviated away from the BTC and SCP pipeline corridors
- Locations of permanent aboveground installations (AGIs) such as block valves and the pigging station
- Temporary infrastructure such as proposed temporary construction camps and pipe storage areas, and access roads where they are known to be different to existing utilised routes.

The object of the survey was to identify any sensitive heritage issues within the proposed work areas, i.e. to establish a cultural heritage baseline.

Areas examined were as follows.

Pipeline
Known archaeological sites on the BTC and SCP pipeline, together with areas where the SCPX route deviated from the earlier corridor (the specific locations are listed in Table 7-63 below, which should be compared with the list of all known sites in Table 7-65).

Table 7-63: Known Archaeological Sites Identified within the BTC and SCP Corridor and Other Locations Visited during the Survey

Identifier	Site Name with BTC KP Marker	Description
CH23	204 Amirarx	Antique period cemetery
CH28	233 Samedabad	Iron Age cemetery
CH29	234 Narimankand	Iron Age cemetery
CH33	241 Yaldili	Antique period cemetery
CH54	289 Faxrali	Medieval settlement
CH58	Hajialili	Medieval settlement
CH59	300.98 Hajialili II	Medieval settlement
CH60	302 Hajialili III	Medieval settlement
CH62	301 Hajialili I	Medieval settlement

Identifier	Site Name with BTC KP Marker	Description
CH65	316 Seyidlar	Modern cemetery
CH66	316 Seyidlar	Bronze Age settlement
CH73	332.7 Shamkirchai Kurgans	Kurgan
CH75	Shamkir	Shamkirchay medieval bridge
CH76	333 Shamkirchai Kurgan 3	Kurgan
CH77	Shamkir	Shamkir citadel
CH78	Shamkir	Medieval town
CH79	335 Chaparli	Chapel and cemetery
CH80	Dallar	Modern cemetery
CH81	Dallar	Spread of prehistoric pottery in quarry pit
CH86	342 Dashbulag	Medieval settlement
CH91	355 Zayamchai Catacomb	Excavation
CH92	356 Zayamchai	Bronze Age cemetery
CH93	356 Zayamchai Cemetery	Medieval cemetery
CH94	356 Zayamchai	Medieval bridge piers
CH95	357.7 Siniq Korpu	Bronze Age Kurgan
CH97	358 Agili Dere	Chalcolithic settlement
CH100	361 Khojakhan	Chalcolithic settlement
CH102	Mentesh	Settlement mound
CH107	Asrikchai	Kurgan
CH108	Asrikchai	Kurgan
CH109	Asrikchai	Kurgan
CH111	378 Tovuzchai	Bronze Age cemetery
CH112	Tovuzchai	Mammoth kill-site
CH113	380 Khunan	Bronze Age settlement
CH117	398.8 Hasansu	Bronze Age cemetery
CH119	399 Hasansu Kurgan	Early Bronze Age burial
CH120	405 Girag Kasaman	Medieval settlement
CH122	406 Girag Kasaman II	Antique period settlement
CH123	408.8 Poylu II	Chalcolithic settlement
CH124	409.1 Poylu I	Chalcolithic settlement
CH125	409.2 Poylu	Nineteenth-century structures
CH126	410 Poylu	Nineteenth-century structures
CH127	432 Soyuqbulaq	Chalcolithic cemetery
CH129	Soyuqbulaq	Pir, religious structure
CH130	438 Beyouk Kasik	Chalcolithic settlement

Table 7-64 describes the site of the pigging station and camp and pipe storage areas examined during the survey. A number of locations had not been identified at the time of the field survey or were unable to be accessed.

Table 7-64: Field Survey Locations against Current Facilities

Identifier	Survey Status	Further Action
Pigging Station	Not visited	Site visit required
Mugan Camp Option 3* and Mugan Pipe Storage Area	Not visited	Site visit not necessary due to known condition of site
Mugan Rail Spur and Offloading	Not visited	Site visit required
Kurdemir Camp Option 4*	Not visited	Cultivated land – no visible archaeological interest
Kurdemir Camp Option 5	Not visited	Site visit required
Kurdemir Pipe Storage Area Option 1 (Mususlu)	Not visited	Site visit not necessary due to known condition of site
Kurdemir Pipe Storage Area Option 2 (Mususlu)	Not visited	Cultivated land – no visible archaeological interest
Ujar Camp Option 5	Not visited	Ex-cultivated land – no visible archaeological interest
Yevlakh Camp Option 1*	Visited	No further action required for ESIA
Yevlakh Pipe Storage Area	Not visited	Site visit required
Yevlakh Rail Spur and Offloading	Not visited	Site visit required
Gazanchi Pipe Storage Area Option A	Not visited	Site visit required
Gazanchi Pipe Storage Area Option B	Not visited	Site visit required
Gazanchi Rail Spur and Offloading	Not visited	Site visit required
Goranboy Camp Option 3	Not visited	Cultivated land – no visible archaeological interest
Camp and Pipe Storage Goranboy 1 and 2*	Not visited	Site visit required
Zazali Rail Spur*	Visited	No further action required for ESIA
Dallar Pipe Storage and Dallar Rail Spur and Offloading	Visited	No further action required for ESIA
Dallar Pipe Storage Area, Option 1B (Bayramli)	Not visited	Site visit required
Samukh Camp Option 3	Not visited	Cultivated area growing alfalfa. No archaeological features visible. A small pir or mosque like building lies to the north-west corner at the junction of the main road and an adjacent track.
Tovuz Camp Option 5*	Visited	No further action required for ESIA
Agstafa Pipe Storage and Offloading Areas*	Not visited	Site visit required
Agstafa Camp Option 3	Not visited	Cultivated land that has grown crops. No archaeological features visible.
Poylu Pipe Storage Area	Not visited	Site visit required
Poylu Rail Spur and Offloading	Not visited	Site visit required
Saloghlu Rail Spur and Offloading	Not visited	Site visit required
Saloghlu Camp	Not visited	Site visit required
Saloghlu Pipe Storage Area	Not visited	Site visit required

* Temporary facilities that have subsequently been rejected and are no longer being considered

7.10.5 Baseline Archaeological Conditions

Examination of the pipeline route has shown no sites identified in addition to those that were identified in previous projects. Largely, this is because sites on the pipeline route have been heavily ploughed and covered with cultivated crops. Archaeological features that reveal themselves as aboveground features have all been previously identified and the pipeline route altered to avoid them. An example of this is the potential prehistoric settlement sites at Bayramli (Site CH89) and Zayamchay (Site CH90) were both seen as aboveground features during the BTC project and subsequently consciously avoided in the SCPX work.

Additional information was obtained on nearly all the sites re-examined. This usually consisted of pottery spreads seen on the cultivated surface, where it was not covered by growing crops.

7.10.5.1 Hajigabul to Amirarx

The Hajigabul to Amirarx section (Appendix A, Figure A8-1, maps 1–3) of the proposed route crosses the lower Kura valley plain and experiences high summer temperatures and poor water supplies. The area has traditionally been used for overwintering flocks of sheep and livestock brought down from the mountains in an annual transhumant migration. The most common archaeological sites found in the east of this area are the extensive remains of earthworks of varying forms that together present evidence of transhumant settlement (Sites CH2–4, 6). Further west in the area there is a greater degree of cultivated land in the landscape. This is reflected by numerous villages, some of which may be of some antiquity as reflected by the size of their cemeteries.

No archaeological sites are known on the SCPX route and they are not particularly evident in the wider region. Evidence of earlier may be limited both by the harsh environment and because much of the earlier environment is buried by what appears to be alluvial deposits laid down by the various routes the Kura River has taken over time.

The pigging station, Mugan Camp Option 3 and Kurdemir Pipe Storage area are all found in this area. The pigging station lies north-west of Hajigabul in an open area of plain with no visible or known archaeological potential. The Mugan camp site and pipe storage area was used for the same activities in the BTC and SCP projects and for earlier projects. It lies in an area with low potential and no archaeological evidence was revealed in the earlier activities. The same information applies to the Kurdemir Pipe Storage area. Kurdemir Camp Option 4 is sited on cultivated land with no visible archaeological interest.

7.10.5.2 Amirarx to Karabakh canal

The Amirarx to Karabakh canal area (Appendix A, Figure A8-1, maps 4–5) is irrigated largely by water abstracted from the Kura River; without this, permanent settlement would be very difficult. The large plain contains fairly high numbers of late prehistoric and Antique period sites. Archaeological studies around Mingechevir when the large reservoir was constructed showed dense concentrations of such sites. A similar occurrence happened during BTC and SCP construction with high numbers of Iron Age and Antique period cemeteries being encountered. Many of these were buried beneath alluvial deposits of soil, making early identification before construction activities difficult (Sites CH21, CH23–24, CH26–30, CH32–33) (Photograph 7-63).

The Ujar Camp Option 5 is located on cultivated land with no visible archaeological interest.

The Yevlakh camp area is located just to the west of Yevlakh. This was used previously during the BTC and SCP projects. There were no previously identified archaeological features in the area and no features were identified during the preparation of the site for those projects.

Photograph 7-63: Site CH29 at BTC KP 234, Narimankand under Excavation during BTC Construction

7.10.5.3 Karabakh canal to Borsunlu, Goranboy

The region from the Karabakh canal to the Borsunlu, Goranboy area (Appendix A, Figure A8-1, map 6) crosses an arid region with few modern villages. There is limited known archaeology in this region, possibly as the harsh environment discourages settlements. The only site located on the BTC and SCP ROW was a spread of nineteenth century pottery around the Goranchay River (CH36), which could be the result of a transhumant settlement area.

7.10.5.4 Borsunlu, Goranboy to Hajialili

The Borsunlu, Goranboy to Hajialili section (Appendix A, Figure A8-1, maps 6–7) consists of a slightly hillier region closer to the foothills of the Lesser Caucasus. There are several rivers flowing towards the Kura River, which allows a greater concentration of population to accumulate. This is seen today in large villages and cultivated fields. The discoveries on the BTC and SCP ROW also increased in number in this area, including Bronze Age cemeteries (Sites CH39–41) and early and late medieval settlements (Sites CH54, CH56–62). Photograph 7-64 below refers to Site CH41.

The proposed Goranboy camp and storage area is found in this area. The site was not visited during the archaeological survey. A close examination of satellite and other aerial images shows that the area is cultivated ground with no surface indications of archaeological features. The site will need to be visited as part of the ongoing archaeological survey. The proposed Goranboy Camp Option 3 area is sited on cultivated land with no visible archaeological interest.

Photograph 7-64: Site CH41, BTC KP272, Borsunlu under Excavation during BTC Construction

7.10.5.5 Hajialili to Qoshkarchay

The Hajialili to Qoshkarchay section (Appendix A, Figure A8-1, map 7) consists of raised upland with few water resources. The modern land use is limited to extensive grazing and the only evidence of previous use is a few transhumant settlement remains visible on aerial photographs.

The proposed Samukh Camp Option 3 has no visible evidence of archaeology, although there is a small religious building, possibly a pir or monument, just outside the boundary of the site on the edge of the road.

7.10.5.6 Qoshkarchay to Hasansu

The Qoshkarchay to Hasansu region (Appendix A, Figure A8-1, maps 7–9) consists of an area with many favourable environmental attributes that encouraged early settlement. There are several rivers flowing through it from the Lesser Caucasus separated by level valley floors with deep soils. Hilly arid areas are limited in scale and the environment generally benefits from a range of diverse and varying resources. Archaeological sites are common and easily identified throughout the region. They include important multi-period complexes such as Mentesh and Goytepe (Sites CH102, 106), both of which originate in the Neolithic, as well as the large medieval towns of Ganja and Shamkir (Sites CH63, 78).

Sites on the proposed SCPX route include:

- Chalcolithic settlements (Sites CH97, 100)
- Kura Arax cemeteries (Sites CH73, 76)
- Bronze Age settlements and cemeteries (Sites CH66, 92, 95, 111, 113, 117, 119)
- Medieval and later sites (Sites CH67–69, 72, 79, 86 (Photograph 7-65), 91, 93, 94).

Photograph 7-65: Site CH86, BTC KP342, Dashbulaq School Party Visiting Excavation during BTC Construction

The Zazali rail spur is an area of rail sidings and former industrial works. Although the area is one of high potential for earlier settlement, the more recent activity has probably removed all evidence of this.

The Dallar pipe storage area is located several kilometres south of Dashbulaq (Site CH86). The site consists of an area heavily affected by recent quarrying and processing work, which will have no archaeological impact. An area to the north of this is an open, formerly cultivated landscape. There is no apparent archaeological interest in this portion of the site.

Further to the west is the location of Tovuz Camp Option 5. This is located in the floor of a reservoir set between two dam walls. The reservoir has not been used for storing water for a long period of time. Current land use is one of arable cultivation with small-scale plots. No archaeological features are visible, but it is difficult to ascertain whether there is an archaeological component to the site. The construction of the reservoir in Soviet times may have resulted in large-scale earthmoving work that has damaged any existing information, or it may have been covered beneath a layer of silt, if the reservoir was frequently filled with water.

The proposed Agstafa Camp Option 3 area is located between the main public highway and the SCP pipeline. It lies in an area of cultivated land that has been heavily ploughed in the past, but is in an area of high potential for earlier occupation.

The Agstafa pipe storage areas Options 1–5 are located on the banks of a tributary river of the Kura. The site is a former industrial site, possibly associated with the airfield to the east. The damage caused by the construction of the works and associated earthmoving means there is likely to be little impact on archaeological features by construction of the pipe storage. However, this is an area of very high potential; other riverbanks have been found to be a focal point for prehistoric settlement and cemeteries. There are also two large settlement mounds not far away: one is 1.3km to the north-east (Site CH132), while the other is further away to the east on the outskirts of Agstafa (Site CH131). Both probably have origins in the prehistoric period.

7.10.5.7 Hasansu to Kura River

The high ground from the Hasansu towards the Kura valley lower terrace (Appendix A, Figure A8-1, maps 9–10) contains few archaeological sites. Although there are good water resources close by, these are not found close to the pipeline route so consequently there are relatively few archaeological sites.

The Kura valley floor has numerous water supplies, which may explain the greater level of human occupation. BTC and SCP work encountered Chalcolithic settlements at Sites CH123 and 124 with settlements of antique and medieval date at Sites CH120, 122, 125 and 126.

One site within this zone is rather remote from the main characteristics of the area. This is the Agstafa pipe store located on the banks of a tributary river of the Kura. The site is a former industrial site, possibly associated with the airfield to the east. The damage caused by the construction of the works and associated earthmoving means there is likely to be little impact on archaeological features by construction of the pipe storage. However, this is an area of very high potential, on other riverbanks they have been found to be a focal point for prehistoric settlement and cemeteries. There are also two large settlement mounds not far away: one is 1.3km to the north-east (Site CH132), while the other is further away to the east on the outskirts of Agstafa (Site CH131). Both probably have origins in the prehistoric period.

7.10.5.8 Kura River to Georgia border

The section north of the Kura encompasses one that is hilly and poorly irrigated before descending to a low plain running towards the Georgian border (Appendix A, Figure A8-1, map 10). One of the high points that overlooked the plain is the site of the Soyuqbulaq kurgans of Chalcolithic date (Site CH127) (Photograph 7-66). Further on from this is the Chalcolithic settlement of Beyouk Kasik (Site CH130), which in its position in the lowland appeared to be partly buried by an alluvial deposit.

Photograph 7-66: Site CH127, BTC KP432, Soyuqbulaq under Excavation during SCP Construction

7.10.6 Sensitivities

7.10.6.1 Cultural heritage management measures on the pipeline route

One of the advantages of the proposed SCPX route largely following the earlier BTC and SCP route is that areas of potential difficulty are recognised and can be avoided at an early stage of design.

This has been best illustrated in avoiding late medieval and relatively recent graveyards that are known or strongly suggested in specific areas. These are located at Sites CH65, 79, 93 and 120. Other routes have been selected to avoid entirely, or to use routes where less extensive deposits of archaeology are anticipated, at Sites CH23, 29, 54, 73, 76, 92, 111, 122, 123 and 124.

7.10.6.2 Archaeological sensitivities: Hajigabul to Amirarx

Few surface indications of archaeological features are known in the Hajigabul to Amirarx area (Appendix A, Figure A8-1, maps 1–3) and little was observed during BTC and SCP construction, so it appears that this is an area with a low probability for the presence of archaeological features. However, there is potential that deeply buried features may be exposed during construction activities.

The pigging station, and Mugan and Kurdemir camps and storage areas are all unlikely to have any archaeological impact as they have all previously been used for similar activities.

7.10.6.3 Archaeological sensitivities: Amirarx to Karabakh canal

Owing to the nature of the archaeological sites in the Amirarx to Karabakh canal area (Appendix A, Figure A8-1, maps 4–5), it is very difficult to identify their location in advance. Evidence from BTC and SCP suggests that archaeological deposits relating to Late Prehistoric and Antique burial are located close to the proposed route (Sites CH28, 29, 33).

There is potential that deeply buried features may be exposed during construction activities in other locations. This was experienced during the BTC and SCP construction when many features not identifiable on the surface were found during trenching operations.

The Yevlakh camp and storage area is unlikely to have any impact upon cultural heritage features as it has previously been used for similar activities.

7.10.6.4 Archaeological sensitivities: Karabakh canal to Borsunlu, Goranboy

There were limited surface indications of archaeological features observed in the Karabakh canal to Borsunlu, Goranboy area (Appendix A, Figure A8-1, map 6). However, there is potential that deeply buried features may be exposed during construction activities.

7.10.6.5 Archaeological sensitivities: Borsunlu, Goranboy to Hajialili

The proposed SCPX route avoids the known Bronze Age kurgan burials around Sites CH39–41. A number of potential archaeological deposits may extend onto the proposed route from the medieval settlements in the Borsunlu, Goranboy to Hajialili area (Sites CH54, 56, 57–62) (Appendix A, Figure A8-1, maps 6–7).

The camp site at Goranboy lies in an area of high potential, although material has been recently dumped on the surface.

7.10.6.6 Archaeological sensitivities: Hajialili to Qoshkarchay

There were limited surface indications of archaeological features observed in the Hajialili to Qoshkarchay area (Appendix A, Figure A8-1, map 7). However, there is potential that deeply buried features may be exposed during construction activities.

7.10.6.7 Archaeological sensitivities: Qoshkarchay to Hasansu

There are many known archaeological sites in close proximity to the proposed SCPX route in the Qoshkarchay to Hasansu region (Appendix A, Figure A8-1, maps 7–9). This includes prehistoric settlement and cemeteries as well as later sites that reflect the heavy level of medieval settlement in the hinterland of the town of Shamkir (Sites CH66, 67, 68, 91, 92, 96, 97, 100, 111, 113) (Photograph 7-67). The Shamkir valley floor adjacent to Chaparli is one area where there is a very high chance of new discoveries.

The medieval site of Dashbulaq (Site CH86) identified in the BTC and SCP construction, falls within the proposed SCPX route. There are medieval pottery fragments on the surface that suggest that a similar level of archaeological evidence potentially will be found sub-surface as experienced during the BTC and SCP at this location.

The Zazali offloading area and Dallar Pipe Storage Area are both in areas of high potential, but have been heavily disturbed by previous activity, so are unlikely to retain any surviving archaeological deposits. The Zazali offloading area is no longer being considered by the project.

Photograph 7-67: Site CH68, 321 Garajamirli under Excavation during SCP Construction

7.10.6.8 Archaeological Sensitivities: Hasansu to Kura River

The first part of the Hasansu to Kura River region (Appendix A, Figure A8-1, maps 9–10) runs through higher ground with less of a chance of the discovery of archaeological features. However, an early Bronze Age burial containing over 60 pottery vessels was located in this area, so similar features may be found during construction.

There were limited surface indications of archaeological features observed in the area. However, there is potential that deeply buried features may be exposed during construction activities. The proposed SCPX Project route may fall within the sites identified on the BTC and SCP pipeline (Sites CH122, 123, 124). There is a high probability that significant deposits may be situated at each of these locations.

The Agstafa pipe store lies in an area of very high potential for the presence of archaeological features, although the level of disturbance and building that have already occurred in this area suggest that there will be no impact upon archaeological features. However, if new earthmoving operations are proposed, there may be a direct impact.

7.10.6.9 Archaeological sensitivities: Kura Valley Plain to Georgia border

The proposed SCPX route is considered to be of sufficient distance to avoid the significant deposits identified in the BTC and SCP pipelines at Sites CH128 and 130. However, there is a significant risk that further deposits may be located on the proposed route between the Kura Valley Plain and the Georgia border (Appendix A, Figure A8-1, map 10).

7.10.6.10 Conclusion

The archaeological process has developed immensely since the WREP pipeline was laid in this area. The BTC and SCP projects added large amounts of data that attracted attention of the outside world to the potential of an area that had been little studied previously. This has led to a number of international and Azerbaijani projects in this area, some of which have led to sites of outstanding potential to be researched (Shamkir medieval town at Site CH102, Mentesh at Site CH106 and Goytepe at Site CH112 prehistoric settlements). The proposed SCPX Project has the potential to add to this corpus of knowledge while also reducing the impact of construction to cultural heritage and archaeology.

Table 7-65: Heritage Sites in the Proposed SCPX Project Area

No.	Name (including SCP KP)	Type	Sensitivity*	Impact	Rayon	Coordinates
CH001	Hajigabul	Modern Cemetery (Intangible Cultural Heritage)	A	None	Hajigabul	8833169 4444289
CH002	Karasu	Transhumant settlement (Archaeology)	D	None	Hajigabul	8817815 4453277
CH003	Karasu	Transhumant settlement (Archaeology)	D	None	Hajigabul	8816204 4454558
CH004	Karasu	Transhumant settlement (Archaeology)	D	Minor	Hajigabul	8816018 4455750
CH005	Karasu	Modern Cemetery (Intangible Cultural Heritage)	A	None	Hajigabul	8815850 4454344
CH006	Karasu	Transhumant settlement (Archaeology)	D	Minor	Hajigabul	8813147 4456584
CH007	Sigurli	Modern Cemetery (Intangible Cultural Heritage)	A	None	Kurdemir	8786021 4466407
CH008	Kurdamir	Modern Cemetery(Intangible Cultural Heritage)	A	None	Kurdemir	8776446 4468466
CH009	Kurdamir	Modern Cemetery (Intangible Cultural Heritage)	A	None	Kurdemir	8766553 4472276
CH010	Ujar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Ujar	8749468 4478445
CH011	Ujar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Ujar	8745799 4478251
CH012	Ujar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Ujar	8744068 4478000
CH013	166 Ujar	Pottery Findspot (Archaeology)	D	None	Ujar	8733998 4483679
CH014	Karadagli	Modern Cemetery (Intangible Cultural Heritage)	A	None	Ujar	8721661 4483196
CH015	Karadagli	Modern Cemetery (Intangible Cultural Heritage)	A	None	Ujar	8718925 4485972
CH016	182 Karadagli	Pottery Findspot (Archaeology)	D	None	Ujar	8718292 4484370
CH017	186 Ujar	Pottery Findspot (Archaeology)	D	Unknown	Ujar	8714666 4485340
CH018	Ujar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Agdash	8710997 4485578
CH019	194 Orta Laki	Pottery Findspot (Archaeology)	C	Unknown	Agdash	8707367 4486769
CH020	Orta Laki	Modern Cemetery (Intangible Cultural Heritage)	A	None	Agdash	8704404 4489607
CH021	200 Agdash	Pottery Findspot (Archaeology)	D	Unknown	Agdash	8702296 4488893
CH022	Laki	Modern Cemetery (Intangible Cultural Heritage)	A	None	Agdash	8702019 4493377
CH023	204 Amirarx	Antique period cemetery (Archaeology)	C	Unknown	Agdash	8701591 4492479
CH024	216 Yevlax	Antique period cemetery (Archaeology)	U	Unknown	Yevlakh	8691000 4497900
CH025	Ashagy Qarxun	Modern Cemetery (Intangible Cultural Heritage)	A	None	Yevlakh	8687609 4497809

No.	Name (including SCP KP)	Type	Sensitivity*	Impact	Rayon	Coordinates
CH026	226 Yevlax	Pottery spread (Archaeology)	C	None	Yevlakh	8682400 4495620
CH027	231 Yevlax	Antique period cemetery (Archaeology)	C	Unknown	Yevlakh	8678700 4498740
CH028	233 Samedabad	Iron Age cemetery (Archaeology)	C	Unknown	Yevlakh	8676800 4499780
CH029	234 Narimankand	Iron Age cemetery (Archaeology)	C	Unknown	Yevlakh	8676016 4500225
CH030	235 Yevlax	Pottery spread (Archaeology)	C	Unknown	Yevlakh	8675029 4500509
CH031	Nemetabad	Modern Cemetery (Intangible Cultural Heritage)	A	None	Yevlakh	8673125 4500149
CH032	237 Narimankand	Antique period cemetery (Archaeology)	C	Unknown	Yevlakh	8672969 4500853
CH033	241 Yaldili	Antique period cemetery (Archaeology)	B	Minor	Yevlakh	8669022 4499641
CH034	Mashadi Garalar	Possible kurgan group with transhumant structures (Archaeology)	C	None	Goranboy	8660990 4500740
CH035	Cinli Boluslu	Modern Cemetery (Intangible Cultural Heritage)	A	None	Goranboy	8657693 4500978
CH036	256 Goranchai	Pottery spread (Archaeology)	D	Minor	Goranboy	8654382 4502913
CH037	Borsunlu	Kurgan Group (Archaeology)	B	None	Goranboy	8641594 4499839
CH038	Borsunlu	Modern Cemetery (Intangible Cultural Heritage)	A	None	Goranboy	8640824 4500210
CH039	272 Borsunlu	Kurgan Group (Archaeology)	B	None	Goranboy	8640457 4501276
CH040	272 Borsunlu	Kurgan Group(Archaeology)	B	None	Goranboy	8640201 4500973
CH041	272 Borsunlu	Kurgan (Archaeology)	B	None	Goranboy	8640063 4500953
CH042	272 Borsunlu	Potential Kurgan (Archaeology)	B	None	Goranboy	8639973 4500967
CH043	272 Borsunlu	Antique Period Burials (Archaeology)	B	None	Goranboy	8639670 4500829
CH044	Nadirkand	Kurgan Group (Archaeology)	B	None	Goranboy	8637722 4504348
CH045	Nadirkand	Settlement mound (Archaeology)	B	None	Goranboy	8637323 4503129
CH046	Muzcurlar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Goranboy	8636817 4507840
CH047	Yolpaq	Modern Cemetery (Intangible Cultural Heritage)	A	None	Goranboy	8636627 4510110
CH048	Yolpaq	Unknown Structures (Archaeology)	A	None	Goranboy	8636175 4510335
CH049	TP053A, Yolpaq	Bones encountered (Archaeology)	D	Unknown	Goranboy	8636006 4510220
CH050	TP054B, Yolpaq	Bones encountered (Archaeology)	D	Unknown	Goranboy	8635994 4510231
CH051	Sarov	Possible settlement mound (Archaeology)	C	None	Goranboy	8635165 4512444

No.	Name (including SCP KP)	Type	Sensitivity*	Impact	Rayon	Coordinates
CH052	Sarov	Modern cemetery (Intangible Cultural Heritage)	A	None	Goranboy	8635068 4512290
CH053	Sarov	Transhumant settlement (Archaeology)	D	None	Goranboy	8634941 4512765
CH054	289 Faxrali	Medieval Settlement (Archaeology)	B	Minor	Goranboy	8632497 4514341
CH055	294 Samux	Burial of unknown date (Archaeology)	C	Unknown	Samux	8627778 4517065
CH056	298 Lak I	Medieval Settlement (Archaeology)	C	Unknown	Samux	8623023 4518144
CH057	300 Lak II	Medieval Settlement (Archaeology)	C	Minor	Samux	8622830 4518286
CH058	Hajialili	Modern Cemetery (Intangible Cultural Heritage)	A	None	Samux	8621796 4519973
CH059	300.98 Hajialili II	Medieval Settlement (Archaeology)	C	Minor	Samux	8621708 4518838
CH060	302 Hajialili III	Medieval Settlement (Archaeology)	C	Medium	Samux	8621234 4519468
CH061	302 Hajialili III	Medieval Settlement (Archaeology)	C	Unknown	Samux	8621173 4519548
CH062	301 Hajialili I	Medieval Settlement (Archaeology)	C	Minor	Samux	8621154 4519534
CH063	Ganja	Medieval Town (Archaeology)	A	None	Samux	8619440 4509152
CH064	Samux	Transhumant settlement (Archaeology)	D	None	Samux	8619320 4522233
CH065	316 Seyidlar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Samux	8609689 4525901
CH066	316 Seyidlar	Bronze Age Settlement (Archaeology)	C	Medium	Samux	8609666 4526209
CH067	318 Seyidlar II	Medieval Settlement (Archaeology)	C	Minor	Samux	8607906 4525924
CH068	321 Garajamirli	Medieval Settlement (Archaeology)	C	Minor	Shamkir	8606234 4524303
CH069	323.57 Garajamirli I	Medieval Settlement (Archaeology)	C	Minor	Shamkir	8604287 4523022
CH070	Garajamirli	Modern Cemetery (Intangible Cultural Heritage)	A	None	Shamkir	8602402 4523742
CH071	Mahmudli	Modern Cemetery (Archaeology)	A	None	Shamkir	8597160 4525832
CH072	332.5 Ashagi Kechili	Nineteenth Century structures (Archaeology)	D	Unknown	Shamkir	8596553 4527028
CH073	332.7 Shamkirchai Kurgans	Kurgan (Archaeology)	B	None	Shamkir	8596460 4527066
CH074	Shamkir	Modern Cemetery (Intangible Cultural Heritage)	A	None	Shamkir	8595465 4524910
CH075	Shamkir	Shamkirchai Medieval Bridge (Archaeology)	A	None	Shamkir	8595388 4523058
CH076	333 Shamkirchai Kurgan 3	Kurgan (Archaeology)	B	None	Shamkir	8595212 4527381
CH077	Shamkir	Shamkir Citadel (Archaeology)	A	None	Shamkir	8595070 4522977

No.	Name (including SCP KP)	Type	Sensitivity*	Impact	Rayon	Coordinates
CH078	Shamkir	Medieval Town (Archaeology)	A	None	Shamkir	8594788 4522912
CH079	335 Chaparli	Chapel and cemetery (Archaeology)	A	Minor	Shamkir	8593132 4527934
CH080	Dallar	Modern cemetery (Intangible Cultural Heritage)	A	None	Shamkir	8591235 4528074
CH081	Dallar	Spread of Prehistoric pottery in quarry pit (Archaeology)	C	None	Shamkir	8591214 4528223
CH082	Dallar	Possible Kurgan (Archaeology)	C	None	Shamkir	8590599 4527724
CH083	Dallar	Possible Kurgan (Archaeology)	C	None	Shamkir	8590238 4528237
CH084	Dallar	Modern Cemetery (Intangible Cultural Heritage)	A	None	Shamkir	8588550 4528501
CH085	Dashbulak	Modern cemetery (Intangible Cultural Heritage)	A	None	Shamkir	8587765 4529593
CH086	342 Dashbulak	Medieval Settlement (Archaeology)	B	Medium	Shamkir	8587250 4529550
CH087	Shamkir	Unknown feature (Archaeology)	C	None	Shamkir	8582349 4531475
CH088	Shamkir	Transhumant settlement (Archaeology)	D	None	Shamkir	8582180 4531737
CH089	Bayramli	Settlement mound (Archaeology)	U	Unknown	Shamkir	8579019 4532117
CH090	Zayamchai	Settlement mound (Archaeology)	B	None	Shamkir	8575420 4533639
CH091	355 Zayamchai Catacomb	Excavation (Archaeology)	B	None	Shamkir	8575317 4533456
CH092	356 Zayamchai	Bronze Age Cemetery (Archaeology)	B	Minor	Shamkir	8574576 4534256
CH093	356 Zayamchai Cemetery	Medieval Cemetery (Intangible Cultural Heritage)	A	None	Shamkir	8574562 4534264
CH094	356 Zayamchai	Medieval Bridge Piers (Archaeology)	B	None	Shamkir	8574439 4534251
CH095	357.7 Sinig Korpu	Bronze Age Kurgan (Archaeology)	B	None	Tovuz	8573546 4534477
CH096	357.8 Siniq Korpu	Human remains visible 2002 (Intangible Cultural Heritage)	B	Unknown	Tovuz	8573482 4534523
CH097	358 Agili Dere	Chalcolithic settlement (Archaeology)	A	Minor	Tovuz	8573201 4534669
CH098	Ashaii Ayibli	Kurgan Mound (Archaeology)	B	None	Tovuz	8570921 4535890
CH099	Ashaii Ayibli	Kurgan Mound (Archaeology)	B	None	Tovuz	8570852 4535853
CH100	361 Khojakhan	Chalcolithic settlement (Archaeology)	A	Minor	Tovuz	8570723 4536425
CH101	Ashaii Ayibli	Modern Cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8570485 4534282
CH102	Mentesh	Settlement mound (Archaeology)	A	None	Tovuz	8570228 4534545
CH103	Ashai Ayibli	Modern Cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8569877 4535971

No.	Name (including SCP KP)	Type	Sensitivity*	Impact	Rayon	Coordinates
CH104	Tovuz	Modern Cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8568409 4537844
CH105	Tovuz	Modern Cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8560561 4541754
CH106	Goytepe	Settlement mound (Archaeology)	A	None	Tovuz	8559412 4537543
CH107	Asrikchai	Kurgan (Archaeology)	B	None	Tovuz	8557554 4540484
CH108	Asrikchai	Kurgan (Archaeology)	B	None	Tovuz	8557543 4540490
CH109	Asrikchai	Kurgan (Archaeology)	B	None	Tovuz	8557517 4540509
CH110	377 Asrikchai	Iron Age Settlement (Archaeology)	B	None	Tovuz	8556956 4542348
CH111	378 Tovuzchai	Bronze Age Cemetery (Archaeology)	A	None	Tovuz	8555736 4542667
CH112	Tovuzchai	Mammoth Kill-site (Archaeology)	A	None	Tovuz	8554745 4540575
CH113	380 Khunan	Bronze Age Settlement (Archaeology)	B	Unknown	Tovuz	8554318 4543319
CH114	Xatinli	Modern cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8553289 4545942
CH115	Tovuz	Modern Cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8552289 4543192
CH116	Tovuz	Modern Cemetery (Intangible Cultural Heritage)	A	None	Tovuz	8552242 4547253
CH117	398.8 Hasansu	Bronze Age Cemetery (Archaeology)	B	Unknown	Agstafa	8543626 4557544
CH118	398.9 Hasansu	Pottery Spread (Archaeology)	B	Unknown	Agstafa	8543418 4557675
CH119	399 Hasansu Kurgan	Early Bronze Burial (Archaeology)	A	None	Agstafa	8543220 4557965
CH120	405 Girag Kasaman	Medieval Settlement (Archaeology)	B	None	Agstafa	8540494 4563290
CH121	Girag Kasaman	Modern Cemetery (Intangible Cultural Heritage)	A	None	Agstafa	8540314 4563260
CH122	406 Girag Kasaman II	Antique period settlement (Archaeology)	B	Minor	Agstafa	8540008 4564098
CH123	408.8 Poylu II	Chalcolithic settlement (Archaeology)	A	Minor	Agstafa	8538514 4565839
CH124	409.1 Poylu I	Chalcolithic settlement (Archaeology)	C	Minor	Agstafa	8538198 4566035
CH125	409.2 Poylu	Nineteenth Century structures (Archaeology)	B	None	Agstafa	8538121 4566080
CH126	410 Poylu	Nineteenth Century structures (Archaeology)	C	None	Agstafa	8537621 4566897
CH127	432 Soyuqbulaq	Chalcolithic Cemetery (Archaeology)	A	Unknown	Agstafa	8522404 4578685
CH128	Soyuqbulaq	Modern Cemetery (Intangible Cultural Heritage)	A	None	Agstafa	8522239 4577435
CH129	Soyuqbulaq	Pir Religious Structure (Intangible Cultural Heritage)	A	None	Agstafa	8519806 4578629

No.	Name (including SCP KP)	Type	Sensitivity*	Impact	Rayon	Coordinates
CH130	438 Beyouk Kasik	Chalcolithic Settlement (Archaeology)	A	Unknown	Agstafa	8517274 4583136
CH131	Agstafa	Settlement mound (Archaeology)	A	None	Agstafa	8536577 4553516
CH132	Poylu	Settlement mound (Archaeology)	A	None	Agstafa	8536136 4556400

*Sensitivity ratings are further described in Chapter 3.