Chapter 7 Environmental Baseline

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7 ENVIRONMENTAL BASELINE

7.1 Introduction

7.1.1 Background

This chapter provides information about the environmental[1] conditions that are known, or are likely, to occur within the footprint of the WREP-SR Project. The purpose of the baseline characterisation is to:

- Document the current conditions
- Evaluate sensitive issues
- Enable the evaluation of potential impacts
- Assist in the definition of mitigation measures to minimise or eliminate impacts.

The baseline information was gathered through a review of relevant literature (including the original WREP EIA from 1996) and multidisciplinary field surveys. In some instances the findings of the baseline characterisation work have highlighted issues that have induced the Project team to implement re-routes or changes in the project design to avoid unacceptable impacts (as described in Chapter 4 Project Development and Evaluation of Alternatives).

Potential impacts on the physical and biological environment and respective mitigation measures are detailed in Chapter 10 Environmental and Social Impacts and Mitigation (Planned Activities), Chapter 11 Cumulative and Transboundary Impacts and Chapter 12 Hazard Analysis and Risk Assessment (Unplanned Events).

The baseline surveys were undertaken between 2007 and 2016 using a combination of local scientists and western experts. A summary of the baseline environmental information is provided in this chapter with detailed field reports included in the Environmental and Social Baseline Report (E&S Baseline Report).

7.1.2 Literature Reviews

A comprehensive literature review was undertaken of available physical and biological environment data sources to define the baseline conditions. The purpose of this review was also to identify gaps in baseline information where it would be necessary to undertake field surveys to obtain up-to-date relevant data to complete the ESIA process. In addition to the original WREP Refurbishment and Construction Project EIA (1996) and its addenda (which contain valuable baseline information; listed in Chapter 1, Introduction, Section 1.7), additional data sources were consulted. This gap-analysis approach allowed the Project to avoid repetition of work already undertaken and maximise the collection of focused, updated baseline data from the Project area.

The environmental literature review focussed on the following subject areas:

- Geology, geomorphology and geohazards
- Soils
- Contamination
- Landscapes
- Hydrology

[1] Socio-economic conditions are discussed separately in Chapter 8.

- Hydrogeology
- Surface and groundwater quality
- Protected areas
- Plant and animal species of conservation value
- Climate and meteorology
- Air quality
- Noise
- Cultural heritage sites.

7.1.3 Corridor and Route-Specific Field Surveys

The results of the literature review and gap analysis indicated there were certain key issues that needed detailed additional study for the WREP-SR Project, and that certain existing baseline data for the Project was either lacking or deemed too out of date (the original WREP EIA baseline data was collected in 1996) and needed supplementary information. The objectives of the surveys were to collect additional baseline data not available in the literature, to assist in the evaluation of the potential impacts along the route and, in some cases, to support the engineering design and routing of the replacement pipeline sections and associated access roads.

It was also concluded from the literature review that certain subject areas were adequately covered within the literature, including the original EIA and its associated addenda, and that baseline conditions either had not significantly changed (e.g. climate and meteorology, geology, hydrogeology, geomorphology and landscape) or that the scope of the WREP-SR Project was such that it did not warrant detailed baseline measurements (e.g. noise and air quality, as no new pump stations are planned for the Project).

The detailed environmental baseline surveys therefore conducted for the WREP-SR ESIA were:

- Land contamination – a baseline contamination walkover and survey was undertaken to document any existing contamination on the pipeline re-route sections and access roads
- Landslides – comprehensive work has been undertaken to identify all landslides in the vicinity of the WREP pipeline and to set up monitoring stations in landslide prone areas
- Soil classification and erosion susceptibility – a detailed soil survey was undertaken along the proposed re-route sections to enable the determination of the erosion risk and to assess the rehabilitation measures needed to stabilise and reinstate each section of the proposed route after construction
- Hydrology – this included surveys of all watercourse crossings along each re-route section to enable appropriate design of pipeline crossings, including defining set back distances and burial depths at each watercourse
- Surface water quality including sampling at all significant watercourse crossings
- Geotechnical investigation – this was carried out along all re-route sections to aid the evaluation of areas of ground instability and the identification of appropriate construction techniques in areas with geohazards
- Ecology – surveys of flora and fauna, with particular emphasis on protected and rare species and a macro-invertebrate survey at the two river crossings that are to be replaced
- Cultural heritage – a baseline walkover survey of the proposed re-route sections and temporary construction areas; a walkover survey of the proposed access roads will be undertaken during Spring 2016

- Traffic – a baseline survey at a key location where the WREP-SR Project could affect local traffic flows.

The baseline surveys were undertaken between 2007 and 2016 using a combination of local and international scientists. A summary of the baseline environmental information is provided in this chapter with detailed field reports included in the separate Environmental and Social Baseline Report (E&S Baseline Report).

7.1.4 Geographical Context

Georgia covers an area of about 69,700 square kilometres (about 26,900 square miles). Situated on the east coast of the Black Sea, it is bounded by Russia to the north and by Azerbaijan, Armenia, and Turkey to the south (Figure 7-1). Rugged mountain ranges dominate Georgia's landscape, constituting about 85% of the total land area. The main ridge of the Caucasus Mountains, or Greater Caucasus, forms most of Georgia's northern border with Russia and contains the country's highest elevations, including Mount Shkhara (5200m/17,060ft), Georgia's highest peak. The highest peak fully contained in the country is Mount Kazbek (5037m/16,526ft), in the central Greater Caucasus. Many other peaks reach heights of 4500m (15,000ft) or greater. The Lesser Caucasus Mountains occupy the southern part of the republic and rarely exceed an elevation of 3000m (10,000ft). These two mountain systems are linked by the centrally located Surami mountain range, which bisects the country along a north-east–south-west axis. The Surami range includes the Meskheti and Likhi ranges. To the west of this range, the relief becomes much lower, and elevations are generally less than 100m (300ft) along the river valleys and the coast of the Black Sea. On the eastern side of the Surami range, a high plateau known as the Kartaliniya Plain extends along the Mtkvari River to the border with Azerbaijan.

The WREP pipeline follows the Mtkvari (Kura) River valley plain from the Azerbaijan/Georgian border, diverging northwards around Tbilisi. It crosses from eastern to western Georgia over the Surami mountain range, progressively losing height as it traverses lower and flatter relief towards the Supsa terminal on the Black Sea coast.

Figure 7-1: Geographical Map of Georgia

7.2 Geology, Geomorphology and Geohazards

7.2.1 Introduction

Given the proximity of the sectional re-route activities to the existing WREP, the geological, geomorphology and seismicity baseline conditions remain as described in the 1996 WREP EIA. For completeness, these are summarised in the sections below. Significant additional information has been obtained in respect of potential geohazards along the WREP pipeline route since the original WREP EIA, with a particular focus on landslides. Comprehensive field assessment and measurements have been made in order to define and classify the landslides along the WREP route. The results of these surveys are provided in the E&S Baseline Report and summarised in this section.

The geological characteristics of the Project area are important for the preparation of an ESIA. Although no significant changes, or impacts, 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.

This section of the report illustrates the general characteristics of the surface geology along the WREP pipeline route, the location of seismically hazardous regions and the areas of geotechnical instability that may possibly affect the integrity of the pipeline.

7.2.2 Geology

Based on the lithological characteristics of the surface deposits along the WREP pipeline route, four regions can be identified. The WREP-SR sections are located within three of these regions, as described below.

From Azerbaijan border to Tbilisi (AM 0–AM 73)

This area crosses the valley of the river Mtkvari and its tributaries. The geology of the area is predominantly of Quaternary age with a net dominance of alluvial and lacustrine deposits of the river Mtkvari and proluvium deposited from the Iori plateau. Lithologically it is represented by loessial alumina, sandstone and shingle-gravel sized deposits. These deposits are often separated from each other by buried soil horizons. Their thickness varies from 10–15m to 200–300m. When the pipeline crosses low land or river valleys, the lithology consists of loose or scarcely cemented sediments (sand to large pebble size) underlying agricultural soils. When the route climbs gentle hills such as to the north of Tbilisi (Saguramo ridge area), the topsoil cover reduces in thickness to 10–15cm and the lithology consists of tertiary continental-marine molassial and terrigenous complexes. The former consists of alternate layers of medium cemented sandstones, conglomerates and clays while the latter consist of sandstones which alternate with clays containing lithified gypsum and argillites (claystones).

RR-001 and RP-001a are located within this geological region.

Kashuri to Zestaphoni (AM 190–AM 255)

In the section from Khashuri to Zestaphoni, the pipeline passes over the Likhi ridge, part of the Surami mountain range. This region has a complex geological structure with two distinctly different geo-tectonical complexes, known as the Dzirula crystalline rock mass:

- A lower pre-Jurassic level represented by crystalline layers (crystalline slates with variable petrographical composition, phyllites, gneisses, granites and granitoids), which are very disturbed and weathered

- A Mesozoic and Tertiary upper structural level, represented by a wide spectrum of volcanogenic deposited rocks (quartz-arkose sandstones, albitophyres. conglomerates, marbled limestones. aspidelitc slates, tuff breccias, tuff conglomerates, porphyrites, clays and marls with sandstone inter-layers).

RR-004a is located within this geological region.

River Supsa (crossings)

The Iithology of the river Supsa paleo-valley consists of fine siIts, sands and gravels. Replacement of both the Supsa river crossings is in this geological region.

7.2.3 Geomorphology

Replacement section RP-001a

This section is situated in the southern foothills of Saguramo-Ialno ridge, in the north-western most part of the Iori upland geomorphological region. Altitudes range from 650m to 950m above mean sea level (amsl).

Re-route section RR-001

Re-route RR-001 is located on the southern and south-western slopes of the Saguramo ridge. Altitudes vary between 600m and 800m amsl on average. This section starts from the base of the northern-eastern slope of Mt. Lurji Tsveri north of Gldani village and traverses low hills with ravines and narrow shallow gullies. The hills are composed of Neogene and Quaternary sandstones, clays and loosely cemented conglomerates.

Re-route section RR-004a

This section is located between AM 224 and AM 226 in the south-western part of the Chiatura structural plateau, north-west of Tkemlana village at altitudes of 725–750m amsl. The area traversed by the re-route is composed of the Cretaceous limestones.

Supsa crossings at AM 372 (WREP) and AM 1 (Export)

The Supsa River crossings are located in an alluvial valley where quaternary alluvial deposits (conglomerates, shingle, sands) are widespread. When these deposits are not associated with active river processes, they represent paleo-valleys of the Supsa River and the lithology consists of silts, sands and gravels.

7.2.4 Geohazards

Geohazards include processes caused by the gravity transport of weathering products such as slope erosion (gullying), mud flows, debris flows, scree or rock avalanches, and landslides caused by the mass movements of unstable materials and seismic hazards. A detailed assessment was undertaken of the risks posed by landslide prone areas along the existing WREP route. Subsequent surveys have also been undertaken for all WREP re-route sections. This section provides a summary of these assessments and briefly discusses other potential geohazards along the WREP pipeline sections.

Landslides

Landslides causing ground displacement form when a sliding movement of a mass of rock or soil takes place on a definite plane. This displacement may occur along a structural plane such as bedding, joints or schistosity or along a curved shear plane causing rotation, heave or slumping of the ground. Landslides commonly occur following movement along a lubricated bedding plane, often at the interface of permeable and impermeable rock types. Slumping in clays involves a rotary movement along a curved shear surface. Gravity, tectonic effects or water may initiate the ground movement and the rate of displacement may vary from slow creep to a sudden event.

Background to landslides in Georgia

Landslides are known to present a major problem to property and infrastructure in Georgia (e.g. Kuloshvili and Maisuradze, 2000; Tatashidze *et al*., 2000). By way of examples:

- Approximately 10,000 houses and 30,000ha of agricultural land were destroyed by widespread landslides during the wet years of 1967–68, resulting in $500M damage
- In 1983–85 around some first-time landslides were triggered and around 1200 pre-existing slides reactivated. This led to the loss of 2038 houses and damage to 1000ha of land. It is likely that these landslides were associated with heavy rainfall
- A combination of heavy rainfall and strong earthquakes in 1991–92 caused widespread damage, affecting 1500 settlements and triggering major rockslides. The total damage caused by landslides exceeded $10M
- A major landslide occurred in June 2011 following heavy rain at the Rikoti Pass causing four fatalities and significant damage to infrastructure including closure of the east-west highway. This was reported as the largest landslide in Georgia in 50 years
- In June 2015 a landslide dammed the river Vere near the village of Akhaldaba. The dam subsequently gave way during a heavy rainstorm and caused a flash flood in Tbilisi. The zoo was devastated, at least 20 people lost their lives and more than 450 people were injured.

It is the combination of uplifted, folded and faulted terrain and the presence of mudrocks within the young (in geological terms) sedimentary rocks that generates many landslide-prone settings. Landslides also occur in association with karst limestone terrain, as in western Georgia. The key landslide triggers are:

- Earthquakes: Tatashidze *et al*. (2000) indicate that recent widespread landsliding has been associated with earthquake events greater than five marks (on the local scale). For example, the Racha earthquake of 1991 triggered a landslide that destroyed the village of Chordi (north of Chiatura, West Georgia; Jibson *et al*., 1994). A further earthquake occurred in this region in 2009, but without serious consequence (Nikolaeva and Waller, 2015). Since 1978, six landslide-triggering earthquakes have occurred. This historical frequency suggests an annual probability of earthquake-triggered landslide activity of around 2.5/10 years (i.e. 0.25) for Georgia
- Heavy rainfall: landslide activity is often associated with wet years, defined by Tatashidze *et al*. (2000) as years when the mean annual precipitation (350–600mm in western Georgia; 400–800mm in eastern Georgia) is exceeded by 200–350mm. There have been 22 wet year sequences in the last 100 years, often preceded by a dry period. The wet years have been: 1897, 1906, 1911, 1915, 1924–25, 1931, 1936–37, 1939, 1940-41, 1951, 1953, 1963, 1967-68, 1970, 1976, 1980, 1983, 1986, 1987-89, 1991, 1993 and 1997). This historical frequency suggests an annual probability of rainfall-triggered landslide activity of around 2/10 years (i.e. 0.2) for Georgia.

Landslides assessment on the WREP route

WREP passes through a number of potential landslide prone areas that were only identified after construction. Technical assurance was initially provided by a Georgian Institute

(Environmental Geology Agency, EGA) with peer review undertaken by international specialists. This work has involved a series of stages:

- Identification of landslide prone areas by EGA (2000); this resulted in the identification of 12 landslide prone areas considered a potential risk to the pipeline
- Review of the EGA landslide study and preliminary assessment of risk by the international specialists (Fookes and Lee, 2000); this field review in July 2000 provided a qualitative risk assessment of each of the 12 landslide prone areas identified by EGA
- Compilation of preliminary landslide inventory for the WREP by the international specialists, based on interpretation of 1:20,000 scale aerial photographs and 6-day field verification (Fookes and Lee, 2001a); this was a systematic survey of landslide features *along and adjacent* to the right-of-way. Each landslide prone area was given a unique reference number linked to the map sheet on which it was recorded; for example 42/6 refers to landside 6 on map sheet 42. This study was updated in 2007 to include an assessment collected during monitoring post-2001 (i.e. the monitoring described below for 2002–2007)
- A quantitative assessment of landslide movement was undertaken (Fookes and Lee, 2001b); this resulted in the creation of a landslide prone area risk register for the WREP. This work also included an outline of the landslide management options available to the Project, including ongoing monitoring and re-routing
- Establishment of a surface movement monitoring programme at 22 landslide prone areas, by EGA under the direction of the WREP operations team (EGA, 2006)
- A landslide risk assessment and report was completed by the Project in 2009 followed by a risk review in 2010
- Review of micro-re-route (RR-001) and update of an assessment carried out in May; this report describes possible options for micro-routing at RR-001 to avoid landslide prone areas.
- A consolidated landslide risk assessment study completed in February 2012
- The WREP QRA was updated in November 2015, culminating in an updated risk register.

The various landslide studies have highlighted the following two areas:

- A series of elongate mudslides and deep-seated rotational landslides have developed in Oligocene-Lower Miocene plastic clays on the steep hill slopes between AM 53 and AM 69, north of Tbilisi
- The rolling upland terrain in the Likhi ridge area between AM 201 and AM 250, where landslides have developed on the steep ridge flanks in sequences of mudstones, sandstones and limestones.

Landslide movement monitoring

The landslide prone areas along the WREP are developed in clay-rich soils (weathered mudrocks); they all belong to the same landslide family and have broadly similar forms. Worldwide, the typical movement pattern of this type of landslide is:

- Creep phase: periods of extremely slow movement (typically mm/year)
- Slow phase: periods of slow movement (typically cm/year)
- Accelerated phase: shorter periods of accelerated movement (typically tens of cm/year to metres/year).

The transition between these three phases can occur in any year, although it typically coincides with wet periods. The landslides will also be influenced by strong earthquakes.

A surface movement-monitoring programme was established in 2002 at 22 of the landslide prone areas, by EGA under the direction of the WREP operations team. Monitoring has been ongoing since the third quarter of 2002, on a quarterly basis. All of the monitored landslides are currently in the creep to slow phase.

Landslide management

Before 2006, the landslide risks were managed by surface monitoring to detect signs of surface movement and then to intervene to protect the pipeline. No intervention was necessary until the acceleration in ground displacement at Dilikauri (AM 247+600). This led to a re-route to avoid this landslide and nearby landslides (at AM 246+800 and AM 247+250). This re-route was implemented in September 2007 using a combination of HDD and deep burial below the landslide mobile interface.

The WREP-SR Project is being implemented to substantially reduce the frequency of failure of the WREP. As part of this the pipeline is to be re-routed to avoid higher risk landslide areas.

Landslide-prone areas along the WREP route

The location and extent of landslides along the whole of the WREP route in Georgia are summarised below; landslides in the vicinity of the proposed WREP-SR Project are shown on the constraint maps provided in Appendix A.

Kvemo-Kartli Plain (AM 0–AM 39)

The pipeline in this area mainly crosses agricultural land and only climbs slightly elevated land to the north-east of Rustavi. There is the potential for the formation of localised swamps on flood plain terraces, landslides and ravine-type mudflows on high terraces and localised subsidence due to preferential dissolution of calcium carbonate or sulphate contained in the topsoil.

No WREP landslide prone areas were identified in this section.

Norio Village – Aragvi River (AM 39–AM 73)

This area extends over narrow fluvial terraces and relatively steep hills along the foothills of the Saguramo ridge. In this area, surface erosion, ravine development and localised subsidence are widespread on considerable sections. Almost all streambeds with steep gradients can be transformed into mudflows during heavy rain, although the solid discharge from the streams is of small volume. Medium depth landslides are frequent in this section and the risk of activation due to erosion of the foot of the landslide is evident. This section of the existing WREP route contains most of the high risk landslides, a number of which have been addressed by geotechnical stabilisation works and/or strain relief of the pipe.

Section RP-001a and RR-001 are being implemented in this area to avoid landslide prone areas where risk of activation is considered significant.

Aragvi River – Ksani River (AM 73–AM 100)

The area between the Argavi and Ksani Rivers is characterised by a fluvial morphology and its associated features: riverbank scouring, localised floods and localised massive sediment transport.

No WREP landslide prone areas were identified in this section.

Okami – Igoeti upland (AM 100–AM 145)

The underlying geology of this area consists primarily of geotechnically stable formations such as conglomerates. However, the presence of clayey strata within the conglomerate, in association with the high permeability of the conglomerate, facilitates the formation of large-scale landslides. This process becomes especially active in the case of slope cutting or other forms of slope de-stabilisation. Other typical processes in this area include surface erosion and mudflow-type floods in upper parts of streams. The potential for fluvial processes to cause scouring of the riverbed and riverbanks at the Liakhvi River (AM 142) led to a decision to replace the pipe at this location during 2014.

Upper Mtkvari valley (AM 145–AM 190)

This region is characterised by fluvial processes and associated geotechnical hazards: scouring of riverbanks, localised subsidence in loess deposits, local mudflows on steep banks of main rivers, erosive stream development and localised floods.

No WREP landslide prone areas were identified in this section.

Likhi ridge (AM 190–255)

This is the most complicated area along the pipeline route from a geological and geodynamic engineering point of view. Here the landslides, rock falls, mudflows, erosion and scour events and karstic features commonly occur. Landslides and landslide-rockfall processes frequently involve several tens of cubic metres of material. All rivers undergo active and sometimes severe erosion of riverbeds and banks. Karstic features within the carbonate strata are well developed in this area.

BP has already implemented various projects in this area to avoid landslides and/or stabilise the pipeline.

In this area, RR-004a is planned to avoid a landslide between AM 224 and AM 226 as part of the WREP-SR Project.

Zestaphoni-Supsa (AM 255–372)

This area consists predominantly of flat river valleys with the exception of a few localised areas where the WREP pipeline route is close to the foothills or climbs small, elevated areas. Geohazard areas are mainly limited to the elevated areas and consist primarily of localised landslides, riverbank erosion and flooding.

Proposed WREP-SR Project activities in this area are the replacement of the Supsa river crossings at AM 372 of the WREP and AM 1 of the Export pipeline.

Seismic characteristics along the WREP-SR route

The Greater and Lesser Caucasus Mountains form the central Asian segment of the ‘Alpine-Himalayan Fault and Fold Belt’. This belt extends from the Swiss Alps in southern Europe to the Himalayan ranges of India and Nepal.

The region is actively being deformed by the collision of the African, Arabian and Indian tectonic plates with the southern margin of the Eurasian continent. The territory of Georgia is seismically active, as it is located at the intersection of these continental plates. Tectonic movements take place along major deep abyssal faults and have determined the topography of Georgia, which now consists of two depressionary features (western and eastern Georgia) and a central elevation zone (Dzirula crystalline rock mass).

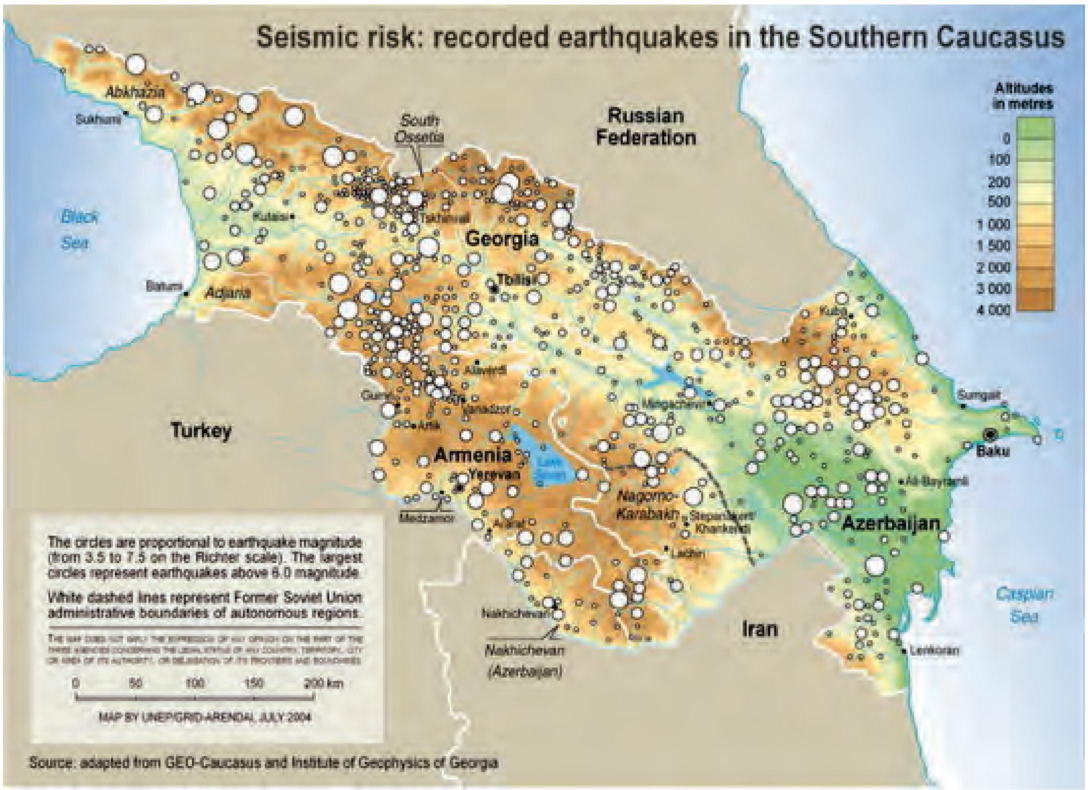

Figure 7-2: Seismicity Map of the Caucasus

The tectonic movements that take place along the deep fault zones are experienced on the earth surface in the form of earthquakes. The territory of Georgia can be divided into seismic zones, based on distribution of abyssal faults in the earth's crust and foci of earthquakes. A seismicity map of the Caucasus region is shown in Figure 7-2[2], where the white dots represent earthquake epicentres; the larger the dot, the higher intensity the earthquake.

Shallower, minor faults also form in line with the direction of movement. Therefore, in Georgia, east–west trending faults have formed, characterised by compressive thrust movements and north-east or north-west trending faults have formed, generally exhibiting lateral strike-slip movements.

A map illustrating the location of WREP in relation to surface and deep crustal faults is provided in the original 1996 WREP EIA.

A study performed in 1989 (Joseliani, Chichinadze, Diasamidze *et al*.) indicated a relationship between earthquakes occurrence in Georgia and the alignment of the major abyssal faults. Between 1802 and 1989, the highest recorded earthquake magnitude along the WREP pipeline route was approximately 5 Richter and was recorded a few kilometres east of the Ksani river crossing. A 6.6 magnitude earthquake was recorded some 15km south of the pipeline route in the valley of the Proni river.

The original WREP EIA concluded that based on this evidence, it did not appear that the pipeline route crosses areas where earthquakes of magnitude in excess of 6 (Richter) had been recorded. This magnitude is considered the threshold above which potential damage to the pipeline could occur. However, it is possible that earthquakes of lower magnitude (lower than 6 Richter) may trigger the formation of landslides or mudflows and thus have a

[2] http://www.grida.no/graphicslib/detail/seismic-risk-recorded-earthquakes-in-the-southern-caucasus_e080

potentially enhanced damaging effect on the pipeline. This is discussed in the Geohazards section above.

7.3 Soils and Ground Conditions

7.3.1 Introduction

Given the proximity of the Project activities to the existing WREP, the soil and sediment baseline conditions remain as described in the 1996 WREP EIA. For completeness, these are summarised in the sections below. Additional desk-based research was also undertaken in 2009 to assess the specific soil types encountered along the re-route sections, based on a 500m-wide corridor. A soil erosion assessment was also undertaken in order to develop adequate mitigation measures and reinstatement methods. A summary of these two reports is presented in this section.

This section also summarises the potential land contamination issues that may affect the WREP-SR Project. It should be noted that this section is based on information available at the time baseline surveys were undertaken, but there is the potential that additional contamination, particularly in the form of fly-tipping, will be identified during ROW clearance and access road preparation at the start of construction.

7.3.2 Description of Soils

Section RP-001a

The section is composed of loosely cemented conglomerates, sandstones, gravelly clays and loess-like loams of the Neogene and Quaternary periods.

Cinnamonic and calcareous cinnamonic soils dominate in this section. Cinnamonic soils have a loamy composition, relatively low gravel content and fairly favourable drainage properties. Average thickness of these soils is 70–100cm and they are prone to erosion Cinnamonic soils are characterised by fairly high fertility (humus content is 3–5% on average in the upper horizon); when irrigated, they provide high yield of corn, vegetables, fruit and grapes in this area.

Saline and solonetz soils of different degrees of salinity are found in minor localised areas, mainly at the bases of small troughs and shallow depressions where soils contain easily soluble salts. Such soils mostly occur in the areas north-east of Tbilisi reservoir. Saline and solonetz soil thickness varies from 80cm to 200cm; these soils have blocky structure, clayey composition and poor drainage properties, and are relatively stable in terms of erosion. Poor drainage, however, will lead to poor trafficability when wet.

Section RR-001

The hills of the southern and south-western slopes of the Saguramo ridge are composed of Neogene and Quaternary sandstones, clays and loosely cemented conglomerates. Cinnamonic forest soils characterised by fairly high fertility (humus content 3–7%) are mostly developed on the weathered material of these strata (refer to Section RP-001a for details on cinnamonic soils).

Brown forest soil of medium thickness with a well-represented humus layer is found in the western part of this section. Brown soils have a loamy composition, high gravel content and consequently, good drainage properties. Average thickness varies from 20–50cm to 70–100cm dependent on relief inclination. Brown soils are prone to erosion.

Section RR-004a

This proposed re-route between AM 224 and AM 226 is in an area of Cretaceous limestones. Yellow brown soils are mostly developed on the weathered crust of the limestones. Yellow brown soils have a loamy composition, high gravel content and good drainage properties. They are easily prone to erosion. Average soil thickness varies from 20–50cm to 70–100cm dependent on relief inclination. Brown and yellow brown soils are characterised by fairly high fertility.

7.3.3 Soil Erosion Potential along the Proposed Route Sections

A detailed soil erosion assessment of the proposed pipeline route was carried out in 2011 by the design engineers in order to evaluate the potential for soil erosion. This assessment allowed suitable stabilisation measures to be evaluated which will be implemented as part of the ROW reinstatement. The assessment was carried out in two steps. The first comprised a desk-based exercise to calculate, based on literature data, the potential for soil erosion owing to natural causes such as prolonged rainfall. The second step involved carrying out field verification of the variables used in the desk study and thus calibrated the calculations of the erosion risk.

The desk study involved collection of information on soil type, rainfall, slope length and gradient, vegetation cover and altitude along the pipeline route sections from available literature. The second step involved verification in the field of the slope lengths, gradients and the soil type.

The desk-based soil erosion assessment of the proposed re-route sections was carried out based on the information contained in a soil literature review (ESB Section 2) and erosion assessment reports (Morgan & Hann, 2001 and Morgan, Hann & Gasca, April 2001). Alignment maps for the re-route sections and the findings of route walks were also reviewed.

As a result of this assessment and subsequent route walks, the proposed ROW was classified into erosion classes detailed in Table 7-1. The re-route sections where erosion classes of 4 (High) or greater have been defined are presented in Table 7-2. Erosion rates of class 3 or lower have proved to be acceptable on the WREP, BTC and SCP pipelines as soil loss is relatively small and can be rectified by routine management measures.

Table 7-1: Erosion Severity Classes (Morgan *et al.*, 2001)

Erosion Class	Erosion Descriptions	Erosion Rate (tonnes/ hectare)	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

Erosion Class	Erosion Descriptions	Erosion Rate (tonnes/ hectare)	Visual Assessment
4	High	10–50	Connected and continuous network of rills every 5–10m 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 needed. Potential 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 needed. Damage to roads by erosion and sedimentation. Siltation of water bodies
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

Table 7-2: WREP-SR Sections with High Erosion Potential (Class 4 and Above)

Section	Distance from Start of Route Section (km)	Erosion Class
RP-001a		
RP-001a	1.32 – 1.98	4
RP-001a	2.05 – 2.14	5
RP-001a	2.14 – 2.30	4
RP-001a	2.30 – 2.44	5
RP-001a	2.44 – 2.50	5
RR-001		
RR-001	0.01 – 0.03	4
RR-001	0.05 – 0.13	4
RR-001	0.17 – 0.35	5
RR-001	0.35 – 0.52	4
RR-001	1.21 – 1.34	4
RR-001	1.43 – 1.82	5
RR-001	1.89 – 1.93	4
RR-001	2.00 – 2.02	5
RR-001	2.07 – 2.18	5
RR-001	2.18 – 2.25	4
RR-001	2.38 – 2.40	5
RR-001	2.53 – 2.84	5
RR-001	2.86 – 3.02	4
RR-001	3.02 – 3.50	5

Section	Distance from Start of Route Section (km)	Erosion Class
RR-001	3.50 – 3.66	4
RR-001	3.66 – 3.72	5
RR-001	3.77 – 3.86	5
RR-001	3.92 – 4.00	4
RR-001	4.00 – 4.34	5
RR-001	4.35 – 4.64	4
RR-001	4.85 – 5.40	4
RR-001	5.40 – 5.43	5
RR-001	5.50 – 5.53	4
RR-001	5.61 – 5.71	4
RR-001	5.90 – 6.28	5
RR-001	6.80 – 6.91	4
RR-001	6.91 – 7.00	5
RR-001	7.00 – 7.21	4
RR-001	7.21 – 7.33	5
RR-001	7.33 – 7.68	5
RR-001	7.68 – 7.85	4
RR-004a		
RR-004a	0.02 – 0.20	4

7.3.4 Land Contamination

The main potential sources of soil contamination affecting WREP and the surrounding area are reviewed and their characteristics summarised below (Table 7-3). A more detailed assessment of potential sources and results of the baseline surface contamination survey are provided in the following section entitled Soil contamination along WREP and Table 7-4.

Land contamination can affect surface waters and groundwater if a suitable pathway exists from land to water. This section addresses land contamination only; surface water quality and groundwater vulnerability are discussed in Section 7.5 and Section 7.6 respectively.

Table 7-3: Potential Contaminants along the WREP-SR Route

Contaminant	Typical Sources	Characteristics
Petroleum hydrocarbons	Contamination from pre-existing illegal taps; production activities; other pipelines; railways; waste disposal (including fly-tipping)	Toxic constituents are typically also the most mobile. Majority of the compounds will biodegrade. Direct toxicity risks associated with inhalation of volatile components. Health risks associated with ingestion and dermal contact. Some constituents (such as benzene) are suspected human carcinogens
Heavy metals (particularly chromium, mercury and lead)	Industrial activities and waste disposal (including fly-tipping)	Often persistent in soil. Some salts have relatively high solubility. Typically less mobile in alkaline conditions. May be toxic to humans, animals and plants. Principal exposure through inhalation and ingestion

Contaminant	Typical Sources	Characteristics
Asbestos	Industrial activities (gaskets, lagging, filters, break pads), waste disposal (including fly-tipping)	Usually white, grey/blue or brown fibrous material. Carcinogenic and respiratory risks to humans through inhalation. Mobility (and therefore exposure risks) limited by surface coatings and damp conditions
Polycyclic aromatic hydrocarbons (PAHs)	Oil production; incinerators and fires; timber preservatives; tars	Often persistent in soils. Generally exhibit low solubility and are at best semi-volatile. Potential human carcinogens (especially benzo[b] fluoranthene and benzo[a]pyrene). Most common exposure routes are through ingestion and inhalation. Dermal contact may also pose risks
Radioactive materials	Military activities, oil exploration and production (radionuclides may be released by operations such as drilling wells, oil collection, produced water disposal and oil storage)	May be encountered in a wide variety of forms and materials. Potentially carcinogenic and mutagenic
Chlorinated solvents (TCE, PCE, TCA etc.)	Industrial activities (degreasants, chemical plants)	Typically colourless volatile liquids with a density greater than water. Mobile in the environment, but with relatively low solubility in water. Potential mutagens and, in some cases, directly toxic. Exposure via inhalation, ingestion or dermal contact
Pesticides and herbicides	Agricultural activities	Various. Typically persistent in soil. Potentially carcinogenic and mutagenic
Polychlorinated biphenyls (PCBs)	Electrical switchgear, waste disposal	Often persistent in soil. Suspected carcinogens in humans. Principal risks associated with inhalation or ingestion and, to a lesser extent, dermal contact
Dioxins	Incinerators, waste disposal	Usually encountered in ash from fires or incinerators that included chlorinated materials in the fuel stock. Potentially carcinogenic at very low concentrations. Persistent in soil. Typical exposure via ingestion or inhalation
Biological hazards	Sewage, animal carcasses, tanneries, occasionally soil	Various. Possible pathogens in soil include anthrax, foot-and-mouth disease and tetanus

Soil contamination along WREP

The re-route pipeline sections are typically located in forest or on agricultural or pastureland with minimal potential for land contamination. However, localised areas of land contamination may affect the WREP-SR Project as listed below and discussed in the following sections:

- Areas of WREP-associated historical hydrocarbon contamination
- Localised fly-tipping of domestic waste
- Unregulated landfill sites
- Potential unexploded ordnance (UXO)
- Past agricultural practices
- Biological hazards.

WREP historical hydrocarbon contamination

Before GPC undertook the WREP construction and refurbishment project in Georgia in 1997–98, the majority of the WREP consisted of an existing Soviet-era oil pipeline constructed in the 1970s. The following sources of hydrocarbon exist associated with the WREP pipeline:

- Areas of pre-existing hydrocarbon contamination prior to GPC's construction and refurbishment of WREP in 1996. These would have been associated with leaks from hot taps. These have been mapped by GPC, although they were not cleaned up by the previous operators
- De-oiling sites from WREP construction and refurbishment 1997–98. During construction, de-oiling of the existing Soviet-era pipeline was needed and some small spillages occurred. These sites were all subject to remediation by GPC
- Illegal taps. Illegal tapping (illegal removal of oil) by third parties along the WREP pipeline has been recorded since WREP became operational in 1998. With regards to sections associated with WREP-SR Project, one illegal tap was found near AR52 (section to be replaced by RP-001a) and one on the road to BVS27 (a potential de-oiling site. From an environmental perspective, this has led to localised ground contamination, (Photograph 7-1). All sites where contamination was found to have occurred have been subject to remediation by BP.

Photograph 7-1: Example of Soil Contamination from Illegal Tap

Locations of pre-1996 contamination sites in the vicinity of the WREP-SR areas are given in Table 7-4. WREP-associated hydrocarbon contamination has been subject to remediation in all areas except those of pre-existing contamination from pre-1996 operations. All sites are considered to be a sufficient distance from the WREP-SR sections as to not cause impact on construction.

Table 7-4: Sites of Known Contamination along WREP-SR Sections (pre-1996)

RP/RR	Location with Reference To Nearest AM on Existing Pipeline	Description
RP-001a	AM 53+100	Illegal tap – remediated
RR-001	AM 63+200	Pre-1996 contamination – not remediated
RR-001	AM 64+500	Pre-1996 contamination – not remediated

Fly-tipping and unregulated landfill sites

Centralised sewage and household waste collection and treatment facilities have only been established recently in many of the villages within the WREP-SR Project area. Historic uncontrolled dumping of waste and sewage imposes a risk of pollution to land, groundwater and surface water. Where domestic waste tips exist, all but the most modern facilities are generally unlined and poorly managed. Unregulated burning usually takes the form of open bonfires. In addition, fly-tipping of domestic waste is not uncommon along the WREP pipeline route and surrounding area. An example of the type of fly-tipping observed along the route is shown in Photograph 7-2.

Photograph 7-2: AM 69 Fly-Tipping of Domestic Waste

Agricultural activities

The WREP pipeline crosses areas that supported intensive agriculture during the Soviet era. It is likely that persistent agrochemicals such as pesticides and herbicides remain in the soil. However, this is not monitored by BP, as it is not considered to constitute a significant risk.

Biological hazards

Anthrax is endemic in Georgia and, according to official data, from 1992 to 2001 only 10 animal anthrax outbreaks were recorded in Georgia. In the 1990–2003 period, 196 human cases were recorded in Georgia. The geographic distribution of human cases indicates that anthrax foci are located in particular districts. Some large outbreaks have occurred, such as those in Dedoplistskaro and Gardabani in 1999 (24 and 16 cases, respectively) and in Akhalkalaki in 2000 (20 cases). Human cases were particularly frequent in the Gardabani area, with 39 cases recorded in the period from 1997 to 2002. In 2014, a total of 57 cases of human anthrax per 100,000 population were recorded in Georgia (NCDC, 2015).

7.3.5 Summary of Land Contamination along the Route Sections

Several contaminated and potentially contaminated sites were identified along each re-route pipe section as part of the baseline study. In summary, these sites include three sites contaminated with oil from soviet era operations of WREP, one of which has been remediated. There is also sporadic fly-tipping along the re-route sections.

7.3.6 Soil Sensitivities

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are:

- Areas with high soil erosion potential as identified in Table 7-2
- Areas of known contamination as identified in Table 7-4.

7.4 Landscape and Visual Receptors

7.4.1 Introduction

Given the proximity of the activities to the existing WREP, landscape conditions remain unchanged from that described in the 1996 WREP EIA. For completeness, these are summarised in the sections below and issues of particular relevance to the WREP-SR Project are highlighted.

Information is also provided on the Landscape Protection Zone (LPZ) associated with the Mtskheta UNESCO World Heritage Site.

The WREP pipeline route crosses the entire territory of Georgia from the Azerbaijan border to the Black Sea and traverses the whole variety of landscapes that can be found in the country with the exception of high mountain ranges. The landscapes encountered include semi desert, mountain and subtropical zones. The landscape is considered to be sensitive in the mountain forests of Tbilisi National Park and the Mtskheta LPZ.

7.4.2 Landscape Character Assessment

This section describes the criteria used to define the visual character and variety class of an area and the visual sensitivity and distance zones (as defined in the WREP EIA, 1996).

Visual character and variety class

Visual character of an area is composed of features that could be natural in appearance, with little or no apparent human disturbance, rural or urban. Four principal elements create an area's aesthetic identity: natural landforms, vegetative pattern, water features and existing man-made modifications to the landscape.

The visual character classification for various types of landscape used in the Project is presented below (USDA, 1987):

- *Class A: distinctive* – landscape features are highly varied and distinctive providing unusual or outstanding visual quality
- *Class B: common* – landscape features are moderately varied and contain a variety in form, line, colour and texture or a combination of thereof, but tend to be common throughout the character type. These areas are not considered outstanding in visual quality
- *Class C: minimal* – landscape features are only slightly varied. Patterns tend to be of low contrast and are not discernible. Overall, the landscape appears to be homogeneous; class C includes all areas not found in class A or B.

Visual sensitivity

The visual sensitivity of a resource is a relative measure of the degree of public interest in the resource, as well as concerns over changes in the quality of the resource. Sensitivity is evaluated by the frequency with which the resource is viewed, the type of viewer (static or transient receptor), and the distance from which the resource can be seen.

High sensitivity

- Areas viewed from primary travel routes and recreational areas with moderate to high volumes of use throughout much of the year and where visual quality is a major concern to users
- Areas providing regionally or locally rare recreation opportunities whose scenic character is natural in appearance
- Areas viewed from scenic highways or local scenic routes.

Moderate sensitivity

- Areas viewed from primary travel routes and recreational areas where visual quality is of minor concern to users
- Areas viewed from secondary travel routes or areas where visual quality is of major concern to users.

Low sensitivity

- Areas viewed from secondary travel routes or areas where visual quality is of minor concern to users.

Distance zones

The level of impact significance is in the part influenced by the distance from which the effects can be seen:

- Foreground – usually limited to areas within 0.25–0.5 mile of the observer where details are apparent
- Middle ground – extends from the foreground to 3–5 miles from the observer. This zone is particularly important due to large areas seen from each viewpoint where moderate detail can be perceived
- Background – extends from middle ground range to the horizon where details are not perceived and colour, shape and texture become increasingly important.

7.4.3 Landscape Character of the Pipeline Sections

Saguramo ridge: RP-001a and RR-001:

Pipeline sections RP-001a and RR-001 are located in the foothills of the Saguramo ridge, where the landscape changes from the flat, semi-desert landscape further east towards the Azerbaijan border, taking features more natural in appearance. Low-mountain landscapes with oriental hornbeam and oak woods on stony cinnamon soils underlain by rocks occur up to 800–1000m. Higher in the mountains they are changed by medium-mountain landscape with beech and pine forests predomination on less developed soils of the same type. The topography and scenic beauty give this section of the route class B variety classification with local distinctive areas (class A) in the most undisturbed territories. The route is located within the foreground distance zones of travellers along the enhanced roadway from Gldani to the north-east and primary travel routes from Tbilisi to Kakheti (within Lachina river canyon) and from Tbilisi to Vladikavkaz. Intensive erosion within existing pipeline and electricity cable rights-of way decreases the aesthetic features of the landscape.

A landscape protection zone (LPZ) has been defined in this area to safeguard the historical landscape surrounding the Mtskheta World Heritage Site. The LPZ includes the Jvari mountain and monastery, the Kartli ridge and the cultural heritage monuments of Bagineti, the unique view of Svetitskhoveli complex, Bebristikhe, Kodmani mountain, Tsitsamuri, Zedazeni and Saguramo ridges. The typical landscape of this area is shown in Photograph 7-3. The LPZ is described in more detail in Section 7.10.5 Mtskheta protection zones, and shown on Photograph 7-3. The WREP-SR pipeline is within or close to the LPZ between KP6.0 and KP7.8 of RR-001.

Photograph 7-3: Typical Landscape around Mtskheta

Western Georgia: RR-004a and Supsa River crossings

Pipeline section RR-004a is located on the western flanks of the Likhi ridge within the upland landscape of western Georgia. Landscapes with oak, beech and chestnut predomination on yellow-podzolic and podzolic-brown soils underlain by Quaternary alluvium have formed within the hillocks. These foothills would generally be classed as class B.

The Supsa River crossings are located within a lowland plain which are characterised by scattered oak forests with evergreen undergrowth on podzolic brown and yellow-brown soils underlain by alluvial deposits. In places, the landscape also includes sphagnum bogs. The plain along the pipeline route is intensively used for agriculture and its diversity is consistent with Class B and C (i.e. low sensitivity).

7.4.4 Landscape Sensitivities

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are:

- Parts adjacent to the Tbilisi National Park (RR-001) where the topography and scenic beauty give this section of the route a high sensitivity rating
- The landscape protection zone (LPZ) surrounding Mtskheta UNESCO World Heritage Site, a key tourist area for Georgia, is crossed by the proposed section RR-001.

7.5 Surface Water Resources

The River Supsa (AM 372) is the only major[3] watercourse crossed by the proposed replacement sections. The remaining watercourses crossed are classed as minor rivers, streams, gullies and irrigation channels.

This section provides a brief overview of the hydrological regime in Georgia and the characteristics of the larger watercourses crossed by WREP. This is followed by a detailed baseline assessment of the hydrological regime and surface water quality of the water body crossings along the proposed WREP re-route sections. In order to provide information on hydrology and water quality, the following surveys were commissioned:

- Hydrology survey (Dzelkva Environmental Advisory Services, 2009 and 2011)
- Water quality analysis (Gamma, 2009 and 2011).

Pre-construction monitoring of water quality commenced in July 2016 and will be repeated approximately quarterly until construction begins. The results will be used to provide a more robust baseline for construction phase monitoring and will be supplied to MENRP as required.

Watercourse crossing locations are also shown in the constraints maps provided in Appendix A.

7.5.1 Overview of Hydrological Regime in Georgia

The hydrological regime in Georgia is characterised by the presence of two main catchment basins: the Caspian catchment and the Black Sea catchment. The watershed that separates the two catchments coincides with the Surami ridge, which also divides Eastern Georgia

[3] In the context of the WREP-SR Project these are rivers characterised by a flow width greater than 50m

from Western Georgia. All watercourses in western Georgia ultimately flow into the Black Sea and all watercourses in eastern Georgia ultimately flow into the Caspian.

Two major drainage valleys act as surface water collectors in the two catchments: The Rioni valley drains western Georgia and the Mtkvari[4] valley that drains eastern Georgia. Several tributaries flow into the Rioni and Mtkvari Rivers.

The characteristics of the Rioni and Mtkvari Rivers are very similar: both rivers are large braided channel systems with predominance of sand and silt sediment transport and a gentle gradient. Seasonal variation of the discharge rate and flow velocity of the two rivers is associated with the inflow of water from their tributaries, which reach their maximum capacity during snow-melt season (April and May).

The tributaries of the Rioni and Mtkvari mainly have Alpine characteristics, as they drain the mountains of the Greater and Lesser Caucasus. Floods are very common during periods of high rainfall as channel gradients are generally steep and hardly any flow control engineering is present to break the energy of the rivers before reaching the main collector valleys. Flash floods with extremely high sediment loads are also common during periods of heavy rainfall.

The WREP pipeline crosses a number of major, high-energy tributaries to the Rioni and Mtkvari Rivers, and the remaining crossings are of minor tributaries of these rivers, or streams, or gullies, or irrigation channels.

7.5.2 Hydrology

A hydrology survey, comprising desk-based assessment and field visits, was undertaken for all WREP-SR watercourse crossings in order to provide photographs and basic information on a number of physical factors. For each crossing along the route, the following information was recorded:

- GPS location of crossing
- Approximate location aerial marker (AM) of crossing
- Photographs (both upstream and downstream)
- Width and depth of water flow
- Width and depth of channel
- Upstream catchment area
- Type of, and distance to, sensitive downstream receptors
- Flow rate (approximate)
- Type of watercourse: natural, modified (e.g. canalised) or artificial (e.g. man-made irrigation).

Summary data on the main watercourses are presented in Table 7-5. The proposed re-route sections of the WREP cross eleven watercourses, comprising one natural river, one stream, one wet gully and nine natural gullies that were dry at the time of survey. The latter are included in this section as they have the capacity to carry water during storm events and snow-melt.

[4] The Mtkvari River is also known as the Kura River

Table 7-5: Hydrological Characteristics of Watercourses Crossed by the WREP

No.	Name	AM Location	Crossing Coordinates		Upstream Catchment Area, km²	Flow Width, m	Flow Parameters		Channel Parameters		Watercourse Type			Distance to Downstream Receptor	Note
			X	Y			Depth, m	Rate, m/sec	Width, m	Height, m¹	Natural	Artificial	Modified		
1	Gully 1	54+670	8491349	4629137	5.75	-	-	-	8	2.0	+	-	-	11.3km to r. Mtkvari	GOGC RoW on negative side covered with plastic netting to aid biorestoration
2	Jokhtaniskhevi gully	63+90	8485475	4633193	8.80	1.0	0.05	0.20	12	1.5	+	-	-	5.2km to r. Mtkvari	
3	Gully 2	63+100	8485475	4633203	8.80	-	-	-	-	-	+	-	-	5.2km to r. Mtkvari	
4	Gully 3	S of 65	8483595	4633353	0.51	-	-	-	4	1.0	+	-	-	5.2km to r. Mtkvari	Dry; there is a road in the gully. There are two houses near the crossing. The route is likely to cross their land plots. No inhabitants were noticed during the fieldwork
5	R. Jachviskhevi	S of 66	8483054	4633352	7.10	0.50	0.10	0.70	15	4.0	+	-	-	2.4km to r. Mtkvari	There is a steel pipe in the riverbed at Jachviskhevi crossing creating a waterfall effect; due to this the bed is washed out to a depth of 2–2.5m downstream of the pipeline
6	Gully 4	67+100	8482146	4634062	0.16	-	-	-	7	5.0	+	-	-	2.2km to r. Mtkvari	Dry

No.	Name	AM Location	Crossing Coordinates		Upstream Catchment Area, km^2	Flow Width, m	Flow Parameters		Channel Parameters		Watercourse Type			Distance to Downstream Receptor	Note
			X	Y			Depth, m	Rate, m/sec	Width, m	Height, m[1]	Natural	Artificial	Modified		
7	Gully 5	67+150	8480600	4634002										2.2km to r. Mtkvari	Not surveyed. Desktop review data
8	Gully 6	67+200	8482121	4634002										2.2km to r. Mtkvari	Not surveyed. Desktop review data
9	Gully 7	SE of 69	8480600	4634002										2.5km to r. Mtkvari	Not surveyed. Desktop review data
10	Gully 8	S of 69	8479881	4634422	3.42	-	-	-	15	5.0	+	-	-	2.7km to r. Aragvi	A 1500mm leaking water pipe passes through the left slope of the gully (likely for supply of Tbilisi). The spilt water flows into the gully. The gully itself is dry
11	Gully 9	WREP Export	8232130	4659738										0.7km to r. Supsa	Not surveyed. Desktop review data
12 & 13	R. Supsa	WREP 372+200 Export 1.62	8232341/ 8232724	4661308/4659742	1.125	80	2.5	0.35	60	3.7	+	-	-	2km to Tskaltsminda Village (left bank), 2.5km to small wetland habitat	

[1] Maximum water level at peak flows (flash floods)

River Liakhvi

The Liakhvi River crossing near AM 142 is no longer part of the WREP-SR Project as it was replaced in 2014. A description of the baseline conditions is included in this section as the river may be used as a source of water for hydrotesting.

The source of the Liakhvi River is located in the vicinity of village Goluata at the altitude of 2337m. The Liakhvi is a tributary of the Mtkvari River with the confluence located at an altitude of 972m near Gori. The river is approximately 98km long, has a total fall of 1755m with an average incline of 17.9%. The total area of the catchment basin is 2440km^2.

The Liakhvi has 591 tributaries and the river basin is located on the southern slope of the Caucasus ridge enclosed by the Racha and Surami ridges to the west, the Kharuli ridge to the east and the Mtkvari River lowland to the south. The river basin is divided into three distinct sections, the high mountainous part, foothills and lowlands. The high mountainous part of the basin is comprised of slatey clays, marls and limestones. The foothill sections are composed of sandstones and slatey clays while the lowland section is comprised of old and recent alluvial sediments.

The river is recharged by precipitation, snow, glaciers and groundwater. It is characterised by spring floods and low water levels in winter. It is used for irrigation and supplies the irrigation systems of Kehvi, Tiriponi, Saltvisi and Zeda Ru and numerous local canals.

Photograph 7-4: River Liakhvi at Existing WREP Crossing (western (right) bank)

River Supsa

Two crossings of the river Supsa are to be replaced: the WREP section between AM 371 and AM 373 and the export pipeline around AM 1. The proposed method of construction of both new crossings is horizontal directional drilling (HDD). At the crossing points, the river is approximately 80m wide, 2.5m deep and has a flow rate of 0.35m/sec with an average multi-year discharge of 48.5m^3/sec. The river banks are comprised of loams covered by herbaceous vegetation with alders and their height is 1.8-2m.

Groundwater in the vicinity of the crossing points (and for the entire Kolkheti lowland) is very shallow (approximately 0.8-1.0m below ground level).

The Supsa is a Black Sea coastal river characterised by flash floods caused by rains throughout the year. The average number of flash floods varies from 15 to 27 per year with the maximum levels usually observed in the autumn. The river discharge is closely dependent on quantity and intensity of precipitation with maximums being recorded in spring (April/May) and autumn (October).

The total length of the river is 108km, with an average inclination of 24.1% and a total catchment area of 1130km^2. Narrow deep gorges and ravines are numerous in the upper reaches of the basin. Central and lower parts of the basin are characterised by low mountainous terrain and relatively smooth shapes. The lowermost part of the river basin is situated in the Kolkheti lowland where the Supsa valley is not clearly delineated.

The geology of the upper reaches of the river basin is represented by tufogenes, quartz-grained sandstones and sandy-clayey slates. The remaining areas of the basin are represented by conglomerates and various types of clays with layers of marls, gravel and sand. The basic rocks are mainly overlain by loamy soils. Despite its low flow velocity near the estuary, the river retains sufficient kinetic energy to facilitate scour of the river bed which is comprised of fine fractions.

Local residents use river for boating and fishing near the estuary mouth which is c.3km from the WREP crossing that is to be replaced and 1.4km from the export pipeline crossing.

Photograph 7-5: River Supsa WREP Crossing

7.5.3 Water Quality

Physico-chemical parameters

A survey of physico-chemical water quality parameters was conducted in the field during the periods 27–29 April 2009, apart from the rivers Supsa and Liakhvi which were surveyed 19-20 July 2011. Pre-construction monitoring of water quality began in July 2016 and will continue approximately quarterly until construction begins; results will be supplied to MENRP as required. Sampling locations have been established at the following locations:

- Jokhtaniskhevi gully where crossed by RR-001
- R. Jachviskhevi where crossed by RR-001
- R. Liakhvi (a potential source of hydrotest water)
- R. Supsa crossing.

In 2009, on-site measurement of pH, temperature, specific conductance, and dissolved oxygen was performed using a portable tester. Surface water samples were also collected for laboratory analysis for a range of analytes comprising metals; total petroleum hydrocarbons; coliform bacteria; chemical oxygen demand (COD); nitrogen compounds (nitrite, nitrate, ammonia); sulphate; chloride; carbonate; turbidity; total suspended and total dissolved solids; and total hardness. It should be noted that it was not possible to analyse the 2011 samples for the full range of determinands that were scheduled in 2009. Details of methodology and co-ordinates of sampling points are presented in Section 3 of the E&S Baseline Report.

Several quality assurance (QA) measures were in place throughout sampling to ensure confidence in results. These included, but were not limited to, single-use sampling containers (sterile for microbiological samples), submission of blind sample containers, measurement/inspection of sample package temperature/integrity upon receipt at laboratory, and use of analytical blanks and ‘spiked’ samples.

Water quality results were compared with the EU Directive 2006/44/EC: Freshwater Fish Directive in order to establish the relative quality status of the water bodies. These include ‘guide’ (i.e. good) and ‘mandatory’ levels for a range of parameters for two types of water body as follows:

- Salmonid waters (i.e. capable of sustaining species such as salmon and trout that generally require uncontaminated, well oxygenated water), and
- Cyprinid waters (i.e. able to support species such as carp, which are generally more tolerant of lower oxygen levels and greater levels of contamination).

Results from the water quality surveys are presented in Table 7-6 and Table 7-7.

All of the physico-chemical parameters recorded (pH, conductivity, turbidity, total suspended solids) were within the range expected for such watercourses. Dissolved oxygen was within expected ranges for all samples.

No gross chemical contamination (including odour) was recorded. Results from a number of analytes (arsenic, chromium, cobalt, copper, nickel, silver manganese, cadmium, mercury and lead), ammonia and light fraction hydrocarbons were below detection limits.

Total coliforms and *E. coli* were present in all samples; the presence of *E. coli* indicates contamination from human wastewater or livestock effluent. In 2011, the levels of bacteriological contamination were high in samples from the Supsa and Liakhvi. No sulphur-reducing bacteria, an indicator of low oxygen conditions, were recorded in either river and total petroleum hydrocarbons (TPH) were below detection limits at all sampling points.

Macro-invertebrates

Macro-invertebrate studies were undertaken for the Supsa and Liakhvi river crossings in September 2011 to further assess water quality. The results are presented in the E&S Baseline Report Sections 5.4c and 5.4d and summarised below.

Overall, a measurement of total taxa richness averaged 62 in samples from the Liakhvi River and 19 in samples from the Supsa River.

The species collected during the Supsa survey were dominated by organisms capable of living under stressful conditions such as habitat disruption or pollution. Fluctuating salinity as a result of tidal influence, the continuous rise and fall of the water level in the estuary and the scouring and deposition that occur as a result of seasonal storms combine to make this stretch of river a very difficult habitat to survive in.

The high percentage of stress tolerant species (71%) identified in the samples from the Liakhvi indicates that, in its mid-reaches, the Liakhvi is dominated by species which can withstand increased sedimentation and/or runoff.

Comparison to water quality standards

A comparison of the available survey data with values from the EC Freshwater Fish Directive 2006/44/EC shows[5]:

- All pH values were compliant
- For dissolved oxygen, all values were compliant with the mandatory value for cyprinid waters (7mg/l), while some far exceeded the salmonid guide values
- For total suspended solids (TSS), all values were compliant, although samples from the Liakhvi had extremely elevated values for TSS and Supsa were only marginally compliant
- For nitrites, the detection limit (0.02mg/l) did not allow the determination of compliance with salmonid waters (0.01mg/l). A sample from the river Jokhtaniskhevi crossing was an order of magnitude above the guide levels
- For ammonium, copper and zinc, all samples were compliant with the most stringent values.

In summary, the watercourses sampled are, in general, capable of supporting healthy populations of cyprinid, and in some cases salmonid, fish. The exception to this is the Liakhvi, which had extremely elevated levels of TSS and bacteriological contamination at the time of sampling in 2011 (in 2011 the Supsa also had similarly elevated levels of bacteria). At these levels, oxygen depletion may occur and may affect the quality of the water such that it is periodically unsuitable for the majority of fish species.

[5] It should be noted that not all determinands were analysed at all locations.

Table 7-6: Water Quality Results: Physico-Chemical Parameters, Chemistry (exc. Metals and TPH) and Microbiology

Crossing	AM point	Temp	SpC	pH	DO	TDS	TSS	Turbidity	Total Hardness	SO_4	NH_4	NO_2	NO_3	Cl	HCO_3	Total coli-forms	e-coli	Sulphate Reducing Bacteria
		°C	µS/cm		mg/l	mg/l	g/l	NTU	mg-eqv/l	mg/l						MPN, CFU per 100ml	MPN, CFU per 100ml	CFU per 50ml
Jokhtaniskhevi gully	63+100	19.8	1242	7.88	7.64	1095	0.010	8.58	22.68	415.6	<0.02	0.12	3.3	29.8	356.2	9000	7200	0
River Jachviskhevi	South of 66	16.6	442	7.46	8.20	373	0.015	18.02	3.52	53.9	<0.02	<0.02	12.2	11.0	214.7	4500	4000	0
River Liakhvi	142	NA	461	8.30	7.27	NA	0.459	880	NA	13.6	NA	NA	NA	0.7	NA	52,000	40,000	NA
River Supsa	372+200	NA	180	7.75	6.19	NA	0.028	21.73	NA	8.0	NA	NA	NA	14.2	NA	15,000	12,000	NA

NA = not analysed

Table 7-7: Water Quality Results: Metals and Total Petroleum Hydrocarbons

Crossing	AM point	Ag	As	Ca	Cd	Cr	Co	Cu	Fe	Hg	K	Mg	Mn	Na	Ni	Pb	Zn	C_6–C_{10}	$>C_{10}$
		mg/l																	
Jokhtaniskhevi gully	63+100	<0.02	<0.005	108	<0.02	<0.02	<0.02	<0.02	<0.1	<0.002	2.64	50.4	<0.2	132.0	<0.005	<0.01	0.020	<0.04	<0.04
River Jachviskhevi	South of 66	<0.02	<0.005	64	<0.02	<0.02	<0.02	<0.02	<0.1	<0.002	1.49	13.2	<0.2	15.0	<0.005	<0.01	0.014	<0.04	<0.04
River Liakhvi	142	NA	<0.01	80	<0.001	<0.01	NA	<0.003	0.6	<0.0002	NA	NA	<0.01	NA	<0.003	<0.01	<0.003	<0.04	
River Supsa	372+200	NA	<0.01	19	<0.001	<0.01	NA	<0.003	0.66	<0.0002	NA	NA	<0.01	NA	<0.003	<0.01	<0.003	<0.04	

NA = not analysed

7.5.4 Surface Water Sensitivities

The following conclusions can be made regarding watercourses crossed by the proposed WREP re-route sections:

- Although significant watercourses are crossed by the WREP route itself along its 373km length, only one major river (r. Supsa) is crossed by the re-route sections; there is one crossing of a small, natural stream and one wet gully
- The Jachviskhevi stream and Jokhtaniskhevi gully are seasonal in nature, with considerable variation in flow conditions. Flooding is caused by snow melt in spring, and rainfall in summer and autumn
- A number of gullies are crossed, which are ephemeral in nature and were dry at the time of the survey. Some of these are used as tracks/roads
- Sensitive downstream receptors include Tbilisi reservoir, Mtkvari River, the Black Sea and associated ecosystems, other rivers and watercourse users including livestock watering, human usage for washing, cooking and irrigation of arable agriculture
- In general, water quality parameters were within expected values. With the exception of highly elevated bacteriological levels in samples from the Supsa and Liakhvi in 2011, no gross anthropogenic contamination was recorded during the surveys
- Overall, in comparison to the EC Freshwater Fish Directive, water quality is overall of a standard high enough to support fish life. The river Liakhvi had elevated levels of total suspended solids, the river Jokhtaniskhevi crossing had highly elevated nitrite levels, and bacteriological levels measured at the Supsa and Liakhvi were also high.

7.6 Groundwater

7.6.1 Introduction

Given the proximity of the sections to the existing WREP, the hydrogeology baseline remains unchanged from that described in the 1996 WREP EIA and associated addenda. Detailed work on the hydrogeological conditions and aquifers, abstractions and groundwater vulnerability along WREP has been undertaken in previous WREP EIA addenda and is not repeated in this supplementary ESIA. A desk-based report was commissioned in April 2009 and in April 2011 to detail the specific hydrogeological regime encountered along each WREP re-route section, based on a 10km wide corridor around the pipeline sections. This is presented in the E&S Baseline Report and summarised in this section. Hydrogeological maps for each WREP re-route section are provided within Appendix A3 (Hydrogeological maps 1–4). The maps provide the following information:

- Hydrogeological formations
- Groundwater circulation depth and total mineralisation at individual sections
- Natural outlets of groundwater in the form of ascending or descending springs with indication of water anion composition
- Gravitational processes developed on the slopes: collapses, screes, landslides, etc.
- Chemical suffusion
- Tectonic faults important in hydrogeological terms, etc.

For the purposes of the hydrogeological characterisation, the 10km-wide study corridor centred on the pipeline sections is divided into three parts:

- Part I – AM 47 to AM 75 (encompasses RP-001a and RR-001; refer to maps 1–2, Appendix A3)
- Part II – AM 219 to AM 232 (RR-004a; refer to map 3, Appendix A3)
- Part III – AM 371 to AM 373 on WREP and around AM 1 on the export pipeline (Supsa River crossings; refer to map 4, Appendix A3)

It should be noted that the description of hydrogeological stratigraphical units does not include characterisation of overlying Quaternary cover unless a pipeline re-route section traverses an area where thick Quaternary strata occurs.

7.6.2 Hydrogeology

Sections RP-001a and RR-001

Overview

The 10km-wide buffer zone of the re-route sections RP-001a and RR-001 extends from AM 47 to AM 75 (part I). Part I of the proposed pipeline alignment traverses various geological units from the Middle Eocene (P_2^2) to recent riverbed and flood plain alluvial sediments (aQ_4). Descriptions of the water-bearing horizons and complexes occurring within the 10km buffer zone of the re-route corridors are provided below, and are illustrated on hydrogeological maps 1–2 (Appendix A3).

According to the hydrogeological zoning of Georgia (Buachidze, 1965), the WREP traverses two hydrogeological regions along part I:

- Artesian basins of Georgian belt (Hydrogeological Region III)
- Pressurised water systems of Ajara-Trialeti folded zone (Hydrogeological Region IV).

Regarding more detailed units (districts), Hydrogeological Region III includes the Kartli Artesian Basin of pore, fissure and fissure-karst water within Part I while Region IV includes the Tbilisi pressurised system of fissure and fissure-karst water.

The Kartli artesian basin extends over a large area and includes Tiriponi, Mukhrani and Ertso depressions. The basin is enclosed by the mountainous zone of the southern slope of the Caucasus in the north; the Surami ridge in the west; the Trialeti range in the south; and the slopes of Kakheti ridge in the east. Altitudes range from 500m to 800m amsl. Structural-morphological elements of Kartli artesian basin are Igoeti and Kartli uplands, which play a significant role in the hydrogeology of the upper series. It is because of this that three independent basins are identified in the Early Quaternary alluvial-proluvial water-bearing complex: (1) Tiriponi-Saltvisi, (2) Mukhrani and (3) Ertso basins. Several pressurised water-bearing horizons are opened via boreholes drilled to a depth of 200m in the Early Quaternary sediments. Boreholes are sub-artesian in the northern part of the basin while they are self-flowing towards the depression centre.

The Tbilisi pressurised system of fissure and fissure-karst water occupies the eastern end of Ajara-Trialeti folded zone. Groundwater is present in the weathered zone of bedrock of different periods. Deep horizons of this system, which are of the Middle Eocene period, contain thermal pressurised water. Thermal springs are associated with the top of anticlinal structures. A good example of a natural thermal spring is Abanotubani in Tbilisi, which is located in the axial part of the Tabori anticline and has a high sulphur content.

Water-bearing horizon of recent alluvial sediments of riverbeds and floodplains

The lithology of the water-bearing horizon of the recent alluvial sediments of the riverbeds and flood plains (aQ_4) is composed of shingles, sands, sandy loams and loams. Part I traverses the recent alluvial deposits in the wide floodplain of the Aragvi River between AM 72 and AM 74 (hydrogeological map 2, Appendix A3) where the groundwater depth varies from 2.0m to 4.0m. This alluvial water-bearing horizon has been studied in detail in the Aragvi River valley, as the potable water supply of Tbilisi relies on the Aragvi River filtrates supplied via the Bulachauri, Choporti, Saguramo and Natakhtari water abstraction facilities. Therefore, the Aragvi River area is a particularly high-risk zone in terms of potential hydrocarbon contamination of potable water sources for the capital. It should be noted that none of the pipeline sections of the WREP-SR Project cross the Aragvi River itself. Filtrational capacity of the recent alluvial sediments is high and varies from 100m/day to 150m/day, which increases potential for hydrocarbon migration through the water-bearing horizon. Total mineralisation of the groundwater associated with the alluvial horizon is low (0.3–0.5g/l); its chemical composition is of hydrocarbonate calcic type. The water has high potable qualities.

Pont-Meotis water-impermeable continental sediments

Pont-Meotis water-impermeable continental sediments ($Nm + p$) have a wide distribution in part I (hydrogeological map 2, Appendix A3); they are not crossed by any of the re-route sections but are within the 10km study zone. They are exposed in the northernmost section in the vicinity of Saguramo village in the areas adjacent to Mt. Vibisi (1471m amsl). Wider exposures of the Pont-Meotis sediments are found south of the pipeline route, in the Tsitsamuri village–Jvari Monastery–George Apostle's Church zone and south-west of the Aragvi River crossing. The lithology is similar to that of the Akchagil series and is composed of clays, sandstones and conglomerates. Natural outlets (springs) are extremely rarely associated with this series. Springs with insignificant yield (<0.05l/sec) are sometimes found at the exposures of sandstone and conglomerate strata; total mineralisation is high (>3.0g/l) and the water is of sulphate-hydrocarbonate chemical composition. The Pont-Meotis sediments are located in the base of wide synclinal depressions and form a regional impermeable zone for overlying thick water-bearing horizons of the Early Quaternary alluvial-proluvial sediments. Owing to insignificant groundwater flow, high water mineralisation and deep circulation, this series is unfit as a potable water supply.

Sporadically water-bearing Upper Miocene (Sarmatian) lagoonal-continental sediments

The Sarmatian series (N_1s_{1+2}, N_1s_3) is represented by all three parts (Lower, Middle and Upper) in part I and is crossed by large sections of RR-001 and RP-001a. The Upper Sarmatian marine and continental molasses sediments (sandstones, clays, conglomerates, with some marls) have particularly wide occurrence. Marls are found more frequently with limestones in the Lower and Middle Sarmatian profile. Saguramo ridge including the SPZ area is composed of the Upper Sarmatian sediments. Their exposures extend in a continuous zone eastwards including Mt. Saghindzle (1337m amsl), the highest peak of the area (hydrogeological maps 1–2, Appendix A3).

Thin interlayers of loose conglomerates with sand matrix occur in the Upper Miocene profile. Low-yield (<0.1l/sec) springs located at the foot of the slopes are associated with these interlayers. Some springs with relatively high yield (~1l/sec) are found in the weathered zones of the Sarmatian strata and tectonic fissures. However, overall the water yield of this series is generally low.

The horizon is recharged mainly from the north by precipitation and partial surface flow. Pressurised water also occurs in deep layers and has been surveyed via sub-artesian boreholes (depth from -20m to -40m). This horizon discharges into the valleys of the Mtkvari, Liakhvi, Ksani and Aragvi Rivers and partially into the overlying Quaternary sediments via ascending filtration. Total mineralisation of the groundwater associated with the Upper Miocene strata is 0.5–1.0g/l within the Kartli lowland; hydrocarbonate-sulphate sodium-calcic chemical water composition prevails. From AM 62 to AM 73 the pipeline section traverses the Upper Sarmatian strata or overlying Quaternary cover. The groundwater is fairly deep (> 15m) along this section and is therefore anticipated to have a low vulnerability to contamination from surface sources.

Middle Miocene sporadically water-bearing marine sediments

The Middle Miocene sporadically water-bearing marine sediments (N_1^2) occur along part I between AM 49–AM 51, AM 52 and AM 56–AM 62 (hydrogeological maps 1–2, Appendix A3). The lithology is composed of alternating clays, sandstones, conglomerates, rarely with layers of limestones and marls. The Miocene groundwater is associated with sandstones, limestones and partially conglomerates. The groundwater is formed in the active circulation zone and discharges in the form of springs under favourable geomorphological conditions while part of the flow follows inclination strata towards the inhibited water exchange zone and forms layers and lenses of pressurised water.

The groundwater associated with the Middle Miocene sediments in part I is characterised by increased mineralisation (1.0–2.5g/l) and sulphate-hydrocarbonate sodium-calcic chemical composition. The groundwater depth exceeds 5m (hydrogeological map 2, Appendix A3). Owing to increased mineralisation and high water hardness, this groundwater is not used for potable purposes. Taking into consideration the depth and clay lithology of the strata, the vulnerability to contamination from surface sources is considered to be low.

Lower Miocene-Oligocene and Upper Eocene water-impermeable lagoonal-marine sediments

The lithology of the Lower Miocene-Oligocene and Upper Eocene water-impermeable lagoonal-marine sediments ($P_3 - N_1^1, P_2^3$) is mainly formed by clays with some interlayers of sandstones. This series is crossed by RP-001a at AM52–53 and is within the 10km study zone to the east of RP-001a (Appendix A3, maps 1–2). Taking into consideration the lithology of the series (clays, firm marls, rarely sandstones), these sediments are characterised by relatively lower filtrational properties in comparison with other water impermeable series. There are practically no springs; however, some outlets with insubstantial yield (0.01l/sec) are found. Total mineralisation is high (2.0–3.0g/l). As regards chemical composition, sulphate calcic water type prevails due to high content of gypsum ($CaSO_4 \cdot 2H_2O$) in the Maikop clays.

The Lower Miocene-Oligocene and Upper Eocene water impermeable lagoonal-marine sediments ($P_3 - N_1^1, P_2^3$) do not contain water fit for potable or irrigation purposes due to high mineralisation (2-3g/l) and insignificant yield of springs (hydrogeological map 1, Appendix A3). Except for river flood plains, the groundwater circulation depth exceeds 10m. Taking into consideration, the impermeability of the clays in this sequence, vulnerability to contamination from surface sources is considered to be low.

Water-bearing complex of Middle Eocene Marine Volcanogenic-sedimentary strata

The water-bearing complex of the Middle Eocene marine volcanogenic-sedimentary strata (P_2^2) is exposed as a minor fragment only in the southern-westernmost area of Part I (map 2). It is not crossed by any of the WREP re-route sections. Exposures of the Middle Eocene volcanogenic strata are approximately 5km off the existing WREP pipeline route, on the southern bank of Mtkvari River.

Section RR-004a

Part II extends from AM 219 to AM 232 (hydrogeological map 3, Appendix A3) and includes the following geological formations:

- Palaeozoic diorites and gabro-diorites ($q\delta P\varepsilon$)
- Upper Cretaceous flysch (K_2)
- Middle Miocene terrigenous sediments (N_1^2)

RR-004a is located on the Palaeozoic quartz diorites and gabro-diorites ($q\delta P\varepsilon$). In hydrogeological terms the Dzirula crystal massif formed by the Palaeozoic intrusive and metamorphic formations comprises a regional watershed between water catchment basins of western and eastern Georgia (water catchments of rivers Rioni and Mtkvari). Despite firm, crystal composition, a weathered crust of 2.0–10.0m thickness has formed in these strata. The crust is composed of stony–coarse gravelly clastic material with loam matrix. The weathered crust of intrusive strata is a favourable environment for groundwater circulation; groundwater outlets are numerous on the lower mountain slopes. The high water content and filtrational properties of these strata are due to the high rate of recharge; annual precipitation (> 1000mm) substantially exceeds evaporation (~600-700mm), which creates positive recharge. The groundwater horizon is associated with numerous springs with yield varying from 0.1 to 5.0 l/sec. The water has a low mineralisation (0.1–0.4 g/l) and is mainly of hydrocarbonate chemical composition, rarely hydrocarbonate-sulphate with insignificant content of chlorine ions in individual samples. It is used for potable purpose. Its circulation depth is 3–4m in the weathered zone.

Supsa River crossings

Part III comprises the Supsa River crossings and adjacent areas (hydrogeological map 4, Appendix A3).

According to the hydrogeological zoning of Georgia (Buachidze, 1965), the proposed crossings and adjacent areas are located in Guria artesian basin of the porous and fissury groundwater (III_6), which, in turn, is part of the hydrogeological region of artesian basins of Georgian belt (III). Guria artesian basin of the porous and fissury groundwater occupies 1500km^2 and includes hilly depression of Guria and adjacent coastline lowland. A thick Quaternary cover comprised of sand and pebbles has the highest water content in this basin. The Quaternary cover overlies the Cretaceous, Palaeocene and Miocene strata.

The following water-bearing horizons occur in the vicinity of the proposed crossing area:

- Water-bearing horizon of recent alluvial sediments (alQ_4)
- Water-bearing horizon of beach formations (mrQ_4)
- Water-bearing horizon of Quaternary marshy sediments (hQ)
- Water-bearing horizon of Early Quaternary alluvial sediments (alQ_{3-1}).

Recent and Early Quaternary alluvial sediments are exposed within the 100m-wide corridor of the existing WREP and proposed Supsa crossing; these are described in more detail below and shown on Hydrogeological Map 4, Appendix A3.

The Supsa is one of the most water-abundant rivers in Georgia with wide occurrence of the water-bearing horizon of the recent alluvial sediments (alQ_4). The horizon thickness varies between 40 and 50m on Kolkheti lowland though it exceeds 300m in the coastline. In general, recent alluvial sediments are comprised of pebbles with sand matrix where interlayers of sand and sandy loam are found. However, the proposed crossing is located near the estuary and the recent alluvium is represented with small/fine fractions such as loam, sandy loam and silt.

Unlike typical alluvium, the alluvium found in the proposed crossing area is characterised by low filtration. The value of the filtration coefficient does not exceed several metres per day. Groundwater flow is somewhat hindered due to low filtration resulting in increased water mineralisation and hardness. In the upper reaches groundwater of the recent alluvial sediments is of hydrocarbonate-calcic chemical composition while it is of sulphate-hydrocarbonate type in the lower reaches (including the proposed crossing area) due to increased mineralisation. Therefore, the groundwater may be characterised by sulphate and/or carbonate aggressiveness. The groundwater depth does not exceed 2m in the proposed crossing area.

The pipeline is to be installed in the Early Quaternary alluvial sediments (alQ_{3-1}) on both banks of the river. This horizon is linked to marine and fluvial sediments of the old terraces in the coastline and subsides under the recent alluvium at the river estuaries near the sea. The horizon's lithology is diverse and represented by sandy loam, loam, sand and sandy pebbles although the latter is very rare in the coastline. The groundwater depth rarely exceeds 3m in the Early Quaternary sediment series; it gradually decreases in the coastal areas (including the proposed crossing site) resulting in formation of swamps.

7.6.3 Groundwater Sensitivities

The areas along the proposed pipeline re-route and replacement sections considered most sensitive are those where groundwater is used for potable and irrigation purposes and the aquifer is relatively shallow, overlain by a thin layer of porous or permeable sediments (i.e. where groundwater vulnerability[6] is high). The main characteristics of the water-bearing geological formations beneath the re-route pipeline sections are summarised in Table 7-8.

Table 7-8: Summary of Hydrogeology beneath WREP SRP Sections

Name	Description	RR location
$Nm+p$	Pont Meotis impermeable continental sediments High mineralisation Non-potable Low vulnerability	RR-001 KP5.5-7.2
N_1s_{1+2}, N_1s_3	Sporadic water-bearing strata of Upper Meocene lagoonal continental sediments. Clays, conglomerates, rarely limestones and marls High mineralisation Not significant aquifer Low vulnerability	RP-001a KP1.0-2.8 RR-001 KP0.0–5.5; KP7.2–7.6
N_1^2	Sporadic water-bearing strata of Middle Meocene marine sediments. Clays, sandstones, conglomerates, rarely limestones and marls High mineralisation Not potable. Non-aquifer Medium vulnerability	RP-001a KP0.0–0.5

[6] Groundwater vulnerability is defined as the tendency and likelihood for general contaminants to reach the water table after introduction at the ground surface

Name	Description	RR location
$P_3 - N_1^1, P_2^3$	Lower Miocene-Oligocene and Upper Eocene impermeable lagoonal-marine sediments High mineralisation Non potable Low vulnerability	RP-001a KP0.5–1.0
K_2	Upper Cretaceous sandstones and siltston (Lower), clastic limestone flysch (Upper) Low mineralisation Potable High vulnerability	Not crossed but within 10km buffer zone
$q\delta P\varepsilon$	Palaeozoic intrusives, namely quartz diorites and gabro-diorites Low mineralisation Highly potable and utilised High vulnerability	RR-004a – entire length
alQ_4, alQ_{3-1}	Recent and Early Quaternary alluvial sediments High mineralisation Utilised High vulnerability	Supsa River crossings

7.7 Ecology

7.7.1 *Overview and Field Survey Methodology*

Overview of flora and fauna in Georgia

Scientists have mapped 867 eco-regions across the globe. Instead of being defined by political boundaries, each is distinguished by its shared ecological features, climate, and plant and animal communities. With the exception of the Supsa River crossing, the area of the Georgian sections of the WREP falls within the Caucasus mixed forests eco-region (area PA0408 on Figure 7-3). The Supsa River crossings are located within the Euxine-colchic deciduous forest region (area PA0422 on Figure 7-3). Both regions are characterised by natural habitats comprised of temperate broadleaf and mixed forest although the lowland colchic region (River Supsa crossing area) is also described as a habitat of swampy broadleaf forest.[7]

[7] www.nationalgeographic.com

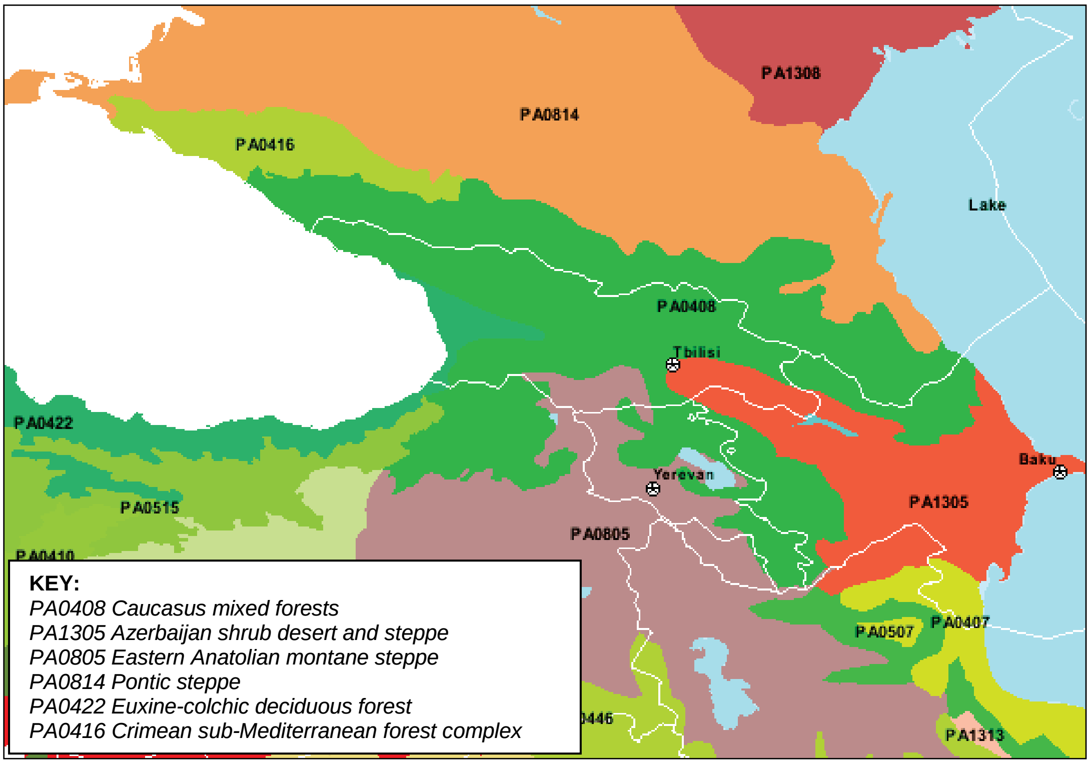

Figure 7-3: Terrestrial Eco-regions of the Caucasus

Temperate mixed forests cover most of the region, dominated by Georgian oak, ash, hornbeam and other broadleaf species. Coniferous forests grow at higher elevations with fir, spruce, and pines. Above the tree line, the dominant habitats are grassy meadows alternating with thickets of rhododendron and patches of rocky scree. More than 1,000 plants, 400 vertebrates, and 2,000 invertebrates have been catalogued in the Caucasus mixed forests. The Euxine-colchic deciduous forests comprise floristically rich alder forest (*Alnus barbata*) in the abundant swampy lowlands and have a rich understory of ferns and vines. Lowland oaks (*Quercus imeretina*) and white poplars (*Populus alba*) grow along the many rivers and streams in unique riparian forests in this region.

Most of the lowland forest in this region has been lost to agriculture or human developments. At higher elevations, overgrazing is causing some habitat degradation, and commercial forestry is an increasing threat. During the Soviet era, Georgian forests were managed for protection and recreation, whereas timber and timber products came from Russia. Since the Soviet Union's collapse, Georgia has increasingly relied on its forests to meet domestic demand for forest products. However, the forest products industry has suffered a collapse, with under-managed harvesting for timber and fuel adding to the problem.

Many Georgian forests have become fragmented, which has led to modification of their species composition. Grassland, some of which is classified as steppe-meadow, has developed in many areas where trees have been felled.

Intensified use of Georgian forests has raised important environmental challenges, including maintenance of soil and water conservation objectives and adequate protection of the region's globally significant biodiversity. Unsustainable timber harvesting, grazing and game hunting have accelerated and threatened Georgia's diverse and abundant biodiversity. Of particular concern in the context of biodiversity are habitat loss and fragmentation, unsustainable forest management practices and illegal logging; poor rangeland management, overstocking and overgrazing; and over-hunting and illegal hunting of large mammal species.

Field surveys

Field surveys of the flora and fauna along the proposed new re-route sections were undertaken between March 2007 and June 2009, June and September 2011, November 2012, August, October and December 2015, and May/June 2016. Where additional information was needed, the field surveys were supplemented by a literature review. Access roads were only surveyed if they require widening and are across natural habitats; most village roads across agricultural land were not surveyed.

A summary of the baseline environmental information is provided in this chapter with detailed field reports included in Section 5 of the Environmental and Social Baseline Report (E&S Baseline Report). Some route sections were surveyed on more than one occasion to take account of route changes as engineering and impact assessment progressed.

The 2009, 2011 and 2012 field surveys covered a 100m-wide corridor centred on the proposed re-route sections and access roads; the 2015 and 2016 field surveys covered a 40m-wide corridor centred on the proposed re-route sections and 20m-wide corridor centred on the proposed access roads. The key objectives of the baseline (phase 1) surveys were to:

- Identify and describe the extent of major habitat and vegetation types
- Identify ecologically important areas where further surveys may be needed
- Identify the extent of occurrence, area of occupancy, population numbers and threats for species of high conservation value (including Georgian Red List Species)
- Record the environmental characteristics, including biotic and abiotic attributes, for key habitats and populations of rare species
- Record incidental sightings and evidence and animal species.

Vegetation cover for species/habitats of high conservation value was estimated using the 10-point Domin scale of cover-abundance that is provided in Table 7-9 and described in more detail in the E&S Baseline Report Section 5.1. Average tree heights were estimated and the average diameter of trees was measured at breast height (DBH).

Table 7-9: Domin Scale of Cover-Abundance

Points	Cover-Abundance
+	One individual, reduced vigour
1	Rare
2	Sparse
3	<4%, frequent
4	5–10%
5	11–25%
6	26–33%
7	34–50%
8	51–75%
9	76–90%
10	91–100%

7.7.2 Protected Areas

During routing of the new sections of the WREP, emphasis has been placed on avoiding designated protected areas, as well as habitats or species sensitive to disturbance. All the proposed works are outside protected areas. The areas with an ecological designation within the vicinity of WREP-SR project are:

- Tbilisi National Park, located to the north of sections RP-001a and RR-001
- The Kolkheti National Park, Wetlands of Central Kolkheti Ramsar site and Kolkheti Important Bird Area (IBA), which are located north of the Supsa River crossings at a distance of approximately 0.5km from the proposed construction works areas, and therefore are not anticipated to be directly impacted by the proposed work.

Tbilisi National Park

Tbilisi National Park (TNP) is located north-east of Tbilisi. It is an IUCN category II reserve and covers around 21,000ha[8]. It was established in 1974 and encompasses the former Saguramo Strict Protection Zone (established in the late 1940s) as well as several memorial parks. The purpose of the National Park is to:

- Maintain and preserve the natural environment
- Promote tourism development
- Provide an area for relaxation close to the capital city
- Provide appropriate infrastructure to meet the above objectives.

The boundaries of Tbilisi National Park have changed many times; those shown in Figure 7-4 were supplied by MENRP and were confirmed as current in January 2016. A management plan has not yet been prepared for the park.

TNP follows the Saguramo range of mountains and has an altitude of 700 to 1390m. The climate is transitional between subtropical continental and marine. The average annual temperature is 10°C degrees (January 1.8°C; August 21.2°C) and the mean annual precipitation is 725mm[9].

TNP has a diverse flora, represented by 675 species of grass and woody plants. Much of the park is forest which is dominated by Georgian oak, beech, hornbeam, ash and oriental hornbeam. Habitats are characterised by strong vertical zoning. Several rare and endangered species occur in TNP including boxwood (*Buxus colchica*), yew (*Taxus baccata*), bare elm (*Ulmus glabra*) and walnut (*Juglans regia*). The park also supports a range of endemic and relic species many of which are relics of the tertiary period Cochic flora[10].

Mammals include fox, wolf, roe, hare, marten and weasel as well as the red list species red deer, brown bear and lynx. Red list birds include Imperial eagle, spotted eagle and Levant sparrow hawk.

Kolkheti wetlands

The Kolkheti wetlands lie to the north of the WREP-SR Project on the Black Sea coastal plain. They are situated between the mouths of the Tikor and Supsa rivers and are designated as a National Park, Ramsar site and Important Bird Area. The shortest distance

[8] As of January 2016
[9] G.INFO: State of the Environment - Georgia - Biodiversity
[10] Colchic flora = plants associated with the ancient country of Colchis, which was south of the Caucasus and bordered the Black Sea

between the protected area boundary and the proposed temporary construction area at Supsa export pipeline crossing is approximately 0.5km.

The National Park was established during 1998 and 1999 as part of Georgia's Integrated Coastal Management Project, which was backed financially by the World Bank and the Global Environmental Facility. Kolkheti National Park covers an area of 44,625ha and incorporates the former 500-hectare Kolkheti State Nature Reserve and its surrounding wetlands.

The Kolkheti IBA is the broadest designation and covers some 56,000ha which incorporates Kolkheti National Park, the 33,000ha Kolkheti Ramsar site and the Ispani II marshes Ramsar site. The key features of the IBA and Kolkheti Ramsar site are migratory raptors (spring and autumn) and wintering and passage waterbirds and passerines.

Figure 7-4: Existing WREP and Re-route RR-001 in Relation to Tbilisi National Park

7.7.3 Plant and Animal Species of Conservation Value

This section provides background information about the plant and animal species that were recorded during the ecological surveys and have high conservation value because they are rare and/or threatened.

The conservation status of species of flora and fauna has been assessed with reference to:

- The Georgian Red List of threatened and vulnerable species (2013)
- Information from local scientists regarding species that are endemic to the Caucasus
- The IUCN online Red List of threatened species
- The CITES[11] list of species whose survival is threatened by over-exploitation through international trade
- The BERN Convention on the Conservation of European Wildlife and Natural Habitats
- The Agreement on the Conservation of African-Eurasian Migratory Waterbirds
- Convention on the Conservation of Migratory Species of Wild Animals.

Conservation status categories, referred to throughout the following sections, are provided in Table 7-10. Table 7-11 lists the species with high conservation value that are known to occur along the WREP-SR Project route. The national legislation relating to the protection of biodiversity is detailed in Table 6-2.

Table 7-10: Threatened Species Status Categories

Status category	Description
Ie	IUCN Species of International Conservation Concern – endangered
Iv	IUCN Species of International Conservation Concern – vulnerable
Int	IUCN Species of International Conservation Concern – near threatened
Ilr	IUCN Species of International Conservation Concern – least risk
GRL	Included in the Georgian Red List of threatened species
CE	Caucasian Endemic Species
CITES	Listed in the CITES Convention as threatened by over-exploitation through trade
BERN	The BERN Convention on the Conservation of European Wildlife and Natural Habitats
AEWA	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds
CMS	Convention on the Conservation of Migratory Species of Wild Animals

Table 7-11: Species of Conservation Value Recorded during 2015/2016 Surveys

Scientific name	Common name	Status
Accipiter gentilis	Northern Goshawk	CMS, BERN
Alcedo atthis	Common Kingfisher	BERN
Anacamptis coriophora (syn. *Orchis coriophora)*	Bug orchid	CITES

[11] CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Scientific name	Common name	Status
Anacamptis morio	Green-winged orchid	CITES, IUCN Iv
Anacamptis pyramidalis	Pyramidal orchid	CITES, IUCN Int
Ardea cinerea	Grey Heron	AEWA, BERN
Buteo buteo	Common Buzzard	CMS, BERN
Canis aureus	Jackal	BERN
Carduelis carduelis	European goldfinch	BERN
Carduelis chloris	European Greenfinch	BERN
Castanea sativa	European chestnut	GRL
Cephalanthera longifolia	Long-leaved helliborine	CITES
Circus aeroginosus	Western Marsh-harrier	BERN
Corvus corax	Common raven	BERN
Cyclamen coum	Eastern cyclamen	CITES
Dactylorhiza urvilliana	Marsh orchid	CITES
Dactylorhiza romana subsp. *Georgica*	Dactylorhiza	CITES
Delichon urbica	Northern House-martin	BERN
Dendrocopos major	Great Spotted woodpecker	BERN
Gymnadenia conopsea	Fragrant orchid	CITES
Epipactis leptochila	Narrow-lipped helleborine	CITES
Falco tinnunculus	Common kestrel	BERN, CMS
Fringilla coelebs	Common chaffinch	BERN
Hirundo rustica	Barn swallow	BERN
Iris carthaliniae	Iris	CE
Iris colchica	Cholchic iris	CE
Juglans regia	Walnut	GRL
Lacerta agilis	Sand lizard	BERN
Lacerta strigata	Five-streaked lizard	BERN
Lanius collurio	Red-backed shrike	BERN
Larus cachinnans	Yellow-legged Gull	BERN, AEWA
Laudakia caucasia	Caucasian agama	BERN
Limodorum abortivum	Violet limodore	CITES
Luscinia megarhynchos	Common Nightingale	BERN
Lutra lutra	European Otter	GRL
Martes spp	Marten	BERN
Meles meles	Badger	BERN
Merops apiaster	European bee-eater	BERN
Miliaria calandra	Corn Bunting	BERN
Milvus migrans	Black Kite	CMS, BERN
Motacilla alba	White wagtail	BERN
Motacilla cinerea	Grey wagtail	BERN
Muscicapa striata	Spotted flycatcher	BERN
Neottia nudus-avis	Bird's nest orchid	CITES

Scientific name	Common name	Status
Oenanthe isabellina	Isabelline Wheatear	BERN
Ophrys Caucasia	Caucasian orchid	CITES
Ophrys oestrifera (syn. Ophrys fuciflora)	Late spider orchid	CITES
Orchis morio (syn. Anacamptis morio)	Green-winged orchid	CITES
Orchis purpurea subsp. Caucasica	Lady orchid	CITES
Paeonia caucasica	Caucasian peony	CE
Parus ater	Coal tit	BERN
Parus caeruleus	Blue tit	BERN
Parus major	Great tit	BERN
Passer montanus	Eurasian Tree Sparrow	BERN
Pelophylax ridibundus	Marsh Frog	BERN
Phoenicurus phoenicurus	Common Redstart	BERN
Phylloscopus trochiloides	Greenish warbler	BERN
Picus viridis	European green woodpecker	BERN
Platanthera bifolia	Lesser butterfly orchid	CITES
Podiceps cristatus	Great crested grebe	BERN, AEWA
Pterocarya pterocarpa	Caucasian wingnut	GRL
Pyrus demetrii	Wild pear	GRL
Quercus imeretina	Imeretian oak	GRL
Riparia riparia	Sand Martin	BERN
Serapias vomeracea	Long-lipped serapias	CITES
Sylvia nisoria	Barred Warbler	BERN
Sylvia sp.	Warbler	BERN
Taxus baccata	Yew	GRL
Testudo graeca	Mediterranean spur-thigh tortoise	GRL, BERN & IUCN Iv
Turdus merula	Common blackbird	BERN
Ulmus minor	Smooth-leaf elm	GRL
Upupa epops	Eurasian hoopoe	BERN
Vulpes vulpes	Red fox	BERN

7.7.4 Forest Fund Land

During review of the draft ESIA, MENRP calculated that, based on the GIS co-ordinates provided by BP, 6,265m^2 is located within Forest Fund land managed by the National Forestry Agency. Removal of trees within this area will require submission of a forest passport and receipt of a Permit for Special Use. Consultation with the National Forestry Agency has commenced with an initial meeting held on 23rd June 2016 (see Section 9.9).

Tree inventories will be prepared once a contractor has been appointed and the centreline of the pipeline has been pegged out. The inventories will be prepared in compliance with Government Decrees Nos.179 and 242 and will record all trees that exceed 1.5m in height and 8cm in DBH (diameter at breast height). It was agreed that the approximate number of young saplings of GRL species per unit area (e.g. m^2 or ha, as appropriate) will be determined by visual estimation.

During the baseline surveys, the number of mature and GRL trees were recorded within a 40m corridor centred on the pipeline sections and a 20m corridor centred on the access roads. These results are provided in Section 5 of the ESB Report. However, the numbers must be interpreted with care as not all trees will be removed and only some areas fall within Forest Fund Land. The number to be removed cannot be determined until the tree inventories are prepared.

7.7.5 Biodiversity of the Pipeline Sections

This section describes the natural habitats that are associated with each of the re-route sections of pipeline and associated access roads. It also summarises information about protected, rare and threatened species for which mitigation measures may be required to reduce potential adverse impacts on their populations as a result of the proposed works. The potential impacts and proposed mitigation measures are discussed in Chapter 10 and constraint maps are provided as Appendix A.

RP-001a (AM 52–55)

Pipeline – habitats and flora

RP-001a crosses the following habitats:

- Grassland (Photograph 7-6)
- Windbreak
- Deciduous woodland including
    - Woodland dominated by Georgian oak
    - Woodland dominated by smooth-leaved elm
- Scrub
- Hemixerophytic shrubbery of shibliak type.

All the habitats within RP-001a have been subject to significant anthropogenic impacts. Most of the corridor has low biodiversity value, except at the locations identified in Table 7-12 where the conservation value is high. Detailed locations are shown on maps 1–5 in the E&S Baseline Report Section 5.2a. Verification surveys of high conservation value plants were undertaken at these locations during spring 2016, as reported in the E&S Baseline Report Section 5.5a.

Photograph 7-6: Grassland

Table 7-12: Areas of High Biodiversity Interest within RP-001a

Location	Code and map no. in E&SBR Section 5.2a	Ecological interest
RR-001a KP0	Map 5	Meadow vegetation supporting a large population (up to 60 specimens) of iris (*Iris carthaliniae*), which is endemic to the Caucasus; recorded in 2007. By May/June 2016 this population had increased to >400 individuals, but is over 700m east of RP-001a starting point and >400m east of AR52 (ESB Report Section 5.5a)
RP-001a KP0.5–1.5 (AM 52–53)	Map 5	Meadow-steppe[2] with forbs and grasses which supports five specimens of fragrant orchid (*Gymnadenia conopsea*), a species listed under the CITES Convention; recorded in 2007. No fragrant orchids were recorded along RP-001a during the May/June 2016 survey (ESB Report Section 5.5a)
RP001a KP1–2.5 (AM 53–55)	Habitat type 7 on maps 2–4	Deciduous woodland dominated by Georgian oak (*Quercus iberica*) and associated by Oriental Hornbeam (*Carpinus orientalis*) and European Ash (*Fraxinus excelsior*)
RP001a KP2.5 (AM 54–55)	Habitat type 8 on map 4	Isolated patches of deciduous woodland dominated by smooth-leaved elm (*Ulmus minor*), consisting of approximately 200 specimens

Location	Code and map no. in E&SBR Section 5.2a	Ecological interest
Near AM55 KP1.1 (AM53-54) KP2.72 (AM55)	Map 5	The edge of a hornbeam-oak forest includes wild pear (*Pyrus sp.*), but the specimens recorded near AM55 in 2007 could not be found in 2016 (ESB Report Section 5.5a). Two additional specimens of *Pyrus demetrii* were recorded in the latest survey near KP1.1 and at the end of RP-001a.

[1] Glossary: DBH = diameter at breast height (a commonly quoted measurement for mature trees)

[2] Glossary: Meadow-steppe = meadow where desertification has changed or is changing the community to one that is more typical of steppe communities

Pipeline – fauna

Section RP-001a generally has low conservation value for animals. Survey results are provided in the E&S Baseline Report, Section 5.2b.

Common bird species were recorded during the survey including Eurasian jay (*Garrulus glandarius*) and raven (*Corvus corax*). In addition, vole (*Microtus* sp.) burrows were recorded along the entire proposed corridor.

During previous surveys in this area, the water bodies are inhabited by Eurasian marsh frog (*Rana ridibunda*) and supported abundant dragonflies. Caspian green lizard (*Lacerta strigata*) and Mediterranean spur-thigh tortoise (*Testudo graeca* – GRL, Iv) were also recorded. The absence of these species during the 2015 survey is likely to because it was undertaken late in the year.

Access roads

Four potential access roads are proposed for this section (AR52, AR54, AR55 and AR55a); survey results are provided in the E&S Baseline Report, Sections 5.3a to 5.3d inclusive, Section 5.3g and 5.5a. AR52, AR54 and AR55 traverse hemixerophytic shrub and secondary grassland heavily disturbed by grazing and trampling. AR52, AR54 and AR55 corridors support a number of smooth-leaved elms (*Ulmus minor* - GRL). A single specimen of Demeter's pear (*Pyrus demetrii* - GRL*)* was recorded on AR55 in 2016. Despite the presence of a few specimens of GRL species, this man-made habitat has a low conservation value due to its limited ecological function. AR55a passes through grazed grassland and scrub of low conservation value, but also supports fragments of oakwood (dominated by Georgian oak *Quercus iberica*), which are assigned high conservation value due to the presence of GRL species (smooth-leaved elms *Ulmus minor*), associated plant species richness and important ecological function as a shelter for wildlife.

The 2015 surveys recorded a number of common bird species, including common raven (*Corvus corax*), eurasian magpie (*Pica pica*), great crested grebe (*Podiceps cristatus*), house sparrow (*Passer domesticus*), as well as signs of presence of vole (*Microtus* sp.), mouse (*Mus* sp.) and red fox (*Vulpes vulpes*).

RR-001 (AM 63–69)

Pipeline – habitats and flora

The diversity and spatial distribution of habitats within RR-001 reflects the varied terrain, soils and anthropogenic factors within the section. Xeromesophilous scrub, hemixerophytic shrubs (shibliak type) and deciduous woodland are dominant with relatively small areas of hemixerophytic grassland, ruderal vegetation and plantations (see the survey map in E&S Baseline Report Section 5.2c):

- Deciduous woodland – mostly represented by Georgian oakwood (*Querceta iberici*) with stands of European ash (*Fraxineta excelsior*) and Smooth-leaf elm (*Ulmeta minor* - GRL) being rare and occupying only small areas. Forest communities that are transitional between elm and ash forests occur in a few areas. More specifically, woodland habitats within RR-001 include:
    - Georgian oakwood with an understorey largely dominated by Oriental hornbeam (*Carpinus orientalis*) (vegetation type Quercetum carpinosum orientalis - see Photograph 7-7). Georgian oakwood with Oriental hornbeam and Butcher's broom (vegetation type Quercetum carpinoso-ruscosum), occurring less frequently
    - European ash forest (Photograph 7-8) occurring as minor fragments with Smooth-leaf elm (*Ulmus minor* -GRL) also present in high numbers forming elm-ash stands (Ulmeto-Fraxinetum)
    - Smooth-leaf elm dominated fragments occupying small areas
    - Spring ephemeroides were recorded during previous surveys in this area; such species are likely to be present but were not recorded in 2015 due to the late survey period
- Xeromesophilous scrub
    - Oriental hornbeam dominated scrub (*Carpineta orientalis*) – a widespread, secondary habitat that has developed in place of the former Georgian oakwood; Georgian oak and Butcher's broom (*Ruscus ponticus*) are frequently present in varying numbers
    - Xeromesophilous polidominant scrub – found in very small fragments; developed as a result of degradation of Oriental hornbeam dominated scrub mostly due to logging and grazing and is transitional from xeromesophilous scrub to hemixerophytic shrubbery of shibliak type. This habitat is marked by the presence of Georgian oak specimens
- Hemixerophytic shrubbery of shibliak type – secondary habitat developed as a result of oakwood degradation. This scrub is represented by different communities such as Christ's thorn thickets (*Paliuretum spina-christi*), Spirea dominated groupings (*Spiraetum hypericifoliae*) and polidominant shrubbery (*Mixtofruticetum*). Christ's thorn thickets are most widespread.
- Grassland (mostly hemixerophytic) – a habitat with fragmented distribution that occurs in combination with other vegetation units, primarily scrub. This secondary habitat has developed due to oakwood logging, scrub removal and intensive grazing.
- Ruderal vegetation
    - Grasses and forbs with a high abundance of weeds, ruderal and invasive species.
- Plantations occur as fragments and are mostly comprise of Black pine, Eldar pine (*Pinus nigra, P. eldarica*) and Mediterranean cypress (*Cupressus semperviren*). Some sections support high number of Smooth-leaf elm (*Ulmus minor* - GRL). Most plantations are subject to grazing and some to logging.

Photograph 7-7: Georgian Oakwood with Oriental Hornbeam Dominated Understorey

Photograph 7-8: European Ash Forest

Areas with high biodiversity interest are mainly associated with the forest ecosystems and are summarised in Table 7-13 which includes the findings of spring surveys undertaken in 2007, 2009 and 2011 (reported in the E&S Baseline Report, Section 5.2c), and in 2016 (E&S Baseline Report, Section 5.5a).

Table 7-13: Areas of High Biodiversity Interest within RR-001

Location	Ecological interest
RR-001 KP0.5 (AM 63-64)	Georgian oakwood (*Querceta iberici*) with Oriental hornbeam understorey (*Quercetum carpinosum orientalis*). Populations of dactylorhiza (*Dactylorhiza romana* subsp. *Georgica,* CITES) and Caucasian orchid (*Orchis caucasica,* CITES) recorded in 2007 and 2009 were not found during 2016 surveys
RR-001 numerous locations	A number of populations of Demeter's pear (*Pyrus demetrii* – GRL), comprising 1-4 individuals were recorded in 2016 at 14 locations (E&S Baseline Report Section 5.5a)
RR-001 KP2.0 (AM 65), KP3.5–7.6 (AM 66-69)	Numerous specimens of Smooth-leaf elm (*Ulmus minor*, GRL) spread along the proposed pipeline route within various habitat types such as hemixerophytic shrubbery, xerophilous shrubbery, deciduous woodland, grassland, plantation
RR-001 KP7.88 (AM 69)	Oakwood with Caucasian hornbeam and European ash
RR-001 numerous locations	38 populations of pyramidal orchid (*Anacamptis pyramidalis,* CITES, Int) recorded during 2016 survey, including three comprised of >70 individuals and 4 with 20-33 individuals; the remainder comprised fewer than 10 plants (E&S Baseline Report Section 5.5a)
RR-001 numerous locations	11 populations of green-winged orchid (*Anacamptis morio,* CITES, Iv*)* recorded during 2016 survey, including 2 large populations close to the centreline (between KP0.45 to 1.1) with over 100 individuals in each (E&S Baseline Report Section 5.5a).
RR-001, KP5.75	A single specimen of narrow-lipped helleborine (*Epipactis leptochila,* CITES) recorded in 2016 (E&S Baseline Report Section 5.5a)
RR-001, KP1.45	One population (2 specimens) of fragrant orchid (*Gymnadenia conopsea,* CITES) recorded in 2016 (E&S Baseline Report Section 5.5a)
RR-001 numerous locations	Five small populations (1-5 plants each) of violet limodore (*Limodorum abortivum)* recorded in 2016 (E&S Baseline Report Section 5.5a)

Location	Ecological interest
RR-001 various locations	Four small populations (1-5 plants each) of late spider orchid (*Ophrys fluciflora*) recorded in 2016 (E&S Baseline Report Section 5.5a)

Pipeline – fauna

This area is known to support a rich variety of invertebrates including around 50 species of diurnal butterflies. Amongst the reptiles, the Mediterranean spur-thigh tortoise (*Testudo graeca* – GRL, Iv) has been recorded during surveys in this area. In 2011, surveys of selected sections of RR-001 (near RR-001 KP4.0 and 6.0) identified the following reptiles in the vicinity of RR-001 KP4.0 (single individuals in both cases): Mediterranean spur-thigh tortoise (*Testudo graeca* – GRL, BERN, Iv); and European legless lizard (*Ophisaurus apodus*). *T. graeca* was also identified along the proposed RR-001 corridor during the surveys undertaken in 2015. Also during the 2015 surveys a five-streaked lizard (*Lacerta strigata*) and Caucasian agama (*Laudakia caucasia* – BERN) were identified.

Among the birds, blackbird (*Turdus merula*), Eurasian jay (*Garrulus glandarius*), chaffinch (*Fringilla coelebs*), robin (*Erithacus rubecula*), great spotted woodpecker (*Dendrocopos major*) and carrion crow (*Corvus corone*) were recorded as numerous along the entire re-route during 2009 surveys. At this time, only one pair of common raven (*Corvus corax*) was recorded at 8485303/4633393. In 2011, only two species of birds, common buzzard (*Buteo buteo*) and Eurasian jay (*Garrulus glandarius*), were recorded during surveys in the vicinity of RR-001 KP4.0 and 6.0. Birds identified during the 2015 survey, not listed above, included red-backed shrike (*Lanius collurio*), great spotted woodpecker (*Dendrocopus major*), greenish warbler (*Phylloscopus trochiloides*), swallow (*Hirundo rustica*), grey wagtail (*Motacilla cinerea*) great tit (*Parus major*), European green woodpecker (*Picus viridis*), long-tailed tit (*Aegithalos caudatus*), Eurasian sparrowhawk (*Accipiter nisus*) European bee-eater (*Merops apiaster*), blue tit (*Parus caeruleus*) and hawfinch (*Coccothraustes coccothraustes*). None of the birds mentioned above are species of conservation concern. A much wider range of bird species are known from a literature review to be potentially present in the vicinity of TNP (as detailed in Section 5.2d of the E&S Baseline). It is of note that the list of species known to be present in this region of Georgia includes the Eastern Imperial eagle (*Aquila heliaca*), which is also included on the Georgian and IUCN Red Lists under the category 'vulnerable', although none were recorded during any of the field surveys.

Mammals recorded during field surveys included wolf (*Canis lupus)*, fox (*Vulpes vulpes)*, badger (*Meles meles),* European hare (*Lepus europaeus*) and roe deer (*Capreolus capreolus)* (E&S Baseline Report Section 5.2d map 2). Other mammals known to inhabit the Georgian oak forest belt include the west European hedgehog (*Erinaceus europaeus transcaucasicus*), Eurasian marten (*Martes foina*), common weasel (*Mustela nivalis*), common shrew (*Sorex araneus*) and roe deer. None are considered endangered.

Mature trees with hollows are present in the relatively well-preserved forest fragments in the vicinity of RR-001 KP6.0. These have been identified as potential bat roosts (E&S Baseline Report Section 5.2d Table 13). A literature search has also confirmed that two bat species included in the Georgian and IUCN Red Lists under the category 'vulnerable' may be present in the forests in this area: Mediterranean horse-shoe bat (*Rhinolophus euryale*); and Mehely's horse-shoe bat (*Rhinolophus mehelyi*). During the 2015 survey an individual lesser mouse-eared bat (*Myotis blythii*) was observed within a tunnel at the border of the re-route corridor (see E&S Baseline Report Section 5.2d). This is not a species of conservation concern.

Access roads

The following potential access roads have been identified for RR-001: AR63, AR63a, AR64.5, AR64.5a, AR66, AR66a, AR69 and AR69a. These roads traverse a variety of habitats, which include hemixerophytic shrubbery of shibliak type, xeromesophilous scrub, deciduous woodland dominated by Georgian oak, oriental hornbeam, European ash, orchards, plantations, meadows and grasslands. During the 2015 survey, smooth-leaved elm (*Ulmus minor* - GRL) was recorded along most of these access roads. In addition, common walnut (*Juglans regia*), also a GRL species, was recorded at AR63.

Spring flowering plants were surveyed in May/June 2016 as reported in the E&S Baseline Report, Section 5.5a. Populations of pyramidal orchid (*Anacampsis pyramidalis* – CITES) were recorded at AR63 (1 individual plant), AR63a (4 populations comprising 1-9 individuals) and AR64.5 (8 populations comprising 1-22 individuals).

Mature trees adjacent to the access roads to RR-001 may be used by bats for shelter. Two individuals of Mediterranean tortoise (*Testudo graeca* – GRL, Iv) were recorded at AR66. A cave near AR69a was found to contain seven wintering greater horseshoe bats (*Rhinolophus ferrumequinum* – BERN, CMS). The surveys also recorded presence of several common bird species, red fox (*Vulpes vulpes)* and a number of other mammals.

RR-004a (AM 224–226)

Pipeline

RR-004a traverses a combination of arable land and pastures along the entire length and finishes in the secondary post-forest meadow where it joins in the existing WREP (see survey map in E&S Baseline Report Section 5.2e). No plants, animals or communities of conservation value were recorded during the survey. The traversed habitats are considered to have minimal value in terms of biodiversity conservation and did not merit a survey of spring flowering plants.

Access roads

AR225 traverses four major habitats including deciduous woodland, which has a high conservation value as it supports four GRL species namely:

- Imeretian oak (*Quercus imeretina*) – over 250 individuals were identified, all in good condition
- Smooth-leaf elm (*Ulmus minor*) - 38 individuals, all in good condition
- Sweet chestnut (*Castanea sativa*) – two individuals, both in good condition
- Yew (*Taxus baccata*) – one individual in good condition.

The three other habitats traversed by AR225 comprise secondary scrub, secondary grass-forb meadow and secondary wet meadow; all three are considered to have a low conservation value and based on findings of the September survey do not support any protected or high conservation value species.

Notwithstanding this assessment, further surveys were undertaken along AR225 during early and late May 2016 to determine whether or not any spring flowering species with high conservation value are present. Several populations of high conservation value, spring flowering plants were identified adjacent to AR225 as reported in the E&S Baseline Report, Sections 5.5b and 5.5c, Most of the species are listed in Appendix 2 of the CITES convention, but none are GRL. Species recorded are listed below, with the number of individuals if they were greater than 5:

- Narrow-leaved helleborine (*Cephalanthera longifolia* - CITES) – the largest population with c.500 individual plants
- Roman dactylorhiza (*Dactylorhiza romana* subsp. *georgica* - CITES) – c. 200 plants
- Long-lipped serapias (*Serapias vomeracea* - CITES) – c.80 plants
- Eastern cyclamen (*Cyclamen coum* - CITES) – 10 plants
- Lesser butterfly orchid (*Platanthera bifolia* - CITES)
- Lady orchid (*Orchis purpurea* subsp. *caucasica* - CITES)
- Marsh orchid (*Dactylorhiza urvilliana* - CITES)
- Bird's-nest orchid (*Neottia nudus-avis* - CITES)
- Bug orchid (*Anacamptis coriophora* syn. *Orchis coriophora* - CITES)
- Colchic iris (*Iris colchica* – Georgian endemic)
- Lily of the valley (*Convallaria transcaucasica* – rare wild ornamental)

The proposed access road and adjacent habitats do not support rich fauna (E&S Baseline Report, Section 5.3f); eight common bird species, a sand lizard (*Lacerta agilis*), a red fox (*Vulpes vulpes*) and a coypu (*Martes spp*) were recorded. A number of mature deciduous trees, which could potentially serve as bat shelters, were identified during the surveys. Bat surveys are being undertaken at these locations during summer and autumn 2016.

Alternative access to RR-004a could be provided by AR223. This is an existing community road through Mandaeti, some sections of which have a tarmac surface. AR223 was surveyed in June 2016 as reported in the E&S Baseline Report, Section 5.3h. It crosses three habitats with low conservation value (secondary grassland, secondary wet meadow and tree lines comprised of Bolle's poplar and black locust) and an area of broad-leaved woodland with high conservation value. The latter is mainly represented by communities dominated by Imeretian oak (*Quercus imeretina),* a GRL species, with some specimens of sweet chestnut (*Castanea sativa*), another GRL species. Some common walnut (*Juglans regia* - GRL) trees are present but are planted specimens.

Due to the high density of the understorey, the ground vegetation is generally species-poor and is dominated by bracken (*Pteridium tauricum*). Two isolated specimens long-lipped serapias (*Serapias vomeracea*), a CITES species, were recorded.

Supsa River crossings (WREP AM 372 and Export Pipeline AM 1.5)

Pipeline and temporary works areas – habitats and flora

The banks of the Supsa River are mainly occupied by agricultural fields with smaller areas of natural and semi-natural habitats represented by the following three major habitat types (see also E&S Baseline Report Sections 5.4a and 5.5b):

- Wetland – characterised by the dominance of yellow nutsedge (*Cyperus esculentus)*. In general, the habitat is extremely species poor and does not support any species or plant communities of high conservation value
- Secondary wet meadow – characterised by an abundance of wavyleaf basketgrass which is not a native species of Georgian flora. The habitat is species poor and does not support any species or plant communities of high conservation value
- Secondary riparian scrub – localised (and limited) areas on the northern (right) bank of Supsa River are dominated by blackberry (*Rubus* sp.) thickets. Only seven species are associated with this type of habitat; neither species nor plant communities of high conservation value are associated with this habitat

The only additional semi-natural ecosystem identified on the southern (left) bank of Supsa River during the surveys was alder (*Alnus barbata*) dominated, thinned riparian forest. In general, the studied forest fragments are heavily disturbed; most of the Alder trees are coppiced and many-branched. This habitat is considered to be of low conservation value due to high degree of disturbance and transformation, abundance of invasive and ruderal species in the ground vegetation and a lack of species of high conservation value.

The only site with high conservation value is the left bank of the R.Supsa Export pipeline crossing, which supports a population of Caucasian wingnut (*Pterocarya pterocarpa*), a GRL species, comprising 6 well established and 10 young trees – see maps in Section 5.4e of the E&S Baseline Report.:

In summary, most of the areas surveyed have been heavily modified and disturbed through anthropogenic activities and, in general, the habitat is considered to be extremely species poor and does not support any species or plant communities of high conservation value. The exception is the wingnut trees (GRL) on the left (south) bank of the export pipeline crossing. Wingnut was once widely distributed in the riparian habitats throughout Georgia but its populations are declining due to the degradation and fragmentation of riparian ecosystem.

Pipeline and temporary works areas – terrestrial fauna

The banks of the Supsa River in the vicinity of the proposed crossing point are occupied by corn fields, wetland fragments with channels (bramble bushes, tall herbaceous vegetation, alder trees (*Alnus barbata*) and Gleditschia *triacanthos* (along channel banks)) and alder stands. Alder, willow and conifers are also present along the riverbanks.

Transects were surveyed along the northern (right) and southern (left) banks and within the target site boundaries (E&S Baseline Reports Section 5.4b and 5.4f). The following mammals, reptiles and amphibians were recorded: vole burrows, European green toad (*Bufo viridis*), marsh frog (*Rana ridibunda*), European pond turtle (*Emys orbicularis*), sand lizard (*Lacerta agilis*), mole (*Talpa sp*.) badger (*Meles meles*), coypu (*Myocastor coypus*), red fox (*Vulpes vulpes*) and golden jackal (*Canis aureus*). During the 2011 survey footprints of common otter (*Lutra lutra*), a GRL species, were recorded. However, during the 2015 and 2016 surveys no evidence of *L. lutra* was detected. A mature poplar on the right bank of the Supsa at the export pipeline crossing is likely to provide shelter for numerous small animals.

A total of 36 bird species have recorded during recent surveys: grey heron (*Ardea cinerea*), common buzzard (*Buteo buteo*), Eurasian sparrowhawk (*Accipiter nisus*), black kite (*Milvus migrans*), Western marsh harrier (*Circus aeruginosus*), white wagtail (*Motacilla alba*), red-backed shrike (*Lanius collurio*), common whitethroat (*Sylvia communis*), marsh warbler (*Acrocephalus palustris*), corn bunting (*Miliaria calandra*), common raven (*Corvus corax),* Eurasian coot (*Fulica atra*), red kite (*Milvus milvus*), turtle dove (*Streptopelia turtur*), common cuckoo (*Cuculus canorus*), swallow (*Hirundo rustica*), common house martin (*Delichon urbica*), common redstart (*Phoenicurus phoenicurus*), blackbird (*Turdus merula*), blackcap (*Sylvia atricapilla*), great tit (*Parus major*), goldfinch (*Carduelis carduelis*), Eurasian tree sparrow (*Passer montanus*), yellow-legged gulls (*Larus cachinnans*) and, common kingfisher (*Alcedo atthis*), hooded crow (*Corvus cornix*), chaffinch (*Fringilla coelebs*), Eurasian jay (Garrulus glandarius), common nightingale (*Luscinia megarhynchos*), European bee-eater (*Merops apiaster*), spotted flycatcher (*Muscicapa striata*), European green woodpecker (*Picus viridis*), great crested grebe (*Podiceps cristatus*), sand martin (*Riparia riparia*), barred warbler (*Sylvia nisoria*), Eurasian hoopoe (*Upupa epops*) common tern (*Sterna hirundo*)., warbler (*Phylloscopus sp.*)

In summary, the areas surveyed are under heavy anthropogenic pressure typified by agricultural crop cultivation and the presence of former/abandoned artificial ponds. A large part of the survey area was waterlogged (swamped) at the time of the survey. The only important feature identified, which was adjacent to the study area, comprises a minor remnant of the flood plain forest located on the southern (left) bank of the Supsa river. This area lies outside the survey area boundaries but is considered significant because otter and jackal footprints were recorded here.

River Supsa – fish

A local ichthyologist undertook a review of recent literature sources (Ninua & Guchmanidze, 2013; Ninua et al, 2013) to identify migratory fish species recorded for the river Supsa. Only two GRL species were noted: Colchic sturgeon (*Acipenser colchicus*) and Beluga (*Huso huso*). Both species migrate upstream to the middle reaches for spawning.

De-oiling Sites

Access roads

New access roads may be required to access block valves BVS26 and BVS28 during de-oiling.

The access route to BVS26 has not yet been identified, but the access road to BVS28 is defined and was surveyed in 2015. The proposed corridor traverses xeromesophilious scrub and hemixerophytic grassland habitats with solitary individuals and micropopulations of smooth-leaved elm (*Ulmus minor* - GRL). These habitats are widespread in Georgia and are of low conservation value due to anthropogenic modification. The survey recorded the presence of sand lizard *Lacerta agilis*, mole (*Talpa* sp.) and several common bird species.

7.7.6 Ecology Sensitivities

A summary of the biodiversity value of habitats crossed by the proposed sections of WREP-SR Project and the associated access roads, is provided in Table 7-14.

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are:

- Protected areas within 10km of the WREP-SR Project:
    - Tbilisi National Park (IUCN category II) which is adjacent to RR-001 and some of its access roads
    - The Kolkheti Wetlands IBA, National Park and Ramsar site which lie 0.5km north west of the Supsa river crossings but will not be directly affected by Project activities
- Native oak forests that are found mainly in Sections RP-001a and RR-001 and along access roads AR55a, AR63a, AR66a and AR69a
- Deciduous woodland dominated by smooth-leaved elm (*Ulmus minor*) in Section RP-001a and adjacent to access roads AR63, AR63a, AR66a and AR69a
- Mature trees adjacent to or within the ROW or access roads, including those at RR-001, AR66a, AR69a and AR225 that are hollow and provide suitable habitat for roosting bats
- Fragments of secondary floodplain forest on the left bank of the river Supsa
- Plant and animal species that have conservation value, primarily because they are vulnerable, rare, protected or endemic to the Caucasus region, as listed in Table 7-11 and Appendix A1
- Otters that may be present at the river Supsa but were not recorded during the 2015 surveys.

Table 7-14 Summary of Habitats and their Biodiversity Value

	Biodiversity value by location															
Habitat type	RP-001a	AR52	AR55	AR55a	RR-001	AR63	AR63a	AR64.5	AR64.5a	AR66	AR66a	AR69a	AR-BVS28	RR-004a	AR225	Supsa crossings
Grassland	Low*	Low	Low*	Low		Low*	Low*	Low*	Low*		Low*	Low*				
Windbreak	V Low	Low*														
Deciduous woodland (dominated by Georgian Oak *Quercus iberica*)	High			High*	Mid-high*		High*				High	High*				
Deciduous woodland (dominated by Smooth-leaved Elm *Ulmus minor*)	High*					High*	High*				High*	High*				
Deciduous woodland (dominated by Caucasian Hackberry *Celtis caucasica)*							Mid-high									
Deciduous woodland (dominated by European Ash *Fraxinus excelsior* and Field Maple *Acer campestre*)								Mid-high								
Deciduous woodland (dominated by European Aspen *Populus tremula*)												Mid				
Deciduous woodland															High*	
Secondary floodplain forest																Low to high*
Scrub	Mid*	Low					Low	Low*			Mid*					
Hemixerophytic shrubbery of shibliak type	Low		Low*	Low*	Low*	Low	Low	Low*	Low*	Low*		Low*				
Xeromesophilous scrub					Low*		Low			Low*	Mid*	Low*	Low*			
Secondary scrub															Low*	Low

	Biodiversity value by location															
Habitat type	RP-001a	AR52	AR55	AR55a	RR-001	AR63	AR63a	AR64.5	AR64.5a	AR66	AR66a	AR69a	AR-BVS28	RR-004a	AR225	Supsa crossings
Grassland (Hemixerophytic)					Low*								Low			
Secondary grass-forb meadow															Low*	Low
Secondary post-forest meadow														Low		
Secondary grassland																Low
Ruderal vegetation					Low*											
Common reedbed with shrubs						Low										
Wet meadow						Low									Low*	
Plantation					Low*	Low*	Low			Low*		Mid				
Orchard						Low*										
Agricultural land														Low		Low
Roadside vegetation							Low*									
High conservation value herbaceous plants present															Yes	
Mature trees - potential bat shelters					Yes						Yes	Yes			Yes	

* = habitats with GRL trees present

7.8 Climate and Air Quality

7.8.1 Introduction

Given the proximity of the activities to the existing WREP, the climatic and meteorological conditions remain as described in the WREP EIA. For completeness, these are summarised in the sections below.

Generally, Georgia is known for its favourable climate, with the Greater Caucasus Range serving as a barrier to the cold air from the north, producing a high thermal regime and a small number of extreme meteorological events. As a whole, the country can be divided into two distinctive climatic zones: humid subtropical in the west of the country, and dry subtropical in the east, naturally separated by the Surami range (Kordzakhia, 1961).

The climate along the WREP pipeline route is largely a product of the Surami Mountain Range, located in western Georgia, and the dry plains of Azerbaijan to the east. The predominantly west-to-east transfer of air masses over the region along with orographic lifting of the air associated with the mountain ranges produces a damp climate in the western parts of Georgia, with almost uniform precipitation throughout the year. Consequently, the eastern side of the mountain ranges experience lower relative humidity, resulting in a dry-subtropical climate.

As no new pump stations will be needed along the pipeline, air quality is not considered a key issue for the WREP-SR Project during construction or operation. Therefore, it was concluded that site-specific air quality baseline data, including field data collection, was not needed for this ESIA. Data has been obtained from literature review sources including the original 1996 WREP EIA, the 2002 BTC Georgia ESIA, UN statistics on greenhouse gases (GHGs) (April 2007) and the International Energy Agency statistics for 2009.

The air quality baseline conditions are considered similar to or marginally worse than those described in the original WREP EIA, due to an increase in motorised traffic within towns and villages. However, since 1996, fuel quality and engine efficiency is also likely to have improved, which will counteract the increase in traffic. There is also likely to be a slight increase in air emissions from industrial sources since the original WREP EIA in 1996. At that time, many of the industries in Georgia were either not operating or were operating at significantly reduced capacity owing to the prevailing economic environment. This had the effect of reducing the total air emissions from industrial sources, and Georgia in general was experiencing significantly improved air quality since the 1980s when the industries were operating at full capacity. Since 2000, industrial production in Georgia as increased by an average of 17.7% per annum. However this increase in output has been accompanied by modernisation of many industrial facilities and a general improvement in combustion efficiency. It is therefore anticipated that air quality along the WREP pipeline route will not have changed significantly.

The WREP-SR Project sections lie in predominately rural areas, where it is expected that air quality would generally be very good owing to the current relatively limited scale of industry and road traffic in Georgia. The current main sources of air emissions along the WREP are summarised in Section 7.8.3.

7.8.2 Climate

Sunshine and solar radiation

The WREP pipeline is subject to a significant amount of solar radiation owing to its latitude. The average annual number of hours of sunshine increases from west to east with Gardabani receiving 2520 hours and Supsa receiving 1945 hours. The altitude of re-route sections of the WREP range from sea-level to 500m and receives annual solar radiation ranging from 115 to 140kcal/cm^2 respectively.

Air temperature

A high thermal regime exists in the region where the WREP is located. This is caused by the interaction between the Caucasus mountain system, the Black Sea to the east and the level of solar radiation. As a result, the air temperature is generally the same across Georgia with an annual average air temperature range from 12°C to 14.5°C.

The summer months tend to be warm with summer temperatures ranging from 22°C to 25°C. The maximum monthly average air temperature recorded in Georgia is 23.9°C, which was recorded in August near the border of Azerbaijan, in the east of Georgia. Winter temperatures are mild but slightly more variable across the pipeline route, ranging from -1.2°C to 4.7°C.

In general, the eastern end of the WREP experiences colder winters and summers than the western end because of anticyclone-type weather. The average air temperature in Gardabani is 0.3°C, whereas the air temperature at Supsa ranges from 4.5°C in January to 22.6°C in August. The central areas of the pipeline are mountainous and experience cool summers and winters. It is estimated that the highest point of the WREP, the Kortokhi crossing, the temperature will range from 15.4°C in August to -3°C in January.

Temperatures have been monitored along the pipeline route and the following extremes recorded:

- Annual absolute maxima of 37°C and 42°C; and
- Annual absolute minima of –25°C and –28°C.

These temperatures are considered unlikely to be experienced during WREP-SR construction and rarely to occur during the pipeline operation as they arose during the most extreme events known to have occurred at the meteorological stations during the time in which data was collated.

Soil temperature

Average annual soil temperatures are very similar for the western and eastern parts of the pipeline route (15–16°C); the central areas at Gori and Korbouli and Mukhrani have average annual temperatures of 11–13°C. Average monthly soil surface temperatures along the pipeline route in August, range from 24°C to 31°C, with highest temperatures recorded at the eastern end of the route. Average monthly soil temperatures in January range from -2°C in Gori to 4°C in Supsa. The number of days in which the ground will be frozen is not known, but is only likely to occur in winter months in the mountainous central region.

Soil temperature at 2m deep is the main parameter that characterises the thermal influences on the pipeline. Predictions of average monthly soil temperatures at 2m depth forecast between 8 and 20.2°C. Therefore, it is likely that the majority of the WREP pipeline is unaffected by frozen ground.

Air humidity

The route of the WREP is generally relatively humid. The average annual air humidity tends to increase from the east to the west of the pipeline and ranges from 68% in Gardabani to 82% in Supsa. The highest and lowest annual monthly air humidity along the pipeline route was recorded in Supsa (86% in July and August) and Gardabani (55% in July) respectively.

Precipitation

There is a pronounced decrease in annual precipitation from the west to the east of the pipeline route, equivalent to approximately a five-fold difference. The greatest average atmospheric precipitation occurs in Supsa (2192mm/year), decreasing to 1040mm/year in Ajameti, 516mm/year in Muchrani and, the lowest amount, 378mm/year in Gardabani.

In western and central areas, the majority of the precipitation falls between September and March, the driest months being April and May. In the east, precipitation is more constant throughout the year with the highest average monthly rainfall recorded between April and June.

The number of days of rainfall in excess of 0.1mm per year generally decreases from west to east, with 157 days at Poti (nearest station to Supsa) and 89 days at Gardabani, although the highest number of days in excess of 0.1mm was recorded at Korbouli (161 days).

Details of heavy rainfall frequencies are important as heavy rainfall can impair pipeline construction working conditions and can also cause erosion of susceptible soils and flash flooding in watercourses. The average number of daily rainfall events in excess of 30mm decrease generally from west to east of the pipeline route. The highest number are recorded at Lanchkhuti, which has an average of 14 days per year in excess of 30mm rainfall, Supsa is also likely to have a similar number of high rainfall days, the lowest average number of days with rainfall in excess of 30mm is at Gardabani, at only 0.8 days per year.

Maximal daily precipitation was only provided for a limited number of stations, the highest (268mm) being recorded in August at Poti (the nearest meteorological station to Supsa) Other areas with maximal daily precipitation exceeding 100mm include Samtredia, Sakara and Tbilisi.

Precipitation falls almost entirely as rain in the majority of the pipeline route. However, all areas have at least an average of six days per year of snow cover. Certain areas, particularly where the pipeline crosses the Surami mountain range, have 30 or more days of snow cover. The greatest average snow days (77) were recorded at Korbouli. Snow days were only recorded from October to April. No days of snow cover were recorded from May to September, which is when the majority of WREP-SR construction is expected to be undertaken.

Wind

The predominant wind direction for the west of Georgia is easterly. Both the west and east slopes of the Surami mountains are affected by east and west winds, as is Gori on the eastern side of the mountains. The predominant wind direction for Tbilisi and areas to the east towards the Azerbaijan border is north and north-west (Figure 7-5). Average wind speeds in the Tbilisi area are generally highest in June (5.7m/s) and lowest in December (3.8m/s), although these values do not significantly vary from the annual average (4.8m/s).

Atmospheric pressure

Station level pressure was recorded for Tbilisi, in the eastern section of the pipeline. Mean annual pressure was recorded as 969.2mb, with a maximum of 973.5mb in November and a minimum of 963.7mb in July. The lowest atmospheric pressures are associated with late spring to early autumn, and the highest with the cold winter months.

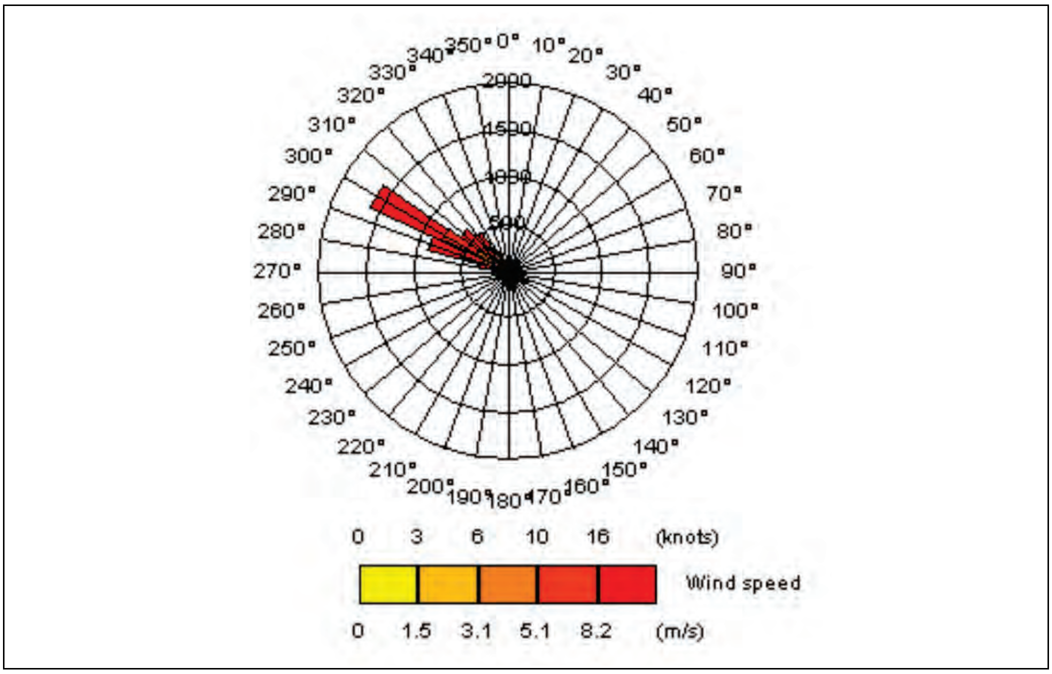

Figure 7-5: Wind Rose for Tbilisi, 1999 (Source: Trinity Consultants, USA)

7.8.3 *Air Quality*

Air emissions sources along WREP

In general, the reported levels of airborne pollutants are lower than or equivalent to those reported to occur in major cities in Europe. The main sources of anthropogenic atmospheric emissions from west to east of the pipeline route are from the industrial centres of Kutaisi, Zestaphoni, Chiatura, Tbilisi and Rustavi. The main sources of atmospheric emissions in Kutaisi (approximately 15km north of the pipeline route) are, amongst others, metal works, rubber works and lime works. Zestaphoni is located very close to the route and until the 1980s was significantly contaminated by emissions from the electric smelting furnaces of the ferro alloy plant. Chiatura is approximately 10km north of the pipeline route. The principal source of air emissions in this area is associated with mining of magnesium. However, all of these industries have been working at reduced capacity since the 1980s.

It is reported that the majority (80%) of air emissions in Tbilisi are related to road traffic. Other sources include a steel foundry, chemical plant and silica plant. However, as the city is located along the Mtkvari basin, the circulation of air from north-west to south-east provides natural ventilation and prevents a build up of smog. This circulatory regime will also disperse any air emissions away from the pipeline route in this area. Rustavi is located close to the WREP route in the east, approximately 25km east of Tbilisi. Rustavi was Georgia's most industrial city and contains steelworks, chemical and metallurgical plants, most of which are now closed or operating at reduced capacity. Winds in this area are generally from north-west to south-east, directing any air pollution away from the WREP pipeline route.

National greenhouse gas emissions

Data from the Georgia's 3rd National Communication to UNFCCC (MENRP, 2015) are provided in Table 7-15. A dramatic reduction in GHG emissions is evident between 1990 and 1994 followed by a levelling period between 1994 and 2004 and a rise between 2005 and 2011.

Table 7-15: GHG Emissions Trends in Georgia in 1990-2011 (Gg CO_2 eq[12])

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2	38,543	29,947	18,078	9,727	6,145	4,177	6,875	7,339	3,373	3,680	3,710
CH_4	5,920	5,030	5,827	4,689	3,952	3,222	3,393	4,445	4,510	4,468	5,230
N_2O	2,724	2,459	1,996	1,624	1,297	1,401	2,003	2,168	1,703	2,058	1,833
HFC								33	40	85	90
SF_6								0.02	0.02	0.02	0.03
Total	47,187	37,436	25,901	16,040	11,394	8,800	12,271	13,985	9,626	10,291	10,863

Gas	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2	3,880	3,685	3,936	4,847	5,047	6,250	7,161	7,116	6,613	6,684	8,354
CH_4	4,579	4,453	4,782	4,755	4,439	6,017	5,592	5,075	4,477	4,233	5,098
N_2O	1,728	2,075	2,181	1,989	2,402	2,083	1,881	1,650	2,030	1,981	1,839
HFC	97	112	152	176	221	279	368	467	547	632	804
SF_6	0.03	0.03	0.03	0.03	0.03	0.05	0.06	0.14	0.17	0.22	0.25
Total	10,284	10,325	11,051	11,767	12,109	14,629	15,002	14,308	13,667	13,530	16,095

Note: Data exclude contributions from land use change and farming (LUCF)

CO_2 comprised the majority of GHG emissions until 1997. With the collapse of the economy, CO_2 emissions were reduced and between 1998 and 2004, methane was the major GHG contributor. In 2005, the economy began to move forward and the relative proportion of CO_2 increased again until economic recession hit between 2008 and 2010. In 2011 a sharp increase in emissions was again observed which the 3rd National Communication to UNFCCC (MENRP, 2015) attributes to the improved economic situation, which led to an increase in emissions in the energy and industrial sectors.

Fluorinated hydrocarbon emissions have increased steadily since recording began in 1997, which reflects an increase in refrigerators and air conditioning units using fluorinated hydrocarbons.

Emission trends by sector (excluding land use) are shown in Figure 7-6 for the period 1990 to 2011. Contributions from the energy sector are dominant but declined dramatically between 1990 and 1995. After the collapse of the Soviet Union, the proportional contribution of the agricultural sector gradually increased. The industrial processes sector overtook agriculture as the 2nd largest contributor in 2007 and accounted for 22.7% of total emissions by 2011 (cf 15.2% for the agricultural sector).

In 2011, emissions from the energy sector constituted 54.7% of the total emission share (excluding the land- use sector). This is 75.9% less than in 1990 and 48.5% higher than in 2000. The collapse of the Soviet economy, decline of industrial output and sharp deterioration in living conditions between 1990 and 1995 resulted in the reduction of total emissions. After 1995 emissions have fluctuated and generally reflect changes in economic growth, living conditions, vehicle use and the rise of hydroelectric power generation.

[12] CO_2 eq represents the total emission of GHG in terms of CO_2, where GHGs other than CO_2 factored by their global warming potential relative to CO_2

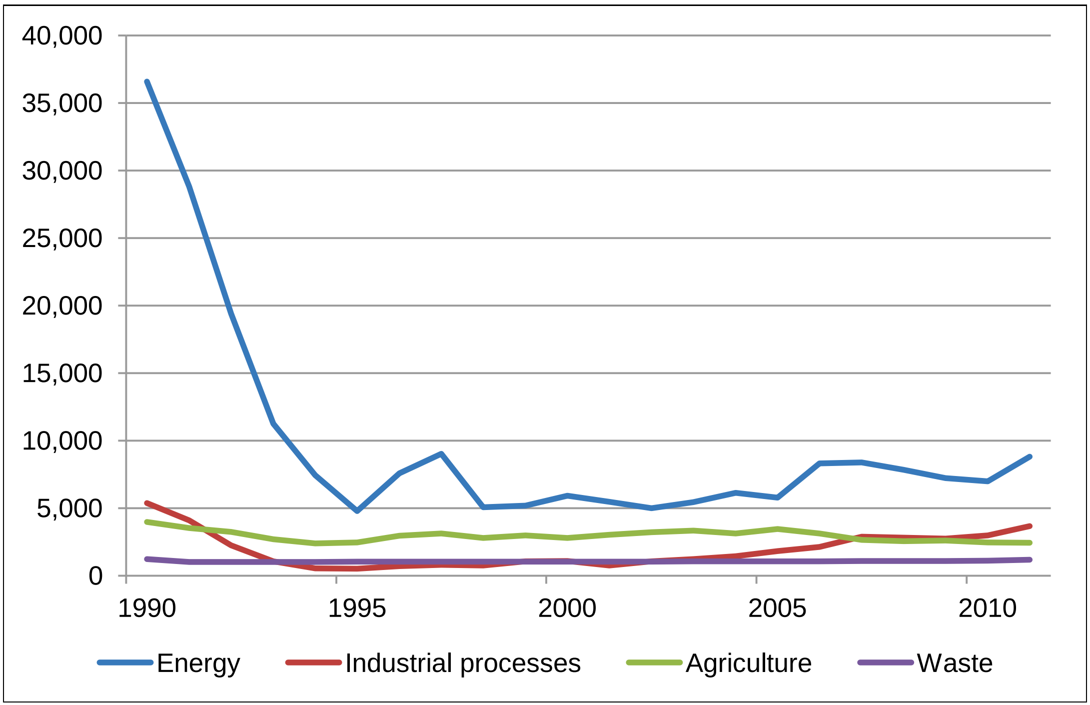

Figure 7-6: GHG Emissions by Sector (Gg CO_2 eq), 1990-2011

7.8.4 Climate and Air Quality Sensitivities

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are listed in Table 7-16 below.

Table 7-16: Dust Sensitive Locations

Approx. KP/AR	Locations potentially sensitive to dust
RP-001a KP1.0 (AM 53)	Stone house/farm 40m from the proposed route
AR63	Houses 10-80m from the access road Cemetery 40m from the access road Industrial units 80–300m from the access road
RR-001 KP0.0, AR63	Houses within 70m of the tie-in area and along AR63
RR-001 KP2.0	Two summer houses within 30m of ROW
AR65	Houses along AR65 within 10-20m
BVS28	Houses occupied by IDPs, 80m from the access road
AR to PRS1	Access via 20km of village roads. Passes through several villages: Korbouili – within 5m of many houses, 10m of Korbouli school #1, 15m of a new school under construction, 20m of Korbouli school #2 and an open market with small shops either side of the road. Shomakheti – within 10m of Shomakheti school. Usakhelo village - for about 1km. Residential houses are very close to the road. Within 20m of Usakhelo school. Zeda Usakhelo/Tsiteli Eklesia settlement - within 50m of village cemetery.
AR223	Mandaeti: schools, shops and houses within 20m from the access road

Approx. KP/AR	Locations potentially sensitive to dust
AR225	Houses within 80m of the access road
AR373	Houses, shop and farm along the access road

7.9 Noise and Vibration

Background noise surveys at the proposed pump stations (which are now operational) were carried out during the original WREP EIA. These locations were considered indicative of the general noise environment of the rural areas through which the pipeline passes. The principal sources of noise were identified as wind, animals and anthropogenic sources such as roads. Background noise levels were found to be within the range 31–46dB(A) during daytime hours. Noise levels during night-time hours were assumed very similar or slightly lower given the low to very low levels of daytime background noise.

Additional baseline noise surveys were not undertaken for this ESIA given that no new pump stations are proposed for this Project and noise emissions will be limited to the construction phase of the Project.

The closest communities and noise receptors to the proposed re-route sections are defined below, with further information provided in Chapter 8 Socio-economic Baseline.

7.9.1 Noise and Vibration Sensitivities

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are listed in Table 7-17 below.

Table 7-17: Noise Sensitive Locations

Approx. KP/AR	Locations potentially sensitive to noise
RP-001a KP1.0 (AM 53)	Stone house/farm 40m from the proposed route *
AR63a	Mamkoda village: house 290m from AR63a
AR63	Houses 10-80m from the access road * Cemetery 40m from the access road Industrial units 80–300m from the access road Cattle farm 250m from the access road
RR-001 KP0.0, AR63	Houses within 70m of the tie-in area and along AR63 *
RR-001 KP0.0 (AM 63), AR63a, AR64.5	Summer houses (west of Mamkoda) within 220m
RR-001 KP2.0	Two summer houses within 30m of ROW *
AR65	Houses along AR65 within 10-20m *
AR66	Houses 190m from the access road
RR-001 KP3.0	Church on hilltop, 160m from the proposed route
RR-001 KP5.2, AR67	Monastery 130m
RR-001 KP6.8, AR69a	Monastery complex 220m from the proposed route and access road
BVS28	Houses occupied by IDPs, 80m from the access road

Approx. KP/AR	Locations potentially sensitive to noise
AR to PRS1	Access via 20km of village roads. Passes through several villages: Korbouili – within 5m of many houses*, 10m of Korbouli school #1*, 15m of a new school under construction, 20m of Korbouli school #2* and an open market with small shops either side of the road. Shomakheti – within 10m of Shomakheti school*. Usakhelo village - for about 1km. Residential houses are very close to the road. Within 20m of Usakhelo school*. Zeda Usakhelo/Tsiteli Eklesia settlement - within 50m of village cemetery.
AR223	Mandaeti: schools, shops and houses within 20m from the access road *
AR225	Houses within 80m of the access road
AR373	Houses, shop and farm along the access road *

* Due to proximity, may also be sensitive to vibration.

7.10 Cultural Heritage

7.10.1 Introduction

The cultural heritage of an area may be affected profoundly by a large-scale construction project if not handled sensitively. With careful management and planning, however, it is possible to complete such projects with minimal impact on the cultural resources of an area and, in addition, provide a substantial increase in the quantity of archaeological information available for a region.

Known archaeological sites within 500m of the WREP-SR Project pipeline re-route sections have been identified and potential areas of concern highlighted. A group of independent Georgian experts – comprising an archaeologist, art historian, architect and BP Georgia's cultural heritage field officers – surveyed a 100m wide corridor along each pipeline route section. The extent and nature of features visible on the ground was taken into account during the pipeline routing process. The most appropriate management technique for each site that could not be avoided, and/or might be affected, was then developed.

Further field surveys along the proposed access roads were undertaken by Georgian experts during February/March and June 2016. In addition, an independent heritage impact assessment (HIA) was undertaken by ICOMOS Georgia to identify and evaluate any potential impacts on the Mtskheta World Heritage Site. The HIA was based on the criteria set out in ICOMOS Guidelines for World Cultural Heritage Impact Assessment (2011).

This section provides an overview of the context of cultural heritage resources in Georgia and details of the legal protection afforded to such monuments. It then goes on to describe the results of the baseline surveys undertaken and provides a list of heritage sites within the vicinity of and the re-routed pipeline corridors. Cultural heritage baseline reports are provided in Section 7 of the ESBR and have been submitted to NACHP as part of the Construction Permit application.

7.10.2 Phased Approach to Cultural Heritage Protection for Construction Projects

A structured programme is generally followed to allow for the identification and protection of cultural heritage sites during a development project. A phased approach is being adopted for the WREP-SR Project to comply with national legislation and in line with relevant international best standards and practice for the management of cultural heritage features within construction projects. The aim is to identify all features and protect them where possible. Where damage is unavoidable, the features will be excavated and recorded, and a programme of research and publication followed.

The following broad phases are generally recognised as good practice and have, or will be, applied to the WREP-SR Project:

Phase 1 – areas of potential cultural heritage interest were identified by various desk-based activities such as the literature review, documentary searches for previous archaeological works and examination of aerial and satellite images. The route of the pipeline was also examined by the several walkover surveys to assist in the determination of potential impacts.

Phase 2 – areas of potential lying within the construction corridor (50m) were examined to determine their nature and significance. This included detailed survey, geophysical survey and trial trenching. The information will be used to assist in the detailed design of the pipeline route and, where possible, the route will be changed or its impact reduced to minimise the potential damage to cultural heritage features.

Phase 3 – in areas where damage to the resource is unavoidable, archaeological excavations conducted by the heritage contractor, extracted and recorded all discovered archaeological materials prior to construction activities.

Phase 4 – it is recognised that construction of a pipeline may reveal previously unknown archaeology. Arrangements will be made for the cultural heritage monitoring of construction and provision of an archaeological expedition to conduct excavations where needed.CH monitoring also will protect all known CH sites – archaeological and architectural – located in the vicinity of the project area.

Phase 5 – study of material and preparation of reports on the archaeological works carried out during the Project. This phase would also see the dissemination of the results of the work both to the archaeological establishment and to the wider public via an appropriate medium.

Phase 1 and 2 work has already been undertaken for the WREP-SR Project and the results are described in this section. None of the identified sites require additional excavation so no Phase 3 work is envisaged for this project.

7.10.3 Overview and Context of Georgian Heritage Resources

The Georgian nation has a long written history and a wealth of historic sites, monuments and artefacts. It also has archaeological sites dating to periods long before written records began. Its earliest archaeological sites date to the late Pliocene geological epoch nearly two million years ago, and have yielded early hominid fossils (*Homo erectus*). Later remains include churches, monasteries, castles and fortifications that date to the well-known medieval period. Larger settlements in Georgia contain a diverse stock of historic secular and non-military buildings from a number of international styles that date up until the time of Soviet period, which began in 1922. Among the best-known and most frequently encountered archaeological remains in Georgia are those of the Early, Middle and Late Bronze Age periods (approximately 3000–800 BC). This period marks the earliest substantial evidence of social stratification, which is exemplified by objects made of intricately worked gold and semi-precious stones that are among Georgia's national treasures. The best known of these objects have been recovered from the kurgans, burial chambers of the Trialeti culture (3000–1500 BC) where presumed warrior leaders were buried.

This historic context section briefly describes Georgian prehistory and history by period and presents the cultural historical information needed to understand the significance of a particular archaeological site or monument.

Lower Palaeolithic (2,000,000–200,000 years ago)

This is a time before the emergence of anatomically modern humans. Early members of the genus *Homo* (*Homo erectus*) lived in small bands, apparently foraging radially from a home base located near some key environmental feature. Fossil remains and crude flake or cobble stone tools are the only artefactual remains from these earliest periods of human history. Remains of this period are extremely scarce worldwide and their importance lies in the clues to anatomical development and behavioural patterns of these earliest members of the genus *Homo*. Sites from this period can be dated by archaeomagnetic study and by potassium/argon dating if volcanic deposits are present.

The site of Dmanisi south-east of Tbilisi yielded a series of Pliocene faunal remains and was first investigated in the 1980s. Later, in 1991 and again in the summer of 2001, international archaeological teams recovered fossilised *Homo erectus* bones from the site. In addition, simple chipped-stone tools of the so-called Oldowan and Acheulean tradition have been found at the site. The site of Dmanisi, dating to between 1.8 and 1.4 million years ago is one of the earliest *Homo erectus* find sites outside of the African continent.

Middle Palaeolithic (200,000–30,000 years ago)

This very long period corresponds to the emergence of archaic *Homo sapiens* such as *neanderthalensis*. Throughout Europe and south-west Asia, the latter part of this period of human history is marked by what is called the Mousterian stone tool assemblage, which in comparison to the Acheulean stone-tool kit involved more elaborate and skilfully made tools and a wider variety of tool shapes. As was the case in northern Europe during much of this period, Georgia was a glacial or peri-glacial environment.

Mousterian stone tools have been found at over 75 sites throughout Georgia.

Upper Palaeolithic (30,000 years ago – 12,000 BC)

The Upper Palaeolithic corresponds to the Late Pleistocene period and saw the appearance in Europe, south-west Asia and Georgia of anatomically modern humans. Technologically, the period showed a dramatic rise in the variety and complexity of stone tool types. Tool assemblages with distinctive stylistic patterns can be tracked geographically, suggesting to some archaeologists the emergence of culturally and perhaps linguistically distinctive groups, i.e. ethnic groups. It is also suggested by some that this period saw the full development of human linguistic capability. Upper Palaeolithic peoples of Georgia probably relied on group hunting techniques of a few types of large animals such as deer, bison, wild horses, mountain goat, bear, and mountain lion, the remains of which are found in abundance at Upper Palaeolithic sites. Natural rock shelters and caves and places strategically located to exploit movements of their prey were the most common habitation sites of this period.

At least 33 significant Upper Palaeolithic sites are known throughout Georgia.

Mesolithic (12,000–8000 BC)

The end of the Pleistocene epoch and the start of the Holocene mark the start of Mesolithic period. Retreat of the Würm glaciation created a more moderate climate allowing exploitation of a wider range of environments. Hunting continues to be a major focus of economic activity, but now focuses on a wider range of prey. Individual animals of a variety of sizes, both herd animals and solitary species were hunted, suggesting smaller scale individualistic hunting techniques. Wild prey included a variety of deer, boar, horses, and sheep. Systematic foraging for seasonal plant resources also became an important part of the economic repertoire. Open-air sites became more common than cave sites at this time in Georgia and elsewhere in Europe and south-west Asia. The most notable shift in artefact assemblages for this period was the proliferation of tool-making materials and tool types.

Microliths (small flint and obsidian blades) and polished grinding stones, all of which were used for plant processing, became common. Net-sinker stones and harpoons suggest greater reliance on fish. The shift from Upper Palaeolithic to Mesolithic society is interpreted, quite simply, as adaptation to a different and broader range of resources that became available in the temperate Holocene environment.

Only 12 significant Mesolithic sites are known throughout Georgia.

Neolithic Period (8000–3500 BC)

The beginning of the Neolithic period is sometimes referred to as a revolution because of the dramatic shift in the human economy that it brought. With the coming of the Neolithic, humans shifted from a hunting-and-gathering way of life to one based on the domestication of animals and plants, i.e. on agricultural and animal husbandry. Along with these basic changes came the invention of pottery for cooking and storage of plant foods and the wide-scale introduction of ground and polished stone tools such as adzes, hoes and axes for clearing the land and tilling the soil. Building technology both for shelter and food storage also saw major advances. It appears that the Neolithic way of life was introduced in a fully developed form from elsewhere, as there is no evidence for the slow transition to an agricultural existence.

In contrast to the Palaeolithic and Mesolithic periods, pottery shards (the remains of cooking and storage jars) become the dominant artefacts in Georgian archaeological assemblages, reflecting the importance of food processing and storage. Georgian Neolithic pottery forms are typically flat-bottomed, round-sided jars and bowls without handles. Appliqué and incised decorations are common from the very start of Georgia’s pottery-making tradition. Surface treatment often includes burnishing. Round-sided bowls and relatively small jars are the most common forms. A wide variety of locally available tempering materials are seen in these early ceramics, including gravel, sand, ground ceramic, straw and crushed obsidian.

The first stand-alone Georgian Neolithic houses consisted of a series of abutting and interconnected rooms made of mud and mud bricks supported by wood beams and probably roofed with saplings and mud. Rooms were round or elliptical in plan with different sized rooms apparently having different standard uses. Large rooms (*c*.2.5 x 5m) had built-in hearths and were probably used for socialising and sleeping. Medium-sized rooms (*c*.1.25 x 2m) were probably used as a craft area, and small rooms (*c*.0.5 x 0.75m) must have served for storage. This settlement organisation is exemplified at the site of Imiris-Gora in south-central Georgia.

Approximately 60 Neolithic sites are known throughout Georgia; most are in western Georgia, although south-central Georgia has a concentration of sites from this period.

Bronze Age (3500–800 BC/IV-I Millennia)

Bronze Age cultures throughout Europe, the Mediterranean and south-west Asia depended on the plant and animal domesticates and associated technical advances, such as pottery and the working of native metals, to build a new type of society. This new society was ruled by a military and priestly elite who apparently practised a religion that included elaborate burial rituals and specific belief in an afterlife in which worldly material goods were of value. The rulers of these first stratified societies justified their status and set themselves apart from the common social classes through elaborate burial rituals and the consumption of luxury goods such as finely crafted ornaments of bronze and precious metals, and precious stones. Other, perishable commodities were surely involved but no physical record was left for us to interpret. Increased technical sophistication of craftspeople and geographically extensive systems of land and sea trade provided the logistic underpinning of these societies in differential access to luxury goods. All of these physical and social characteristics of Bronze Age society emerged slowly over hundreds of years in Georgia, first becoming apparent in the Kura-Araxes culture of the Eneolithic (Late Neolithic) and

Early Bronze Age periods (3500–3000 BC) and later during the Middle Bronze Age "florescent period" of the Trialeti culture (2500–1900 BC). Both cultures appear, from the geographical distribution of their remains, to have been centred in Georgia, especially south-central Georgia, but to have extended beyond into Armenia, Azerbaijan, eastern Turkey and further south.

The Kura-Araxes culture (also known as Mtkvari-Araksi), the first Bronze Age culture of Georgia, corresponds to the Eneolithic and Early Bronze Age periods in the area (3500–3000 BC). It is so named because of the geographical concentration of its occupation sites between the Mtkvari and Araxes rivers. Sites include necropolises (burial clusters) and settlements. Typical houses were single storey and constructed of mud brick, stone and dried mud with wood reinforcement. Floor plans were very similar, being rectangular with a small rectangular room at the door end and an adjoining, larger, square room at the rear. Variation in size, but not proportions, was common. A typical overall house plan was 4m x 7m. Houses were clustered together in rows, oriented to optimise solar exposure and shelter from the wind and tended to be located on small rises just above the flood plains. Typical settlement area was approximately one-half of a hectare.

The Kura-Araxes culture, as defined by characteristic ceramic decorative traits and other diagnostic elements, is first identified in the Late Neolithic. Kura-Araxes peoples either developed or adopted bronze smelting technology in the mid-fourth millennium BC.

The Trialeti culture (3000–1500 BC) corresponds to approximately the Middle Bronze Age in Georgia. Its area of influence extended beyond the boundaries of present-day Georgia, especially to the south and east. The culture is named for the Trialeti plateau, an area of south-central Georgia where the culture was first investigated archaeologically in the 1930s. This area also has the densest concentration of Trialeti remains. The Trialeti culture is best known for the large and elaborate tombs or *kurgans* that characterise its florescent period (2500-1900 BC). These were large circular stone and wood tomb constructions, some as large as 12m high and 100m across. Trialeti's florescent period is marked by the first *kurgans*, which were designed as the resting places of single elite individuals. Previously, the tombs held the remains of multiple individuals who were interred sequentially over time. Burial goods include an array of plain and decorative chipped stone, ground stone and metal tools and weapons, as well as ornamental objects of gold, silver and precious stones. Some of the best-known and most impressive objects displayed in the Treasury of Georgia's National Art Museum were excavated from large Trialeti *kurgans*.

The Middle and Late Bronze Age in Georgia saw the start of the historical distinction between eastern and western Georgia. At this time west Georgia, including the area of the Black Sea littoral, saw the complementary development of the Colchis (Kolkheti) culture. This culture was, from its early stages, distinct from the Trialeti tradition in nearly all aspects of its material culture. The Colchis (Kolkheti) culture, whose designation became synonymous with western Georgia, lasted well into the Iron Age and was in commercial contact with Greeks from Miletus and elsewhere. The best-known Colchis (Kolcheti) site is Vani, a major commercial, political, and religious centre that has been subject to years of archaeological excavation and study.

Iron Age (800–400 BC)

The transition from the Late Bronze Age to the Iron Age is in fact very difficult to identify. A conservative archaeological opinion is that ironworking did not become the predominant metallurgical technology until the first quarter of the first millennium BC. Nonetheless, it is clear that long before this, in the late Bronze Age (after the demise of the Trialeti culture), a series of significant technological and economic changes were occurring. Not all of these changes were caused by or even associated with a shift from the alloy-casting bronze techniques to iron smelting. The changes included use of an increasingly effective range of agricultural techniques, including deeper ploughing facilitated by draft animals and more sophisticated ploughs, use of crop rotation and the development of drought-resistant wheat.

These agricultural improvements in turn assisted in a transition from nomadic to sedentary herding techniques. All of the technological changes led to a larger more sedentary population that also appears to have made populations more prone to regional economic independence. In Georgia and elsewhere in Europe and south-west Asia, it has been speculated that the wider distribution of raw materials for ironworking and the more robust and diversified local agricultural economies were the primary factors that allowed greater regional independence. According to this view, the earlier Bronze Age economies required greater access to trade goods to assure access to needed food and craft products.

There are hundreds of significant Iron Age sites throughout Georgia. Sites are concentrated in alluvial settings in both West Georgia (traditional Colchis or Kolkheti) and East Georgia (traditional Iberia).

Prehistory to History

Traditionally, the Iron Age ended not because of new technological developments but rather because of the advent of history. Written accounts allow us to identify societies not by their typical artefacts or material but by reference to specific named kings, dynasties, wars and invasions. This increased detail brings additional complexity that challenges historical understanding. In the case of Georgia, this is especially true. The sweep of events and cross-cutting influences in Georgian history is almost overwhelming, involving influences from numerous civilisations, many ethno-linguistic and religious groups, and a seemingly countless series of invasions and re-invasions. Context for resource management of Georgia’s historic period can best be presented as a series of three periods, each of which interacted with one another and with indigenous Georgian cultural patterns in a different way.

Classical Period (500 BC to Late 400s AD)

The major civilisational influences on Georgia in ancient times are described below.

Nomads from the central Asian steppes

There was constant contact between Caucasian peoples and horse-riding nomads since about 300 BC onward.

Persians and Persian Empires

The Achaemenid Empire dominated eastern Anatolia and the Caucasus directly between *c*.550–*c*.330 BC. At that time, a number of proto-Georgian groups were pushed northward along the Black Sea coast. Persia’s access to Georgia came overland from the south and east, thereby affecting eastern Georgia more directly. Many believe that the Greek influence on Georgian culture is more evident in the later shared Christian traditions and that the Persians had a more profound effect on pre-Christian socio-political systems than did the Greeks. The old Georgian socio-economic system, ‘naxarar’ was also more Iranian and less classical. In this system, a semi-divine monarchy and a clan structure are the central elements of the political process, as opposed to elected magistrates with a centralised bureaucracy as was the case with Rome and Byzantium. Graphic and other decorative arts of the later Medieval Christian period still showed the strong influence of the Persian artistic tradition.

The Greeks

Greek traders and, later, the conquest of Alexander the Great are just two examples among many of Greek influence on Georgia during the ancient period. Greek presence in, and knowledge of, the area is attested to by the writings of Greek historians such as Herodotus and by Greek legends (which were based on experiences that extend back into the Bronze Age). Construction of the Greek trading port of Phasis (Phasii) the Georgian coast of the

Black Sea, and the inland distribution of identifiable Greek artefacts are elements of the Greek influence attested to by the archaeological record. The Kingdom of Colchis (Kolkheti) in western Georgia, with its inland capital at Vani was the principal counterpart for Greek trade in the Classical period. The most marked and continuous contact between Greece during the Archaic and Classical periods was via sea trade across the Black Sea. Later a major overland influence came to Georgia as the Greek armies of Alexander defeated the Achaemenid Persians in the 330s BC, also occupying Georgia.

Romans and the Roman Empire

The Romans replaced the Greeks as the dominant ‘classical civilisation’ competing for control of the Eastern Mediterranean and other adjacent regions. The Roman Legions, led by Pompey, occupied Georgia in the first century BC as part of a successful military campaign against the Parthians of Persia. The writings of the Greek geographer Strabo (Strabon) provide some of the most reliable information on ancient Georgia at the time of the Roman occupation.

There are numerous archaeological sites and excavated monuments from this period. Recent archaeological excavations at the fifth–fourth century BC site of Vani, in Colchis (Kolkheti), have yielded artefacts with Iranian motifs. An archaeological site in the suburbs of Tbilisi that dates to the second to third century AD is the Hellenistic necropolis at Armazis-Khevi near the medieval Iberian capital of Mtskheta. A bowl was recovered there with an inscription in Pahlavi, and other artefacts were recovered that display both Iranian and classical influence. Parthian gold coin hoards were recovered in Iberia (west Georgia). Other archaeological evidence includes carved stone stele showing seventh century AD Iberian and Armenian nobles wearing Iranian dress.

The most important sites of this period are located on prime agricultural land in alluvial valleys in western and eastern Georgia.

Medieval Period (Late AD 400s–1450s)

Indigenous Christianity

The Georgian Christian tradition began shortly before the start of the medieval period when St Nino came from Cappadocia (north-eastern Turkey) to evangelise in Georgia in the early fourth century AD. King Mirian of Georgia converted to Christianity in AD 347. The earliest surviving example of the Georgian writing system in Georgia is an inscription in the Bolnisis Sioni Church dating to AD 483, shortly after that time. A slightly earlier inscription has been identified in Jerusalem. (Nearly 800 years earlier, in fourth century BC, the Georgian King Pharnavaz had developed a system of writing for the Georgian language.) Since the fourth-century conversion of Mirian, despite numerous pagan and Muslim incursions, Georgia has retained its identity as a Christian nation.

Nomadic Invaders

There was constant contact between Caucasian peoples and Central Asian nomads since the fourth century BC. In the eleventh century, the Seljuks appeared. Georgia, however, continued as a united political entity in the face of such invasion, until the later Mongol period in the thirteenth and fourteenth centuries. In the fifteenth century, the Ottomans conquered Anatolia, and, as a result, they made frequent incursions into the Caucasus - Georgia, Azerbaijan and eastern Armenia. They then fell under the rule of the Persians once more, and there was continued fighting between the Turks and the Persians.

Arab Invasions

Beginning in the seventh century, the Arabs invaded and held portions of western Georgia, conquering Tbilisi for the first time in AD 645. During the Arab period, major Georgian centres fell to the Arabs and were again liberated by Christian uprisings. For a period in the ninth century, western Georgia was ruled directly by the Islamic 'Tbilisi Emirate'.

There are numerous archaeological sites and monuments from this period throughout Georgia, including the Mtskheta monuments (see sections 7.10.4–7.10.6). Some structures are complete, well preserved and still in use; others are dilapidated. Some remains are in still poorer condition, being limited to foundation stones of main buildings, or sometimes partially standing walls or parts of buildings.

Modern Period (AD 1450s–present)

Historical themes of the modern period include internal political fragmentation in Georgia, as well as influence and aggression from a new mix of foreign powers vying for control of the area.

The Ottoman Turks

The Ottoman Turks captured Byzantium in 1452, and extended their control westward into the Balkans and southward through the eastern Mediterranean into Egypt. The Ottoman Empire became a force for relative stability and later of secular modernisation in the region. The Ottomans invaded and ruled parts of Georgia until the start of the nineteenth century, fighting with the Persians for control of the Caucasus.

Shiite Safavids

Persia under the Shiite Safavids expanded its influence in the 1500s directly into the area, taking control of the eastern Caucasus and incorporating Azerbaijan into its Empire. Shiite orientation of Azeri Islam dates from this period. The sixteenth century also saw Safavid invasions in eastern Georgia. Under the combined threat from Safavid, Persia and Ottoman Turks, and as a result of declining regional overland trade with the Orient, this was a period of decline and fragmentation for Georgia.

Russian Empire

The Russian Empire expanded south-eastward into the Caucasus under Tsar Nicholas I (1801–1825). Weakening of the Persian Safavids allowed the Russians to enter the eastern Caucasus. The steadily mounting power of Russia throughout this period brought the Russians into a three-way struggle for control of the Caucasus. The three powers were the Ottomans, the Safavids and the Romanov royal family.

Soviet Union (1922–1991)

Georgia and the other Caucasus states were incorporated forcibly into the Soviet Union in the 1920s. Unlike previous Russian Imperial involvement in Georgia, the Soviet period had the effect of cutting off cultural contact with international traditions. This had a dramatic effect on architecture of all types. Civic buildings including government and cultural structures, residential structures, industrial structures and civil works all took on standard characteristics of the centrally planned Soviet economy.

The modern period was a time of regional decline for the eastern Mediterranean and the Middle East, and of national decline for Georgia itself. The European discovery of alternate sea routes to the Orient and the discovery of the Americas at the end of the fifteenth century marginalised the formerly central economic role of the Middle East.

Subsurface remains from the pre-Russian part of this period have a legitimate archaeological value in Georgia, although they have not been a major focus of investigation to date. Later subsurface remains (from the Russian and Soviet periods) have not yet taken on archaeological significance. There are numerous significant monuments from the modern pre-Russian and Russian period throughout Georgia. Such monuments, including churches, theatres, government and residential structures, are most often located in towns or urban centres. Structures from the Soviet period are generally not considered a positive aspect of Georgia's architectural heritage and are rarely inventoried as historic monuments.

7.10.4 Heritage Resources in WREP-SR Project Area

The summary of heritage resources in the Project area that is described in this chapter includes archaeological sites and historical monuments, including known and potential resources. Archaeological sites are defined as below ground historical resources, while monuments are above ground. The distinction between the two is made for resource management purposes because protection of each requires different types of investigative and possible mitigation procedures. Certain resources may include a combination of archaeological and structural components thus qualifying them as archaeological sites and monuments.

Archaeological sites consist of surface and near-surface artefacts and related materials in a spatial and stratigraphic context, which constitute a scientific record of the past cultures that created them. Where no contemporary written records of a culture exist, archaeological remains may constitute the only extant record of that culture. Without necessary knowledge and planning, ground-disturbing projects such as the proposed WREP-SR Project have the potential to damage archaeological sites and artefacts. Although heritage management principles always favour protection of archaeological sites by avoidance, such sites can often be rescued by scientific excavation, in which case a ground-disturbing project may be undertaken with limited adverse impact to the resource.

Historic monuments are remaining structures that – owing to aesthetic qualities, association with significant events or people, or through great age alone – represent a significant and irreplaceable historic resource. Monuments, in addition to being of interest for art historical study, may also be highly visible and well known, symbolising the importance of past events and possibly historic persons to the public. The value of an important historic monument is attached closely to its specific location and setting, and to the surrounding landscape. Unlike archaeological sites, it is very rare that an historic monument can be moved or altered without substantial loss of its scholarly and public value. Avoidance and direct protection are usually preferred for historic monuments.

Known cultural heritage sites in the vicinity of the WREP-SR Project are limited to sections RP-001a and RR-001 and their access roads, and AR225. The sites date from the Late Neolithic period onwards and include Late Neolithic bone fragments and obsidian flakes, Late Neolithic and Bronze Age settlements and burial features including large and small tombs grouped together in necropolises (burial grounds), Classical period settlement remains and ruined and abandoned medieval settlements (Table 7-18).

Historic monuments in the vicinity of the WREP-SR Project include, most significantly, the complex of sites around Mtskheta, one of the most important areas for Georgian cultural heritage. Parts of this area have been designated as a UNESCO World Heritage Site (see also Section 7.10.5) because of the religious architectural monuments such as the cathedral of Svetitshoveli and the monastery of Jvari (Photograph 7-9)). However, in the area there are over 40 cultural heritage sites. These show that there has been heavy settlement in the area since the Bronze Age. Mtskheta was the capital of Katrli, the kingdom of east Georgia, from 300 BC, and was described by the Roman writer Strabo. The city became a centre for trade and artistic development as can be seen from the finds from the palace site south of the Mtkvari River gorge and from the cemetery at Samtavro. The town of Mtskheta and Jvari Monastery attract significant volumes of tourism both from within Georgia and internationally owing to their cultural significance and World Heritage Status.

Section RR-001 of the WREP-SR Project is close to the Mtskheta area, but has been routed to avoid the areas of greatest sensitivity (see Chapter 4 Project Development and Evaluation of Alternatives).

Photograph 7-9: Mtskheta Town and Jvari Monastery (on top of hill) UNESCO World Heritage sites

7.10.5 Legal Protection of Heritage Resources in Georgia

This section presents the current status of heritage management and regulation in Georgia at the time of writing this ESIA document.

The protection of heritage resources in Georgia is based on the Georgian Law on Cultural Heritage Protection, 2007 (last amended December 2014). This law is regulated by the Ministry of Culture and Monuments Protection of Georgia (MoC) and the National Agency of Cultural Heritage Preservation. Within this Law, monuments are classified by their significance. Monuments on the UNESCO World Heritage List represent the highest category.

Mtskheta World Heritage Site

This section focuses on the protection status of the Mtskheta area that also includes small satellite settlement remains, as this is the most significant heritage site in the vicinity of the WREP-SR Project. The historical monuments of Mtskheta (the former capital of ancient Georgia) have been listed on the UNESCO World Heritage site list since 1994. They are cited in the list as “outstanding examples of medieval religious architecture in the Caucasus showing the high artistic and cultural level attained by this ancient kingdom”.

In 2003, with the assistance of UNESCO/UNDP and participation of international and Georgian experts, the Mtskheta Heritage and Tourism Master Plan was developed. The Master Plan is considered as the general guideline to be used when considering development projects in and around Mtskheta. The Mtskheta monuments were added to UNESCO’s List of World Heritage in Danger in 2009. Since then considerable effort has been invested in improved management and protection of the sites with a view to securing their removal from this list. A joint ICOMOS/ICCROM[13] monitoring mission in November 2014 acknowledged that significant progress had been made in implementing agreed corrective measures, but serious concerns remain.

Mtskheta protection zones

In October 2006, Joint Order No 3/471 11-1/1243 was passed in accordance with article 32, paragraph 2 of the Law of Georgia on Cultural Heritage Protection (1999). This order defines cultural heritage protection zones around Mtskheta to regulate development and safeguard the sensitive cultural heritage sites and historic landscape. The protection zones are shown in Figure 7-7 and are defined as follows:

- Immovable monuments protection zone (IMPZ)
- Development regulation zone (DRZ)
- Archaeological heritage protection zone (AHPZ)
- Landscape protection zone (LPZ).

IMPZ

The purpose of the IMPZ is physical protection of the monument and protection of the monument's visual and aesthetic value. The IMPZ physical protection area is designed to protect the area in the immediate vicinity of a historic monument from any activity that may physically harm the monument, and is defined as a radius of distance that equals twice the height of the monument but no less than 50 metres. Various restrictions are imposed in this area including limiting activities with significant ground vibration or deformation.

The IMPZ visual protection area is defined as the space beyond the physical protection area that, if modified, is likely to affect the historical environment and/or comprehensive perception of a monument. No activity is permitted within the visual protection area that could affect the historical surroundings of a monument and its visual appreciation, or reduce its significance. The area of visual protection is determined as:

- Monuments of national significance – within a radius of 500 metres
- Monuments included in the World Heritage List – within a radius of 1000 metres.

DRZ

The DRZ is a buffer zone designed to preserve the integrity of Mtskheta's historical centre and its historical landscape. The DRZ is defined in three locations:

- The Mtkvari gorge development regulation zone
- The development regulation zone of the right bank of Aragvi River
- The development regulation zone of the left bank of Aragvi River.

Its purpose is to ensure harmonious integration of any new development within the heritage area, and includes provisions for enhancement and preservation of the existing historic monuments. Certain development activities are permissible, although their location requires careful assessment to avoid impact to the aesthetic and heritage value of the area.

[13] International Council on Monuments and Sites; International Centre for the Study of the Preservation and Restoration of Cultural Property

AHPZ

The purpose of the AHPZ is to safeguard the most significant archaeological complexes within the territory of Mtskheta and its surroundings: Samtavro Burial Ground, Armaztsikhe-Bagineti, Mogvtakari (The Magi Gate), Armaziskhevi and Gartiskari. For the purpose of their protection, five AHPZs have been established:

- Samtavro-Aragviskari archaeological zone
- Gethsimania archaeological zone
- Mtskheta Royal Sepulchre archaeological zone
- Armaziskhevi Complex archaeological zone
- Armaztsikhe-Bagineti archaeological zone.

Restricted activities within the AHPZ include earth works, unless for agricultural purposes and in connection with archaeological works; disposal of construction, domestic or industrial waste; and vehicular traffic that may damage heritage sites.

LPZ

The LPZ has been defined in order to safeguard the natural landscape surrounding Mtskheta and puts into context the wider historical landscape of the Mtskheta area. The LPZ includes the Jvari Mountain and monastery, the Kartli Ridge and the archaeological monuments of Bagineti, the unique view of Svetitshoveli Complex, Bebristikhe, Kodmani Mountain, Tsitsamuri, Zedazeni and Saguramo Ridges.

The LPZ is shown on Figure 7-7 and in the vicinity of the WREP-SR Project the LPZ borders Tsitsamuri village in the north-west and the Tbilisi National Park in the north-east.

Within the LPZ, specific requirements are to protect the natural environment including managing vegetation growth; ensuring natural regeneration of forest and vegetation cover; protecting areas from landslides and scour; and minimising visual intrusion from existing and proposed development projects. Development projects within the LPZ are severely restricted, although permitted projects include: “linear facilities of State interest, which do not cause significant modification of historic terrain and landscape, or deterioration of the perception of cultural heritage protected within such zone or located within areas of visual protection”.

The WREP-SR Project falls into this category. Approximately 1km of section RR-001 (KP6.7 to 7.7) and access roads AR69, AR69a, AR69b and 100m of AR67 are within the Mtskheta LPZ.

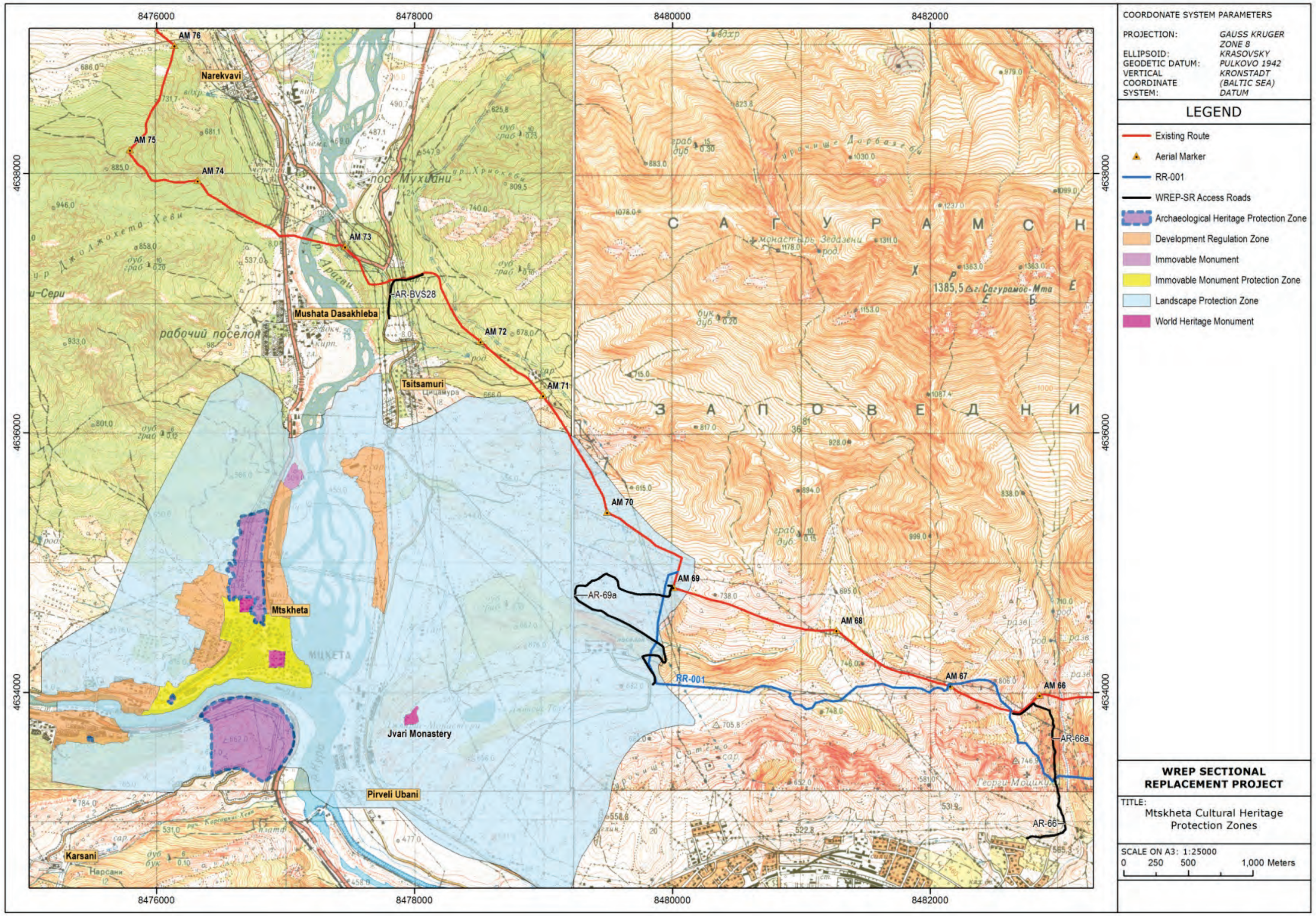

Figure 7-7: Map of Mtskheta Protection Zones

7.10.6 Baseline (Phase I) Assessment Methodology

Phase 1 archaeological studies were undertaken in order to define the cultural heritage baseline for the Project. Cultural heritage literature reviews and field surveys along the proposed re-route sections were undertaken in 2007, 2008, 2011 and 2012, and covered the following Project components:

- Pipeline re-route sections
- Access roads known at that time
- Tie-in sections known at that time.

The objective of the phase 1 baseline survey was to identify any sensitive heritage issues within the proposed work areas to refine the location of pipeline route and access roads where necessary, and to assist in the design of mitigation measures. Some pipeline sections were surveyed on more than one occasion to take account of route changes as engineering and impact assessment progressed.

A number of access roads have been identified since the phase 1 survey was completed. These roads were surveyed during February/March and June 2016. The field reports are provided in Section 7.1 of the ESB Report. Key findings have been incorporated into this final ESIA.

Literature review

Sources for the literature review include the original WREP EIA (1996), results from cultural heritage excavations associated with WREP construction, scientific material that has been published since 1996[14], and the BTC/SCP ESIA. These literature sources indicated the presence of a number of heritage sites located in the vicinity of the proposed WREP re-route sections.

Field survey

Following the literature review, a surface inspection of a 100m corridor was undertaken by BP/GPC's cultural heritage monitor Zurab Tskvitinidze in 2007 and by a group of Georgian independent experts (archaeologist Lali Akhalaia, architect Guram Kipiani and art historian Giorgi Patashuri) jointly with Zurab Tskvitinidze in 2008. Some of the proposed access roads were surveyed by the group of experts (archaeologists: Nikoloz Tushabramishvili, Zurab Tskvitinidze, Vakhtang Shatberashvili, art historian: David Khoshtaria) in 2009. The same of experts surveyed the additional areas and tie-in locations in 2011 and de-oiling, laydown and river crossings in 2012.

Field surveys were undertaken for all WREP-SR pipeline sections, including areas where alternative routes were being considered. At this stage, the field survey comprised a visual assessment for the presence of visible archaeological features and above-ground monuments and did not include any kind of intrusive works. All access roads have been subject to a cultural heritage field survey except for AR223 which was identified at a late stage. AR223 will be subject to an archaeological watching brief during construction.

Literature review and field survey results are summarised in Section 7.10.7. Detailed survey reports are provided in the Environmental and Social Baseline Report, Section 7.

[14] Information regarding excavated sites has been given in scientific journals: *Pipeline Archaeology*, Vol. I, 1999 and Vol. II, 2003; and Mtskheta 1998, Narekvavi I; Tbilisi, 1999

7.10.7 Heritage Sites within the Project Area

The baseline survey identified a number of known and potential archaeological sites in the vicinity of the proposed pipeline route and access roads. These are detailed in Table 7-18 and shown on the constraints maps in Appendix A.

Table 7-18: Heritage Sites in the WREP-SR Project Area

Site ID (from constraints map)	RR, RP or AR (access road) number	Details of Site
RP-001a AM 352-55		
CH-4	AR52	Possible burial mound located 175m to SE of proposed access road.
CH52-1	AR52	Elevated land (8m x 4m), within scrub south-east of the existing windbreak. No evidence of archaeological features or artefacts on the ground surface but several fragments of clay pottery were collected downslope approximately 100m south of the site. These fragments may have been washed down from the site occupied by the scrub.
CH55-1	AR55	Two ceramic fragments found on the ground surface where the proposed access road goes up on a steep ascent, but no evidence of archaeological features.
RR-001 AM 63–69		
CH63-1	AR63	A fragment of pottery bottom (coloured with red clayey paint) dating from the Classical or Early Medieval periods on the right bank of the gorge. This fragment does not originate from a stationary cultural layer and has been washed down from the upper reaches. Thus, this artefact has been identified without associated cultural layer / archaeological material and, therefore, it is not possible to characterize the source archaeological feature.
CH63-2	AR63	Settlement remains near road but not directly affected The four identified buildings may comprise a semi dugout terrace settlement where the roof of the lower building was a front yard of the upper house. The buildings are recent (possibly, XIX century), converted later on. The buildings are located at a fair distance from the access road situated in the gorge.
CH-5	AR66	Access road to be used for ROW construction Cultural layers at two sites within cuttings in the access road. These have been investigated and yield the following: Site I – along the motor road on the left side of the gully, the road cut bank contains a 30–40cm-thick cultural layer with ash content, with a large amount of bone material and obsidian flakes (likely to be Eneolithic and Bronze Age). Fragments of medieval ceramics (presumably ninth to tenth century) have been collected on the slope and in the trench on the left of the road. Ceramic material of Late Classical period was uncovered inside the trench along the road heading west. Site II – inside the cut bank on the left edge of the motor road in about 200 metres from site I, there are clear signs of burnt clay layers. Large stonework can be identified inside the cavities. In addition to the above sites, there is also a pit with sides plastered by a thick clay layer visible under a 20 cm humus layer in the road profile. There are signs of large fire on the plaster. The pit is full of stones, plaster fragments and ground. Pit depth is approximately 2m, width in the upper part – 2.2m, plaster thickness is 20-25 cm.

Site ID (from constraints map)	RR, RP or AR (access road) number	Details of Site
CH-6	KP3.0 (AM 66)	St. George's Church on top of hill, 70m to SW of re-route. The church is a plain single-nave building and is a working church. The monument dates from eighteenth century earliest. The roof, cornice and gutter have been restored recently.
CH-7	KP3.0 (AM 66)	Medieval village remains Structural remains (stone walls) of the settlement can be seen on the surface, spread across a fairly large area, mainly to the SW of the re-route. Route impinges on edge of site boundary.
CH-8	KP5.5 (AM 68)	Medieval village remains associated with those found at AM 66 and represent part of the same site, which is spread across a large area between AM 66 and AM 68. The route goes through the northern boundary of the site for approx. 350m metres
CH-23	AR 69	Access to ROW and Jvari Monastery This road is the main road to Jvari Monastery, which is a UNESCO World Heritage Site and major cultural and tourist attraction.
CH-24 (Mtskheta town)	RR-001 KP5.5 – 7.8 (AM 68.5 to AM 69)	Mtskheta town. The pipeline route is within or close to the historic LPZ associated with the Mtskheta World Heritage Site. The pipeline has been re-routed to avoid known archaeology and the highest risk area although the possibility of chance finds remains.
RR-004a AM 225–225+500		
	AR223	Not surveyed due to late identification as a potential access road
	AR225	Cultural heritage artefacts found at scattered locations along this access roads (E&S Baseline report Section 7.1b) include ceramic fragments, a bull-horeshoe, flint slate fragments, stones and boulders; no cultural layers were identified.
CH225-1	AR225	A flint plate / slice was found at AM 228
CH225-2	AR225	A kvevri side fragment was identified in the road profile at AM 225. This site is an extension of a private land plot. Artefact, which looks like dating from fairly late periods, was found without associated archaeological material.
Supsa River crossings AM 371 – 373 (WREP) and AM 1 (export pipeline) – no archaeological constraints identified		

At a number of locations, the pipeline route was moved slightly or an alternative route adopted to avoid an area of potential or known archaeology (see Chapter 4 Project Development and Evaluation of Alternatives). Examples of such mitigation measures include adopting route option B for RR-001 to avoid the Mtskheta area.

7.10.8 Mtskheta Heritage Impact Assessment

Following initial consultation with NACHP, ICOMOS Georgia was commissioned to undertake an independent heritage impact assessment (HIA) to identify and evaluate any potential impacts on the Mtskheta World Heritage Site. The HIA was based on the criteria set out in ICOMOS Guidelines for World Cultural Heritage Impact Assessment (2011) and the report is provided in Section 7.3 of the ESB Report.

The assessment was based on the following key documents:

- Retrospective statement on Mtskheta WHS Outstanding Universal Value (OUV), as submitted to the World Heritage Centre in 2011
- Mtskheta Cultural Landscape Survey, Ongoing and Planned Development Activities Impact Assessment and Landscape Protection, Rehabilitation and Development Guidelines – commissioned by NACHP in 2013
- Mtskheta WHS Management Plan, 2012
- Mtskheta WHS last State of Conservation Report
- Decisions of 33rd-39th Sessions of the WHC (Annex 1)
- Recent World Heritage Centre Mission Reports and ICOMOS Recommendations (Annex 2)
- World Heritage Cities Free of War. WATCH, 2013
- Information provided in this ESIA.

The desktop information was supplemented by four field visits to survey the existing and proposed pipeline route within the LPZ and to assess potential impacts on the landscape from established viewpoints.

Consultation with stakeholders for the WHS included the Patriarchate of Georgia, which provided dates for feast days in Mtskheta. Feast days attract mass processions of pilgrims which could be disrupted by construction activities or by construction traffic using the Jvari monastery road. The identified dates are as follows:

7 January – Christmas

19 January – Baptism

27 January – Feast day of St. Nino

6 February – Commemoration of St. Melchizedek I, Catholicos-Patriarch of Georgia

Sunday before Easter – Palm Sunday

Easter

Third Sunday after Easter – Feast day of the Holy Cross of Mtskheta

First Wednesday after Pentecost – Feast day of the Apparition of the Cross in Mtskheta

7 April – Annunciation; Feast day of Mtskheta and Benediction of the City

1 June – Feast day of St. Nino

13 July – Feast day of the Svetitskhoveli Cathedral

2 August – Feast day of Prophet Elijah

19 August – Transfiguration

14 October – Feast day of the Life-giving Pier in Svetitskhoveli Cathedral; Feast day of Mtskheta

2 November – Commemoration of Gabriel Salos.

7.10.9 Key Cultural Heritage Sensitivities

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are:

- The landscape protection zone (LPZ) for the Mtskheta World Heritage Site which is close to or crossed by section RR-001 and access roads AR69, AR69a, AR69b and 100m of AR67
- AR69 which is used for mass processions to Jvari monastery on certain feast days
- AR66, where cultural heritage features and artefacts have been recorded
- Other areas with known cultural heritage that are within or close to the proposed Project areas, as identified in Table 7-18.

7.11 Traffic

7.11.1 Introduction

Plant and traffic movements during construction of the WREP-SR Project will be along the ROW, agreed access roads and along public highways. Pipeline construction will, therefore, result in a temporary increase in traffic flow on public highways in order to enable personnel, materials and equipment to be delivered to pre-determined access points along the route.

In order to assess the potential impacts the Project may have on traffic flows, a baseline survey was carried out to determine the levels of existing use by vehicular and other users.

7.11.2 Survey Location and Methodology

A one day survey was carried out at the road to Jvari monument at its junction with AR69 (an access road for RR-001). This location was selected as it is used by local residents and visitors to Jvari monument, with predominantly light vehicles and buses, and will most likely experience increased traffic due to Project activities.

The survey was designed to measure traffic flow in both directions and was carried out between 9am and 5pm. The survey followed general UK guidance on traffic surveys utilising Manual Classified Counts and comprised manual counts of road users by counters/enumerators situated at an observation point at the side of the road at the agreed survey location.

Traffic was recorded continuously for 50 minutes, with a 10-minute break before the next 1-hour recording session. The flows recorded for each 50-minute interval were converted to hourly flows by a correction factor of 60/50. GPS data was recorded to identify the survey location.

7.11.3 Analysis of Survey Data

Traffic data obtained from the survey was analysed and presented in summary sheets within a Traffic Survey Report (see E&S Baseline Report, Section 6). The summary sheets provide data on the total traffic flow and its composition by vehicle type in both directions, as well as the proportion of heavy vehicles.

Data from the traffic survey has been summarised in Figure 7-8 which shows the percentage breakdown of vehicle type at each location[15]. The majority of vehicles were light vehicles which made up between 94% and 97% of the vehicles recorded. Heavy vehicles accounted for only 2–4% of all recorded traffic.

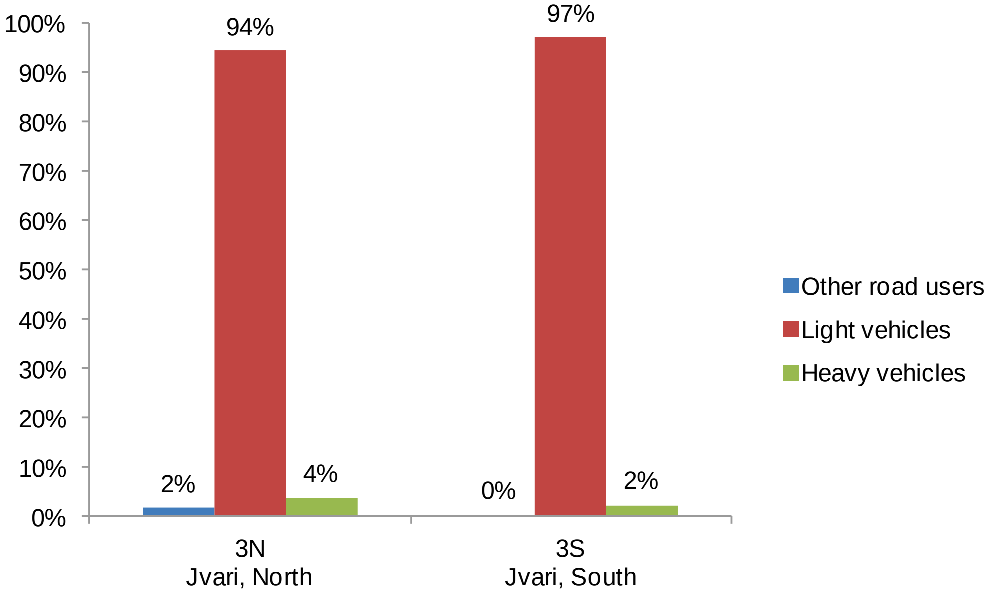

Figure 7-8: Percentage Breakdown of Vehicle Type Recorded

Figure 7-9 below shows the average and peak flows. On average, 25–27 vehicles passed the survey point in each direction per hour, with peak flow reaching 37 vehicles.

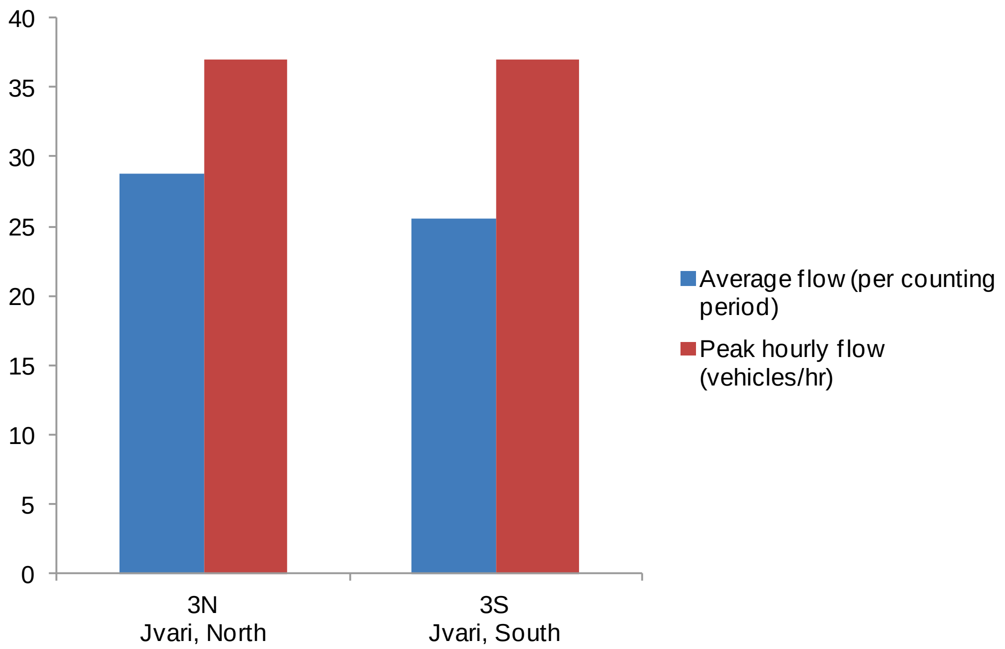

Figure 7-9: Average and Peak Traffic Flows

[15] Other Road Users include pedestrians, animal flocks, bicycles, motor cycles and agricultural vehicles; light vehicles include cars and light goods vehicles; and heavy vehicles include rigid vehicles with two or more axles, heavy trucks, buses and coaches.

7.11.4 Traffic Sensitivities

The components of the baseline conditions that, in the Project context, are considered the most important based on the anticipated impacts of Project implementation are:

- AR69 which is the access road to Jvari monastery and therefore used by visitors
- AR63, AR65, AR to PRS1 and AR223 where there are schools and/or houses close to the access road.

7.12 Key Sensitivities

Certain environmental components identified are particularly sensitive to the development. In some cases they display the same sensitivities throughout the WREP-SR Project area:

- Soil is sensitive to compaction, soil degradation through long-term storage and soil erosion
- River water quality is sensitive to discharges of effluent containing chemicals, wastewater containing organic material, heavy metals and bacteria (e.g. domestic wastewater) into rivers, spills of oil and grease, additions of soil (e.g. due to erosion processes) and artificial changes to river flow rates
- Groundwater quality is sensitive to contamination from spills of oil and chemicals and discharges of wastewater, and groundwater levels are sensitive to abstraction of water for the WREP-SR Project. Some of the PACs have inadequate water supplies, wastewater treatment and waste disposal.

In other cases, differences can be distinguished between the sensitivities in different parts of the WREP-SR Project area as identified in Table 7-19. In addition, areas with high soil erosion potential are identified in Table 7-2 and areas of known contamination in Table 7-4. Sensitive social receptors that may be affected by dust, noise and vibration from Project activities, are summarised in Table 8-8, Chapter 8.

Table 7-19: Sensitive Environmental Receptors

Approx AM/AR	Section KP	Sensitive Environmental Receptors
RP-001a AM 52–55		
AM 52–53	RP-001a KP0.5	Meadow with fragrant orchid (*Gymnadenia conopsea*), which is listed under Convention on Trade of Endangered Species (CITES)
AM 53–55	RP-001a KP1–2.5	Deciduous woodland dominated by Georgian oak (*Quercus iberica*) and associated by Oriental Hornbeam (*Carpinus orientalis*) and European Ash (*Fraxinus excelsior*)
AM 54–55	RP-001a KP2.5	Isolated patches of deciduous woodland dominated by smooth-leaved elm (*Ulmus minor*), consisting of approximately 200 specimens
Near AM55	RP-001a KP2.7	The edge of a hornbeam-oak forest that includes wild pear (Pyrus sp.). Two species of this genus, *Pyrus ketzkhovelii* and *Pyrus demetrii*, are included in the GRL (2013) but identification is problematic unless the specimens are flowering or fruiting. Location in relation to the current ROW needs to be confirmed during favourable botanical conditions

Approx AM/AR	Section KP	Sensitive Environmental Receptors
RR-001 AM 63-69		
AM 63+100	RR-001 KP0.0	Crossing of Jokhtaniskhevi gully which is used for animal watering and flows into the Mktvari
AM 63	RR-001 KP0.5	Orchids (CITES): Dactylorhiza (*Dactylorhiz romana subsp. Georgica*), Caucasian orchid (*Orchis caucasica*)
AM63, AM65	RR-001 KP0.0	Smooth-leaf elms (Ulmus minor - GRL) – several individuals
AM 63–69		Route and access roads are close to Tbilisi National Park (IUCN Category II Reserve)
AM 64	RR-001 KP0.8	Mature trees – potential bat shelters
AM64	RR-001 KP1.5	Potentially specimens of GRL wild pear (*Pyrus demetrii, P. ketzkhovelii, P. sachokiana*)
AM 65–AM 66	RR-001 KP2.4 – 3.7	CITES species: Ophrys (*Ophrys oestrifera*), Green-winged orchid (*Orchis morio),* Cephalanthera orchid (*Cephalanthera longifolia*)
AM 66	RR-001 KP2.5	Proposed ROW crosses Jachviskhevi stream which has a vertical eroding banks in places and flows into the Mktvari river. It is subject to flash flooding and may be used for irrigation and animal watering at downstream locations
AR 66	RR-001 KP2.5	The ground adjacent to the access road includes a cultural layer consisting of ash, obsidian artefacts and animal bones
AM 66	RR-001 KP3.0	St George's Church on top of hill, 70m to SW of proposed ROW
AM 66	RR-001 KP3.0	Medieval village remains on the ground surface, spread across a fairly large area to NE of the route. Route avoids site boundary but is within 3m at closest point. Significance of the site is determined as low.
AM 67	RR-001 KP4.7, KP5.0	Potentially specimens of GRL wild pear (*Pyrus demetrii,P. ketzkhovelii, P. sachokiana*)
AM 68	RR-001 KP5.0	c.350m of proposed ROW is through northern boundary of medieval village; significance of the site is determined as low
AM 66	AR66a	Mature tree – potential bat shelter
AM 66–69	RR-001 KP5.0	Smooth-leaf elms (Ulmus minor - GRL) scattered throughout this area
AR 69	RR-001 KP5.9	Access to ROW is the main road to Jvari Monastery, which is a UNESCO World Heritage Site and major cultural and tourist attraction
AM 68.5–AM 69	RR-001 KP6.0 to KP7.8	Pipeline route is within or close to historic landscape protection zone (LPZ) associated with the Mtskheta World Heritage Site.
AM 69	RR-001 KP5.8, KP6.1, KP6.8, KP7.4 AR69a	Mature trees – potential bat shelters
AM 69.8 – AM 69	RR-001 KP6.0 – 7.88	Oakwood with Caucasian hornbeam and European ash supporting Narrow-lipped heleborine (*Epipactis leptochila* subsp. *Leptochila*, CITES), Caucasian peonies (*Paeonia caucasica*, Caucasian endemic species) and potentially protected varieties of wild pear (*Pyrus demetrii, P. ketzkhovelii, P. sachokiana*)

Approx AM/AR	Section KP	Sensitive Environmental Receptors
RR-004a AM 224 – AM 226		
AM 223, AM225	AR225	Mature trees – potential bat shelters
R Supsa AM 371 - 373		
AM 372	Supsa KP0.0	There is a small remnant of riparian forest on left bank; otters (*Lutra lutra* - GRL) were recorded in previous surveys at this locaiton.