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Shurtan GAS CHEMICAL COMPLEX

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT (ESIA) – VOLUME II

Project Document No

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SGCCUP – ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT – VOLUME II

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for Review	K Kamyshina / S McClymont	T Romanenko	T Goodhand	29 Sep-17	N/A	
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CHANGES SINCE THE PREVIOUS VERSION INCLUDE:

SECTION	DESCRIPTION

HOLDS:

NO.	SECTION	DESCRIPTION
VOLUME I		
1	2.5.3	Construction Accommodation Camp: Location of construction accommodation camp to be confirmed
2	2.5.5	Temporary Construction Facilities Land Area: The actual layout and land location for the temporary construction facilities requires confirmation
VOLUME II		
3	7.5.3.3	Local Surface Watercourses: Description of Project site drainage system and volumes is required from Project Team
4	8.6	Eco-system Service: Awaiting inputs from socio-economic assessment
5	8.6.2	Agriculture: Awaiting inputs from Social Baseline Assessment
6	8.6.3	Livestock: Awaiting inputs from Social Baseline Assessment
7	8.6.4	Capture Fisheries: Awaiting inputs from Social Baseline Assessment

8	8.6.5	Edible Plants: Awaiting inputs from Social Baseline Assessment
9	8.6.6	Hunting: Awaiting inputs from Social Baseline Assessment
10	8.6.8	Biochemicals, natural medicines and pharmaceuticals: Awaiting inputs from Social Baseline Assessment
11	9.11.2	Intangible Cultural Heritage and Traditional Beliefs - Awaiting Project Specific Information from in-country studies

CONTENTS

Appendices

7. PHYSICAL ENVIRONMENT BASELINE

7.1 Introduction

The Baseline Physical Environment Section provides a detailed description of the physical environmental conditions relevant to the SGCCUP, and its surrounding study area. For each environmental discipline a summary of the existing baseline conditions are presented and this also includes a summary of the baseline survey and additional data collection undertaking where this requirement was identified during the Scoping Phase.

7.2 Climate and Meteorology

7.2.1 General Overview

Relevant information from the Scoping Phase of the ESIA (Advisian, 2017) is summarised in the sections below. Additional baseline survey was not conducted as part of the ESIA and additional closer meteorological data could not be sourced. Key aspects identified following project scoping included the potential for:

- Excessive rainfall and flooding causing damage to assets that then may result in contamination;
- Prolonged drought and effect on local and regional water resources; and
- Climate change projections and consideration of impact to project resilience.

7.2.2 Baseline Survey and Data Collection

The Scoping Phase identified a lack of site based meteorological monitoring data to enable comparison with the data from the more regional Guzar and Karshi stations. Additional baseline survey was not conducted as part of the ESIA and additional closer meteorological data could not be sourced.

7.2.3 Climate

Uzbekistan's climate is classified as continental with hot summers and cool winter. The Project site is located in a cold semi-arid climate area according to the Koppen climate classification. Precipitation ranges from 100-200 mm/yr in the deserts and steppes, increasing to 300-400 mm/yr in the foothills and up to 600-800 mm/yr on the west and southwest slops of mountain ridges (World Bank, 2013)

There has been a trend of warming temperatures across the whole of Uzbekistan since the 1950s, with the rate of warming (approximately 0.3˚C per decade) is more than twice the global average. Average temperatures are projected to increase by 2 to 4˚C by the 2050s over the central Asia region.

There is a general trend of increased winter precipitation and a slight decrease in summer precipitation. Climate projections indicate a 10-15% increase in winter precipitation and a 5-15% reduction in summer precipitation by 2100. More frequent and prolonged droughts are expected combined with higher flash flood risk due to increased days with heavy precipitation. [Ref. Climate change risks and vulnerability of Uzbekistan's energy sector – Workshop briefing note. IFC, WorleyParsons, Acclimatise].

The evaporation potential is also forecasted to increase by 10-15% (Rakhmatullaev et al, 2012).

7.2.4 Meteorology

This Section presents the key meteorological features of the Project area. The meteorological data presented herein is referenced directly from the Oltin Yo'l GTL Environmental Social, Health and Safety Impact Assessment (ESHSIA). Data presented is generally from the Guzar and Karshi meteorological stations located approximately 40 km to the northeast and north northwest from the Project area respectively. A 50 year record (1963 to 2012) is available for Guzar and a 10 year record (2000 to 2009) for Karshi.

7.2.4.1. Air Temperatures

The project area is characterised by climatic patterns, typical of Uzbekistan and other semi-arid territories of Central Asia, with relatively hot and dry summers and cold and dry winters. Recorded maximum temperatures within the project area were read at over 40°C and minimum temperatures below -25°C (Ministry of Agriculture and Water Resources, 2001).

7.2.4.2. Wind

Wind direction and wind speed data for the years 2000 to 2009 have been obtained from Karshi Meteorological station. Average annual wind speeds recorded within this period are presented in Table 18 below. Annual wind speeds fluctuated around an average 2.56 m/s within this ten-year period.

Table 18– Average annual wind speed at Karshi Meteorological Station (2000-2009) (Source: Golders, 2014)

Parameter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Average annual wind speed (m/s)	2.8	3.5	2.7	2.5	2.3	2.2	2.5	2.3	2.3	2.5

7.2.4.3. Precipitation

Precipitation occurs predominantly within winter and spring months. The average annual rainfall for the available data periods ranges from 225mm to 341mm for Karshi and Guzar respectively (Tables

19a and b)) with most rainfall (>95%) occurring between November and May. Minimum precipitation occurs between June and October (<5%).

The average annual evaporation data was obtained over a 28 year period, ending in 2012, from the Guzar station. Based on the available record, the average annual evaporation is 5475 mm (Table 16).

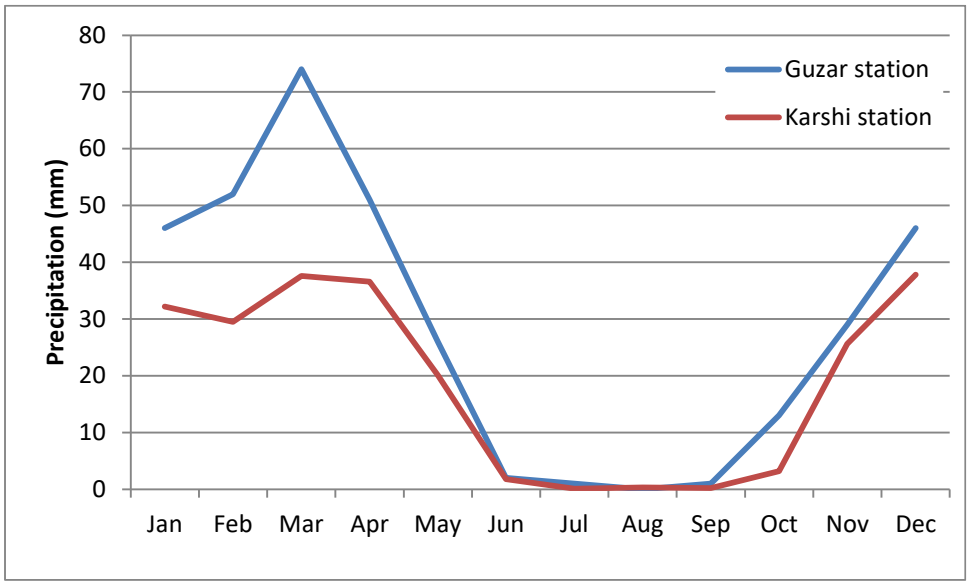
Levels of precipitation in exceedance of >0.2 mm/day are considered sufficient to suppress wind-blown dust emissions (Office of the Deputy Prime Minister, 2005; IFC, 2007). Data from the Karshi station indicates that, on average, precipitation exceeded >0.2 mm/day for 58.9 days of the year, with the month of March experiencing the greatest number of days of precipitation >0.2 mm/day, with approximately 9.8 rain-days during the month (Table 19b).

Table 19a – Average monthly evaporation and rainfall data for the Guzar meteorological station (1963-2012) (Source Golders, 2014)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average precipitation (mm)	46	52	74	51	26	2	1	0	1	13	29	46	341
Average evaporation (mm)	98	134	206	321	557	861	978	898	683	400	219	118	5473

Table 19b – Monthly and annual rainfall data for Karshi Meteorological Station (2000-2009) (Source: Golders, 2014)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average precipitation (mm)	32.2	29.5	37.6	36.6	20.1	1.8	0.1	0.3	0.2	3.2	25.6	37.8	225
Number of days with precipitation >0.2 mm/day	9.7	8.9	9.8	7.5	3.3	0.7	0.2	0.3	0.4	2.7	6.1	9.3	58.9



13. Monthly average precipitation for the Guzar and Karshi meteorological stations

7.3 Air Quality and GHG Emissions

7.3.1 General Overview

In order to describe the current state of air quality in the project area a number of key locations were identified for reviews and studies. The studies were based on review of monitoring results carried out in the recent years by the Shurtan and other entities as well as general reports available in the public domain. The selected locations include:

- The SGCC existing residential camp (used for staff rotations), about 2.5 km to the north of the plant;
- Otkuduk village about 6.5 km to west of the plant;
    - Navbahor village about 10 Km to the west of the plant;
    - Southeast farms, about 8 km southeast of the plant;
    - Unidentified industrial facilities 1 to 3 km northeast of the plant;
    - Dam and reservoir about 3 km to the north; and
    - Oltin Yo'l GTL construction camp 2.5 km northwest of the plant.

In addition to the above locations, the proposed location of the Oltin Yo'l GTL facilities and associated residential complex (to be located in 3 to 4 km to the west and northwest of the proposed plant respectively) was also taken into account for the baseline studies. The proximity of these receptors to the plant is the main reason for including them in the analysis.

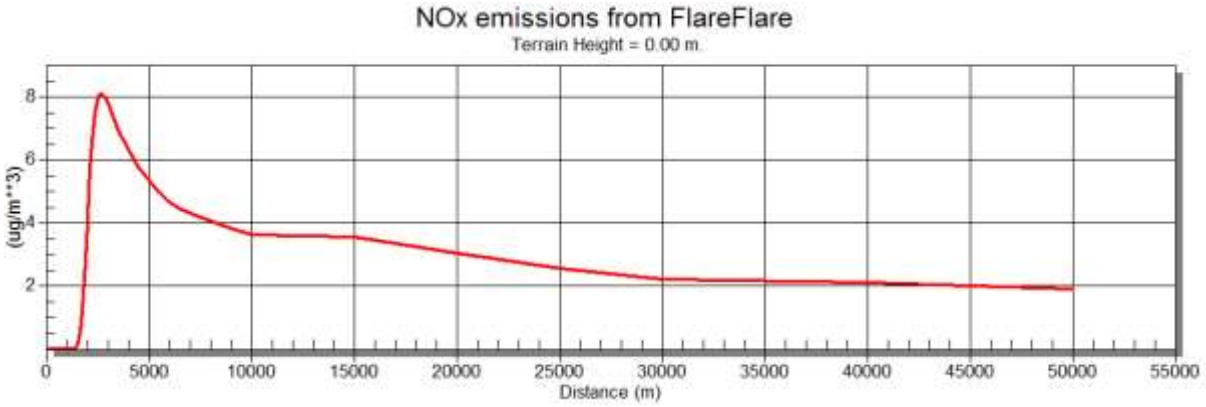
7.3.2 Baseline Survey, Modelling and Data Collection

Review of the available reports and aerial maps indicate that so far the existing SGCC facilities are the key emissions sources in the project area. New emissions sources will be introduced to the region when Oltin Yo'l GTL and proposed Polymer and Naphtha Plants commence operations in 2025.

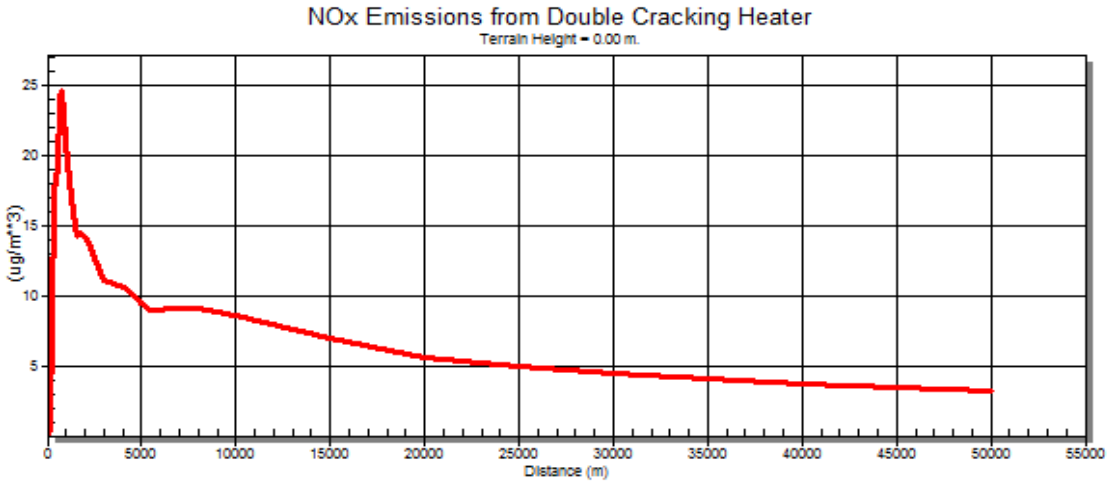
An air quality monitoring has been carried in 2014 for the Oltin Yo'l GTL plant that will be located in the vicinity of the existing SGCC. The results of the above mentioned monitoring are applicable to the current ESIA studies since the area of influence of the GTL and new SGCC facilities are almost the same and no additional emissions source has come to operation in the region since completion of monitoring. Therefore, no direct air quality monitoring or other onsite survey was carried out specifically for this ESIA. SGCC undertakes an annual approved schedule of quality monitoring (covering air quality, wastewater and soil) by the Eco-analytical Laboratory, within the existing residential / rotation camp. All of the air quality related baseline data was supplied by desktop reviews and modelling as ware discussed in the later sections.

A screening modelling was carried out to define area of influence for the air quality impact assessment and to decide on the appropriate detailed air dispersion modelling domain. Figures 14 and 15 present the results of screen modelling for NO_x emissions from flare and cracking heaters of the Naphtha Plant.

As can be seen on the Figures 14 and 15, concentrations of the atmospheric pollutions beyond 25 km from the source become insignificant. Therefore a domain of 50 km x 50 km centered to the plant was adopted for detailed air dispersion modelling. The results of the detailed air dispersion modelling was applied to the air quality impacts assessment (Section 10.3.5.3). Appendix 2 presents the Air Dispersion Modelling Report.



14. NOx concentration in different distances during flare operation



15. NOx concentration in different distances during operation of Cracking heater SRT-VII 1 & 2

Emissions from the cracking heaters of the Naphtha Plant mainly include NOx, CO and VOC. . Emissions from boiler and flare comprise NOx, CO and unburnt hydro carbon. Volume of SO_2 emissions from the emergency diesel generators depend on the levels of sulphur content of the fuel that is estimated to be 20 mg/m^3 maximum. Flue gas emissions (comprising the above mentioned gases and water vapour) from the cracking heater may exceed 343,000 kg/h and 360,000 m^3/h during normal and peak operations respectively.

Addition of a new flare for the polyethylene upgrade will increase the intermittent flue gas emissions. However, the increase in flaring emissions will not be proportional to the increase in plant capacity. The new flare unit can be operated in conjunction with existing flare to provide a maintenance load from one system to the other.

Off gas emissions are also expected from the acetylene regeneration and amine unit. Off gas emissions in the new plant is estimated to be approximately 7,300 kg/h that will be discharged to the atmosphere at approximately 450°C. The C4/C5 emissions to the atmosphere are expected to be about 6,000 kg/h that will be emitted from hydrogenation reactor regeneration.

Acid gas from the Amine Unit is estimated to be more than 22000 kg/h that will be sent outside the plant battery limit for disposal. These emissions will be assessed as part of the ESIA with all other emissions irrespective of the disposal location.

Addition of the new cooling tower has potential to disperse approximately 8 m^3/h of alkaline water that will result in deposition of the chlorides and sulphates, containing-water droplets, entrained by the cooling tower exhausts, in the surrounding area.

Continuous vents and fugitive emission of hydrocarbons from valves, flanges and compressor seals are the key emissions to atmosphere that contribute to greenhouse gas emissions and global warming in addition to the impacts on the local air quality.

According to the Reference Document on BAT in the Production of Polymer, (EC, 2007), the dust and VOC emissions from the plant can be proportioned to the quantities of the LDP, LLDP and HDP based on the following emissions rates stated in the table below:

Table 20: Expected dust and VOC emissions per ton of LDPE, LLDPE and HDPE production

Emissions to Air	Emissions per ton of LDPE Production (grams)	Emissions per ton of LLDPE Production (grams)	Emissions per ton of HDPE Production (grams)	Remarks
Dust	17	11	56	Dust Includes all dust reported by the industry. Dust emission in HDPE production is mainly from drying powder prior to extrusion.
VOC	1270	200-500	650	VOC includes all hydrocarbon and other organic compounds including fugitive emissions

7.3.3 Air Quality

The most recent baseline air quality monitoring has been carried out as part of Oltin Yo'l GTL ESHSIA studies. The results of this air quality monitoring indicate that the concentration of key air pollutants in the project area are very low and mostly contribute to a fraction of the ambient air quality standards. Table 21 below presents the concentration of the key atmospheric emissions and relevant air quality standards. These data are deemed valid as the baseline information for the current ESIA studies and will be referred to in the impact assessment section.

Table 21: Concentration of key atmospheric emissions in the project area

Emission		Concentration µg/m^3	Location of observation	Most stringent standard µg/m^3	Sources of standard
SO_2	24 hours	16	Navbahor	20	SGCC, IFC
	15 minutes	36	Navbahor	500	SGCC, IFC
NOx	24 hours	0.7	GTL camp	250	Uzbekistan, SGCC, IFC
	Annual	0.6	GTL camp	60	Uzbekistan, SGCC

Emission		Concentration µg/m^3	Location of observation	Most stringent standard µg/m^3	Sources of standard
NO_2	24 hours	0.4	Rail Yard	60	Uzbekistan, SGCC
	Annual	0.3	all	40	Uzbekistan, SGCC
BTEX	Max	18.9	SGCC residential camp	-	-
	Min	2.6	Otkuduk	-	-
	Average	7.3	all	-	-
Petroleum Hydrocarbons C_5 to C_{10}	Max	102.6	GTL camp	1000	Uzbekistan, SGCC

7.3.4 GHG Emissions

According to the latest Uzbekistan national report on “Inventory of Anthropogenic Emissions Sources and Sinks of GHG” (GEF/UNEP, 2016), the GHG emissions in the country have been increased by 13.7% between 1990 and 2012. The total direct GHG emissions in the 2012 have been estimated to be 205.2 million tonnes CO_2 equivalent (CO2e). The report indicates that 82.4% of the GHG emissions have been generated by energy sector. Agriculture and waste contribute to 14% and 18% of total GHG emissions respectively. Figure 16 presents the state of GHG emissions in Uzbekistan in 1990 – 2012.

GHG	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2	113.2	113.3	106.3	106.8	101.4	101.0	104.0	102.3	100.0	104.1	108.6	107.9
N_2O	12.9	13.4	13.3	12.8	11.9	11.5	11.4	11.2	11.2	10.8	10.7	10.3
CH_4	54.2	56.5	56.7	83.5	70.3	71.7	73.6	65.9	62.4	67.3	78.7	81.6
HFCs	-	-	-	-	-	-	-	-	-	-	0.006	0.006
Total	180.4	183.2	176.3	203.1	183.6	184.2	189.1	179.4	173.6	182.2	197.8	199.8
Change in emission by 1990,%	-	1.5	-2.3	12.6	1.8	2.1	4.7	-0.6	-3.8	1.0	9.7	10.7
GHG	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Δ (2012-1990)
CO_2	111.0	106.8	104.8	100.9	103.6	103.4	113.2	107.6	101.8	105.1	105.6	-6.7%
N_2O	10.6	10.5	10.5	9.4	9.1	9.1	9.5	9.9	10.4	11.0	11.2	-13.8%
CH_4	82.6	84.4	83.6	85.9	99.0	100.0	104.6	90.0	86.9	87.9	88.4	63.1%
HFCs	0.002	0.009	0.038	0.012	0.036	0.011	0.032	0.019	0.022	0.074	0.094	
Total	204.2	201.7	198.9	196.2	211.7	212.5	227.3	207.6	199.2	204	205.2	13.7%
Change in emission by 1990,%	13.2	11.8	10.3	8.8	17.4	17.8	26.0	15.1	10.4	13.1	13.8	

16. GHG emissions in Uzbekistan in 1990 to 2012 (Source: National Inventory of Anthropogenic 16. 16.Emissions Sources and Sinks of GHG" (GEF/UNEP, 2016)); Figures in million tonnes

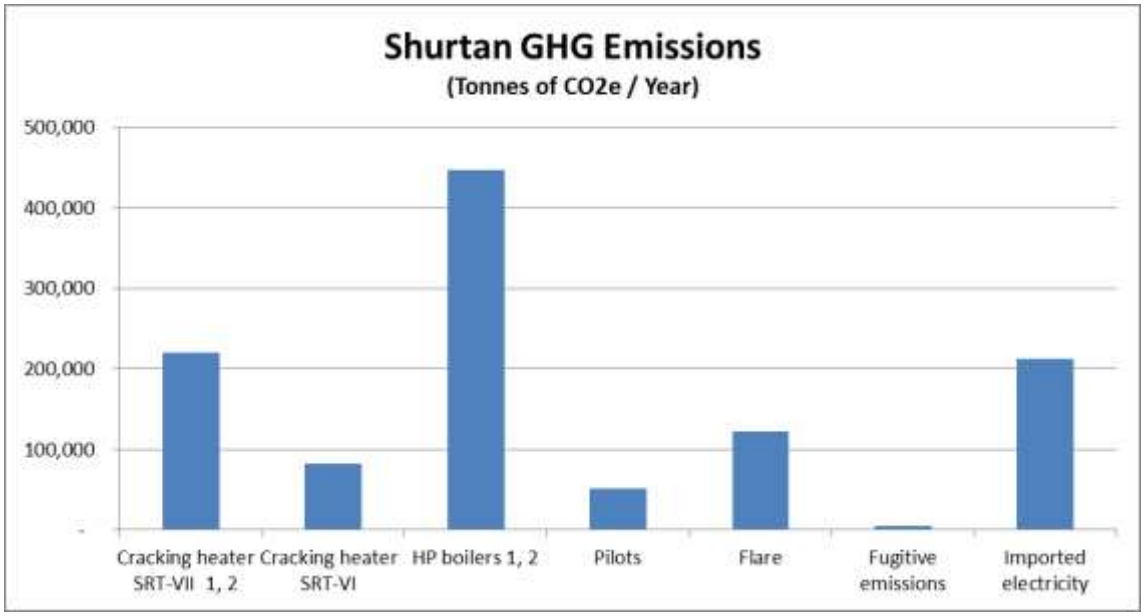
The potential direct sources of GHG emissions of the proposed Naphtha Plant, Polymer and associated utilities include gas fired cracking heaters and HP boilers. Contribution of flare to the total GHG emissions is expected to be insignificant. The total GHG emissions of the project are estimated to be slightly over 1.1 million tonnes CO_2 per year. HP boilers and cracking heaters generate about 65% of the total GHG emissions.

The indirect GHG emissions will be due to consumption of 50 MW/h electricity power from the national network. The indirect GHG emissions are estimated to be about 212,662 tonnes CO_2e per year.

Table 22 and Figure 16 presents the state of GHG emissions of different components of the project.

Table 22: Annual GHG emissions from different units of the SGCCUP

Emissions source	GHG emissions (Tonnes of CO2e)
Cracking heater SRT-VII 1, 2	220,931
Cracking heater SRT-VI	82,295
HP boilers 1, 2	447,092
Pilots	51,384
Flare	121,839
Fugitive emissions	5,283
Imported electricity	212,662
Total	**1,141,486**



17. Shurtan GHG Emissions

7.4 Geology, Geomorphology and Soils

7.4.1 General Overview

This section presents the geological and geomorphological setting and soil features of the Project area. Relevant information from the Scoping phase of the ESIA (Advisian, 2017) is summarised in the sections below. Additional baseline survey was not conducted as part of the ESIA as there were no expected impacts.

The Project site is wholly within the footprint of the existing site boundary, with regrading to the proposed platform level. No fill material external from the site (e.g. borrow pits) are understood to be required to reach platform level. The area of influence for geology, geomorphology and soils is therefore considered as the existing site footprint.

7.4.2 Baseline Survey & Data Collection

A desk based study was conducted reviewing various open source documents. Additional baseline data was collected as part of a site investigation programme on the site in February 2017. Work was undertaken according to the scope and approach documented in O'Zgashkliti, 2017.

Soil samples from the local area were also collected by SGCC in September and October 2016 and analysed for basic parameters.

7.4.3 Topography and Geomorphology

The SGCC site is located on the foothill plain of the southwest spurs of the Ghissar Mountain range. The plain is gently undulating (10-15 m elevation change) and is associated with erosion due to surface water flow orientated to the northwest (Golders, 2014). The regional topography slopes gently from southeast to northwest; there is a low lying depression located approximately 4 km to the west of the site at an elevation of around 400 meters above mean sea level (AMSL).

The site elevation is between 421.0 m to 428.5 m AMSL and gently slopes in a northeast direction (O'Zgashkliti, 2017). The finished site level for the Project site is to be 425 m AMSL.

As the Project site is within the existing site boundary and utilising the existing development platform, it is not anticipated to impact geomorphology.

7.4.4 Soils

7.4.4.1. PHYSICAL

The natural soil layer was removed or reworked during construction of the SGCC project. Soil samples were collected as part of the Oltin Yo'l GTL project within 100 m of the boundaries of the SGCC site (Golders, 2014) as well as during the recent, 2017, ground investigation.

Soil cover can be divided into two layers between 0 and 1.5 m depth; a topsoil approximately 0.4 m thick and subsoil below (Golders, 2014). The topsoil is fine graded, displaying signs of the development of a platy structure with a presence of a thin surface crust when dry. In moist conditions, this layer is soft in consistency and the platy structure forms a weak, massive aggregation of particles (Golders, 2014). In accordance with The World Reference Base for Soil Resources (WRB), this layer is classified as an ochric horizon (Golders 2014; WRB, 2006).

The subsoil layer is classified as pale-dull brown to whitish-brown in colour, with a hard massive structure and calcium carbonates and gypsum dispersed throughout the matrix (O'Zgashkliti, 2017; Golders, 2014). Calcium carbonates are present within the soils and are found to be more pronounced within the soil sub-horizon, forming hard calcium nodules further down the soil profile (Golders, 2014).

The soil types are typical of semi-arid regions and are classified as calcic and gypsic horizons (Golders, 2014; WRB, 2006).

As no natural soils remain on the site the Project is not anticipated to impact soil conditions.

As a low rainfall semi-arid region, the soils in the broader area require irrigation for successful crop production. The irrigation schemes have been proven to damage the soil through salinization and modification of the soil structure lowering permeability and affecting plant growth.

7.4.4.2. CHEMICAL QUALITY

Investigations undertaken during the Golders 2011 soil specialist study into the chemical status of the soils identified high concentrations of sodium and to a lesser extent magnesium. These

concentrations may be rendering the soils to low infiltration rates, and are potentially responsible for the surface crusting and hard setting of the soils upon drying (Golders, 2014). The pH values of the soils are classified as basic which is considered typical of arid climatic conditions, particularly in the presence of high concentrations of calcium (Golders, 2014). Basic pH values can result in the fixation of trace elements necessary to sustain plant growth (Brady, 1984). The recent geotechnical investigation also recorded major ion chemistry for soils in the Project site (O'Zgashkliti, 2017). These are summarised in Table 23. The results confirm the previous work by Golders (2014) with high amounts of calcium carbonates, gypsum, magnesium, sodium and potassium (K) in the soil solution as well as basic pH. In addition, the presence of calcic and gypsum were confirmed. High chloride in some of the samples also indicates salinity damage to the soils, possibly from irrigation / watering activities.

Analysis for contamination within soils around the boundaries of the SGCC site did not detect any metal concentrations above background concentrations according to Uzbekistan guidelines (Golders, 2014).

Table 23: Major ion chemistry for soils in the Project site

Location	Sample depth, m	Content of ions in mg/kg							Gypsum, %
		$HCO3^-$	Cl^-	SO_4^-	Ca^{2+}	Mg^{2+}	Na^++K^+	pH	
Well-1	1.0	310	1820	1700	300	60	1640	8.7	0.48
Well-1	2.0	180	1890	2930	460	100	1880	8.1	1.12
Well-3	1.0	280	30	1750	550	210	230	8.5	0.70
Well-4	1.0	370	630	8630	2100	210	3330	8.2	3.62
Well-5	1.0	210	70	5120	180	240	50	8.0	4.63
Well-6	2.0	230	1290	2440	500	60	1810	8.2	0.86
Well-7	1.0	120	630	8910	3300	150	2150	7.9	20.38
Well-10	1.0	180	1750	6600	2000	240	2790	7.7	3.66
Well-14	1.0	130	1710	6840	1700	180	330	7.8	4.39

SGCC have also undertaken two rounds of soil sampling in the wider area in 2016. The results are provided in Table 24. The low total nitrogen confirms the poor fertility of the soils. The high chloride in the forestry enterprise territory is likely to show the impact of irrigation and deteriorating soil quality. The soils show no impact by hydrocarbon products.

Table 24: Soil sampling data from the local area

Chemical	Kengsay		Otkuduk		Waste dump		Forestry enterprise territory	
Sample date	09/16	10/06	09/16	10/06	09/16	10/06	09/16	10/06
pH	7.81	7.21	7.74	7.4	7.68	8	7.85	7.88
Total nitrogen (mg/m^3)	1.5	1.44	2.6	2.36	1.96	2.32	3.4	0.89
Manganese (mg/m^3)	1.67	1.87	1.38	0.65	2.19	1.25	1.93	1.95
Chlorides (%)	0.18%	0.31%	0.39%	0.24%	0.72%	0.59%	0.91%	0.36%
Iron (mg/m^3)	0.2	0.23	0.067	0.16	0.15	0.048	0.44	0.29
Petroleum products (mg/m^3)	0	0	0	0	0	0	0	0

A large number of liquid chemicals will be used on the site or generated by the plant processes. A full list is provided in the Project Hazardous Material Listing (WorleyParsons Doc. Ref. SGCCUP-00-SR-LST-0001, 2017). The majority of chemicals are highly volatile or flammable and will have short residence time at ambient pressures and temperatures. All tanks storing hazardous chemicals will be located in a bund that can take 110% of the tank volume.

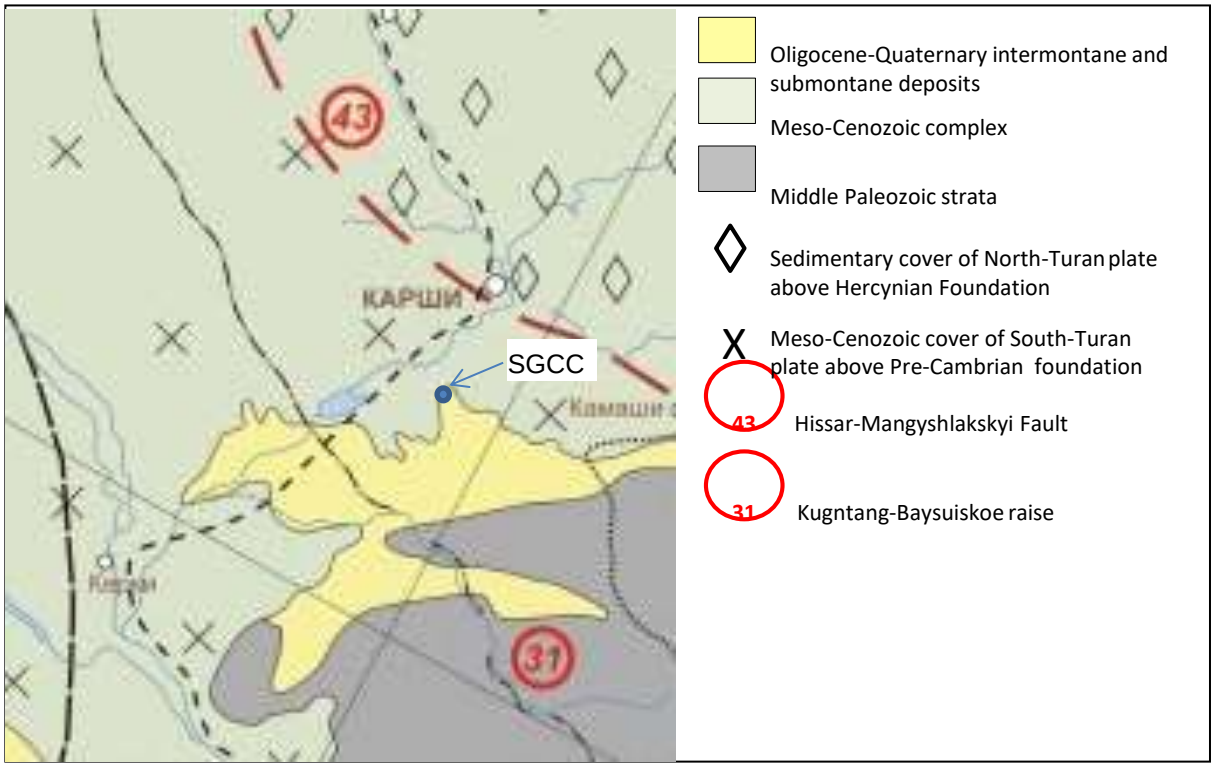
The plant operates a closed drainage system for areas where contaminative activities take place, with the flows diverted to the effluent treatment plant prior to discharge.

7.4.5 Geology

7.4.5.1. Regional Geology

The regional geology is largely associated with mountain structures formed by the Tian Shan and Turan tectonic plates up to the end of the Paleozoic era (250 million years ago) and subsequent erosion during the Mesozoic era (65-250 million years ago) (Golders, 2014). During this period of erosion, the Amu Darya basin, which is believed to be one of the largest sedimentation zones (approximately 30 km wide and 800 km long), developed (Golders, 2014) covering a large part of the region. The SGCC site is located on the edge of this sedimentation basin.

To the southeast of the region there are middle Paleozoic strata at surface in the mountain ranges (Figure 18). Meso-Cenozoic strata, comprising eroded material from the mountains, are found at surface across large areas of Uzbekistan. Locally there are Oligocene to Quaternary alluvial and proluvial materials.



18. Geological Extract.

7.4.5.2. LOCAL GEOLOGY

Middle Quaternary proluvial deposits are developed from the surface everywhere in the locality of the site and comprise loess/sandy loam and clayey sand. Sediment cores taken approximately 500 m to 1.5 km west of the SGCC site are characterised by thick Neogene aged clay dominated strata exceeding 150 m in some instances (Golders, 2014). The Meso-Cenozic Complex underlies the area.

The ground investigation conducted on the SGCC site in 2017 indicates the shallow geology immediately beneath the site comprises of:

- Topsoil and loam/loess type deposits up to 10 m thick; and
- Quaternary proluvial deposits comprising light brown clay and sand with gypsum noted throughout. The sequence becomes weakly cemented at depth with nodules / veins of gypsum.

The Project site is within the existing site boundary and utilising the existing development platform, it is not anticipated to impact geology.

7.4.6 Naturally Occurring Radioactive Materials (NORM)

A radiation survey was undertaken by INP 2012 as part of Oltin Yo'l GTL baseline survey (Golders, 2014) in order to investigate any potential sources of Naturally Occurring Radioactive Substances

within the operating SGCC, development plant of the Oltin Yo'l GTL project and its construction camp. During the gamma radiation survey no anomaly zones with high radiation counts were identified. The gamma radiation Equivalent Dose Rate (EDR) did not exceed the acceptable Level for EDR (0.3 μSv.h-1). Concentrations of SGCC radionuclides in soil samples and bottom sediments from the sewage collector also did not exceed acceptable levels (Golders, 2014).

Radon concentrations in all studied water samples across the SGCC, Oltin Yo'l GTL project and it's construction camp were lower than 2 Bq.kg-1, which is below the maximum allowable limit of radon in water (60 Bq.kg-1) (Golders, 2014). Total specific alpha and beta activity in water samples did not exceed 0.002 Bq.kg-1 and 0.04 Bq.kg-1. The recorded concentrations were much lower than the maximal allowable levels of 0.1 Bq.kg-1 and 1 Bq.kg-1 (Golders, 2014).

Rooms within the SGCC site were surveyed for potential radiation and the Indoor Radon concentration (VAR) and Equivalent Equilibrium Volumetric Activity of Radon Progenies (EEVARn) in studied rooms did not exceed any specified norms (Golders, 2014).

7.4.7 Seismicity

Uzbekistan is located in the middle of Central Asia within a zone of high seismic activity. The Project site is in a seismically active area of moderate to high risk, with a seismicity of 7 points according the Uzbekistan seismic code KMK 2.01.03-96 "Norms and Regulations for Construction in Seismic Zones". Design of the Project site is to 8 on the Richter scale.

7.5 Hydrology, Hydrogeology & Water Resources

This section presents the surface and ground waters setting and water resources of the Project area.

7.5.1 General Overview

Relevant information from the Scoping phase of the ESIA (Advisian, 2017) is expanded upon or updated in the sections below. Additional baseline survey was conducted as part of the ESIA with the collection of groundwater monitoring and quality data and surface water quality.

Key aspects identified during the Scoping Phase include the effect of unplanned events, including:

- Chemical and oil spills;
- Off-specification release of treated wastewater effluent; and
- Dust /silt loading in drainage waters.

7.5.2 Baseline Survey & Data Collection

A desk based study was conducted reviewing various open source documents. Groundwater baseline data was collected as part of a site investigation programme on the site in February 2017. No specific baseline information on the surface water bodies was collected. Surface water quality samples collected in 2010 as part of the Oltin Yo'l GTL ESHSIA (Golders, 2014) have been utilised in the

baseline assessment. Samples of the drainage discharge effluent have been collected and provide a proxy for quality in the SGCC export canal.

The baseline information provides a description of the current water environment against which the impacts can be assessed and future changes monitored.

7.5.3 Hydrology

The hydrology of the area is made up of complex water diversions and reticulation schemes conveying water across the region. Relevant elements of this complex network are summarised within this sub-section.

7.5.3.1. Regional Surface Watercourses

The SGCC site is located in the Amu Dayra basin whose greater catchment area is approximately 1,300,000 km^2 shared between Tajikistan, Afghanistan, Uzbekistan, Kyrgyzstan, Iran and Turkmenistan (Envsec, 2010). The Amu Dayra is the dominant surface water course in the region and is formed by the confluence of the Vakhsh and Panj rivers and flows west-northwest to its mouth at the Aral Sea. The Vakhsh and Panj rivers are fed by melting snow and glaciers from the Alai Valley in Kyrgyzstan and Wakhan River in Afghanistan, respectively (Envsec, 2010). Once the river leaves the highlands it flows across the Turan Plain where it forms the boundary between the Karakum and Kyzylkum Deserts. The lower reaches of the river form the boundary between Uzbekistan and Turkmenistan. Tributaries to the Amu Dayra include the Kafarnigan, Surhandarya and Sherabad rivers. The Zarafshan is no longer a tributary to the Amu Dayra as it flows are diverted before its confluence.

The long-term average flow in the Amu Dayra is approximately 2,000 m^3/s, as measured at Kerki gauging station in Turkmenistan (Envsec, 2010). The catchment area upstream of this gauging station is 309,000 km^2 and is shared by Tajikistan (72.8%), Afghanistan (14.6%), Uzbekistan (8.5%), Kyrgyzstan and Turkmenistan (Golders, 2014).

Large scale diverting of the Amu Dayra occurs for irrigation and hydro-power (Figure 19). The major diversion of relevance to the Project site is the Karshi Main Canal, which offtakes on average approximately 120 m^3/s (USAID, 2016).

Additional rivers of importance in the region include the Kashkadarya and its tributaries which are located to the north of the Project site and flow in a general northwest direction (Figure 19). The Kashkadarya River has numerous inflows from the mountains, fed by snow and high rainfall during spring (April-May) and the summer months. All flows within the Kashkadarya River (38 m^3/s) are diverted and it has no confluence with downstream rivers (Figure 19).

The river diversions have led to major environmental issues, including the deterioration of surface water quality from increased dissolved solids and salinity from agricultural use, as well as the long term drying of the Aral Sea (Golders, 2014). Furthermore, almost 50% of all irrigated land is classified as saline, and approximately 5% (213,000 ha) of irrigated land is classified as severely saline (Golders, 2014). Water pollution from industrial waste and soil contamination is prolific, and has the potential to cause human health disorders (Golders, 2014).

19. Regional surface water features (Envsec, 2010).

7.5.3.2. REGIONAL SURFACE WATER BODIES

Major surface water bodies are reservoirs associated with hydro-power or storage areas as part of the river diversion schemes in the region. The Talimardzhan reservoir is the largest feature fed by the KMC

(Figure 19). The Chimkurgan and Pachkamar reservoirs are located on the Kashkadarya and its tributary respectively (Figure 19).

The Talimardzhan reservoir has a capacity of 1.5 Bm3 and also supplies water in to the KMC. The reservoir is filled from October to March approximately 500 mm^3 with water released into the canal for the irrigation network in Karshi Plain during the growing season, releasing approximately 450 mm^3. The Chimkurgan and Pachkamar reservoirs have capacities of 500 and 260 mm^3 respectively (Cawater, 2017).

7.5.3.3. LOCAL SURFACE WATERCOURSES

The KMC serves an extensive network of feeder canals and irrigation ditches that cover the Karshi Plain. The water supplies irrigators and domestic users as well as the SGCC. The capacity of the KMC is 250 m^3/s (Golders, 2014), but average flows are lower as noted previously. The flow in the canal varies seasonally depending on the demand for irrigation water, but monthly averages vary between 191.5 m^3/s in July to 4.8 m^3/s in January (between the years 1988 to 2012) (Table 25) (Golders, 2014).

Table 25: KMC average monthly flow m^3/s (1994-2012) (Source Golders, 2014)

KMC Ave Monthly Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	4.8	6.9	69.9	111.8	85.6	119.0	191.5	138.3	13.2	41.1	69.4	10.3

The SGCC is supplied from the KMC via two pump stations. One supplies directly to the SGCC facility, the other to a storage reservoir (SGCC reservoir) as a back-up water supply. The SGCC permitted off-take quantity is 922.5 L/s.

The Project site is located between two northwest orientated broad ephemeral drainage channels that join near a depression located 4km to the west of the site. The drainage to the east of the site abuts the eastern project margin edge and is intersected by the SGCC export canal. The course of the export canal from the SGCC is initially (500 m) in a northeast direction before turning to a northwest direction. It is joined by a canal from the SGCC reservoir and flows in a general northwest direction joining the SPT-1 canal. The SPT-1 canal joins into 5-K-5 canal, which transports the water to YuKL-3 and then to the South Canal. The water runs through the canal system serving the irrigation areas before discharging into Lake Sultandag.

The SGCC export canal serves as the outfall for the on-site drainage system. The existing on-site drainage system has two components: Drain No. 1 “clean” mineralized effluent, which is discharged without treatment. The permitted discharge allowance is 259.6 m^3/h; and Drain No. 2 from closed drain and foul water systems which are biological treated prior to discharge. The permitted discharge allowance is 109.0 m^3/h. Actual discharge volumes are not known.

The planned Project site is estimated to discharge approximately 750 m^3/hr of treated wastewater. Some of this (approximately 570 m^3/hr) maybe recovered for re-use within the production facility. A variation to the permit will be required for the higher discharge amount.

HOLD – Description of Project site drainage system and volumes is required from Project Team

7.5.3.4. LOCAL SURFACE WATER BODIES

The SGCC Reservoir, located approximately 3 km to the northeast of the project, is a contingent water storage reservoir for the SGCC. It was constructed in a natural depression, Davrazakam hole, and has a capacity of 11.5 mm^3. The reservoir is directly fed from the KMC. As well as being a back-up water supply for the SGCC, the reservoir is also used for irrigation of the Shurtan forest plantation around SGCC.

The SGCC Reservoir is the planned source of water for the Oltin Yo'l GTL via the existing pump station.

7.5.3.5. WATER PROTECTION ZONES

Pumping stations on the KMC that supply the SGCC are located in a zone of sanitary protection. This prevents discharges within a set distance of these abstraction points.

The SGCC Reservoir has a designated water protection zone of 20 m from the water's edge. The water protection zone is marked by concrete columns at 100 m spacing.

7.5.3.6. WATER QUALITY

Two surface water quality samples were collected in 2010 as part of the Oltin Yo'l GTL ESHSIA (Golders, 2014). The samples were collected from the SGCC Reservoir and the SGCC export canal. Results from the SGCC Reservoir showed slightly elevated concentrations of salts, requiring pre-treatment prior to use (Golders, 2014). No water samples have been collected from other surface waters since 2010. More recent samples have been collected from the export canal by SGCC at the locations shown in Figure 20. Average data (2014-2016) in the export canal downstream of the two discharge points is summarised in Table 26.

20. Baseline surface water sampling locations

Table 26: Water quality data

Discharge point		pH	Suspended Solids mg/l	Sulfates mg/l	Chlorides mg/l	Phosphates mg/l	Iron mg/l	Petroleum products mg/l	BOD mg/l	COD mg/l	Dissolved oxygen mg/l	Nitrous aluminum mg/l	Nitrates mg/l	Nitrites mg/l
Target		6,5 – 8,5	30,0	500,0	390,0	1,0	0,5	0,3	6,0	40,0	4,0	2,0	45,0	3,3
Mineral flow	2014	7,7	14,04	442,7	378,1	**1,02**	0,21	0,0	2,19	0,0	**4,34**	1,1	1,12	0,0017
	2015	8,13	15,3	432,3	**403,6**	**1,06**	0,13	0,0	2,1	25,7	**4,53**	1,29	1,54	0,002
	2016	8,07	14,9	428,4	386,8	**1,1**	0,13	0,0	2,17	25,3	**4,67**	1,25	1,48	0,0017
Treated wastewater	2014	7,4	20,9	381,8	225,5	**1,0**	0,26	0,065	3,35	**87,26**	3,9	**2,9**	0,91	0,0022
	2015	7,6	21,08	382,0	195,2	**1,06**	0,26	0,031	3,98	**77,87**	**4,3**	**2,85**	0,89	0,0024
	2016	7,9	22,2	371,4	178,8	**1,08**	0,27	0,26	4,29	**74,4**	**4,47**	**2,75**	1,07	0,0033

The sampling data from the export canal shows some concentrations are above the target concentrations, most notably in the treated wastewater stream, although phosphates are marginally above in both streams.

The quality of water to be discharged by the Project site is detailed in Table 27 alongside the IFC guidelines for wastewater. Planned discharge quality will be below the IFC guidelines.

Table 27: Project site discharge water quality

Properties	Unit	Concentration in discharge water	IFC standards
Molecular Weight	kg/kmol	18.02	
Density	kg/m³	900-1100	
Viscosity	cP	1	
pH	pH Units	6 - 9	6-9
Total Hydrocarbon Content	mg/l	2 - 3	10

Properties	Unit	Concentration in discharge water	IFC standards
Biological Oxygen Demand	mg/l	HOLD	30*
Chemical Oxygen Demand	mg/l	HOLD	125
Total Suspended Solids	mg/l	7 – 10	50
Phenols	mg/l	0.1 – 0.15	0.5
Sulphides	mg/l	0.1	
Heavy Metals	mg/l	4.7	5
Chlorides	mg/l	250	
Surface Tension	mN/m	70	
Nitrites	mg/l	3.3	
Nitrates	mg/l	45	
Nitrogen as Ammonia	mg/l	2	10^
Sulphates	mg/l	500	
Phosphates	mg/l	1	2
Iron	mg/l	0.5	3
Mineralisation (by dry residue)	mg/l	2000	
Petroleum Products	mg/l	0.3	
Total coliform bacteria	MPN**/100ml		400
Notes:			
*BOD_5			
** Most Probable Number			
^ Total nitrogen			

7.5.4 Hydrogeology

The drilling of the boreholes in the project area provides direct data to characterise the hydrogeological conditions in the project area. Groundwater information over a large distance around the footprint of the

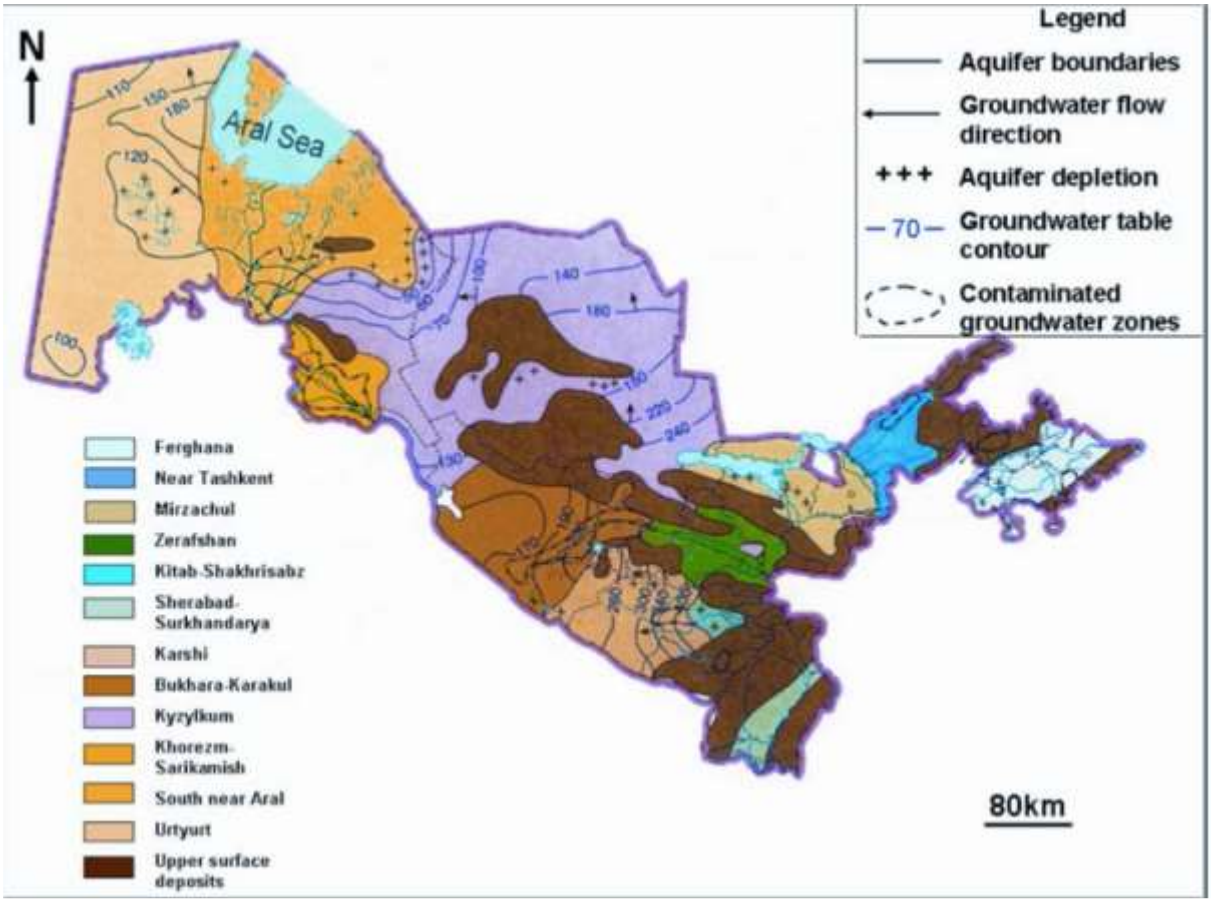
proposed Project site is not available. Accordingly the description of the hydrogeological base line conditions is limited to the Project site.

7.5.4.1. REGIONAL HYDROGEOLOGY

The plain regions of Uzbekistan are characterized by complicated hydrogeological conditions where Quaternary and Pliocene alluvial and prolovial sand, loam and clays are interstratified, creating unconfined, confined or semi-confined hydro-stratigraphic units. Within the Kashkadarya province five hydro-stratigraphic units have been defined with groundwater resource potential (Rakhmatullaev et al, 2012).

Depth to groundwater in the Karshi hydrogeological province is approximately 300 m (Figure 24). The Aral Sea Basin Initiative Report (2006) indicated that groundwater levels have increased in some areas due to over irrigation (IPTRID FAO). The rise in groundwater levels is having an impact through salinization of soils (Golders, 2014). Unconfined aquifers are also impacted by salts, nitrates, and pesticides (Rakhmatullaev et al. 2012).

The regional groundwater flow direction in the Karshi hydrogeological province is approximately westwards (Rakhmatullaev et al, 2012) (Figure 24).



21. Hydrogeological map of Uzbekistan (Rakhmatullaev et al. 2012)

Groundwater recharge is estimated at between 5 and 22.5% of precipitation in Uzbekistan (Rakhmatullaev et al. 2012). Infiltration from irrigation channels, seepage from irrigation practices and infiltration from water reservoirs provide an additional source of recharge to groundwater. Direct precipitation recharge is estimated to account for 37% of total groundwater recharge, with artificial recharge estimated to be the predominant mechanism at 63% (Rakhmatullaev et al. 2012).

7.5.4.2. LOCAL HYDROGEOLOGY

The local hydrogeology description is based on information provided in Oltin Yo'l GTL ESHSIA (Golders, 2014) and site data collected as part of the recent ground investigation.

To the west of the SGCC site, ground conditions are recorded as predominantly clay material to depths up to 50 metres below ground level (mbgl) (Golders, 2014). Testing indicates that this material has a low primary permeability (10^{-8} to 10^{-10} m/d) and is considered to limit groundwater movement (aquitard) (Golders, 2014). Paleo-channels infilled with sand and gravel material occur (Golders, 2014) and may result in localised higher permeability pathways for groundwater flow. The 2017 ground investigation at SGCC would appear to confirm these findings, with indications of infilled paleo-channels present under the site.

Groundwater levels were recorded as 5 to 24 mbgl in monitoring wells installed to the west of the SGCC site. A geotechnical study undertaken at the SGCC site in 1998 identified that groundwater was not encountered at depths of 25-35 mbgl but was expected to be encountered at depths of >50 mbgl (SGCC (1), 1998). The recent, 2017, ground investigation encountered groundwater at between 6.7 m and 10 m below ground level (413.1 to 417.7 m above datum) in deposits above low permeability clays.

The groundwater flow direction is measured as approximately north-northeast and reflects the topography and is likely also reflects the underlying topology of the clay. A steeper hydraulic gradient is observed on the site (1/70) compared to that reported in the wider area (1/200) (Golders, 2014).

Groundwater recharge is considered to be low (1% of precipitation) in the area due to low permeability clays at /near the surface, low annual rainfall and high evaporation rate (Golders, 2014). Any recharge is predominantly from seepage from irrigation practices.

Given the low permeability of the ground and low rates of recharge, any potential releases from the surface are likely to migrate at very slow rates in the subsurface.

The water quality in shallow hydrogeological units is undergoing degradation due to salinization. This is primarily from the agricultural practices, with a strong correlation to groundwater level rise from irrigation practices noted (IPTRID FAO, 2006; Rakhmatullaev et al. 2012). However, the sodic nature of soil (solonetz and solontchaks) also contributes to the poor quality (Rakhmatullaev et al. 2012).

Samples collected from six on-site wells during the 2017 ground investigation are summarised in Table 28. The groundwater is shown to be brackish, with concentrations of chlorine ranging between 1,687 mg/L and 8,015 mg/L, and very hard (Table 28).

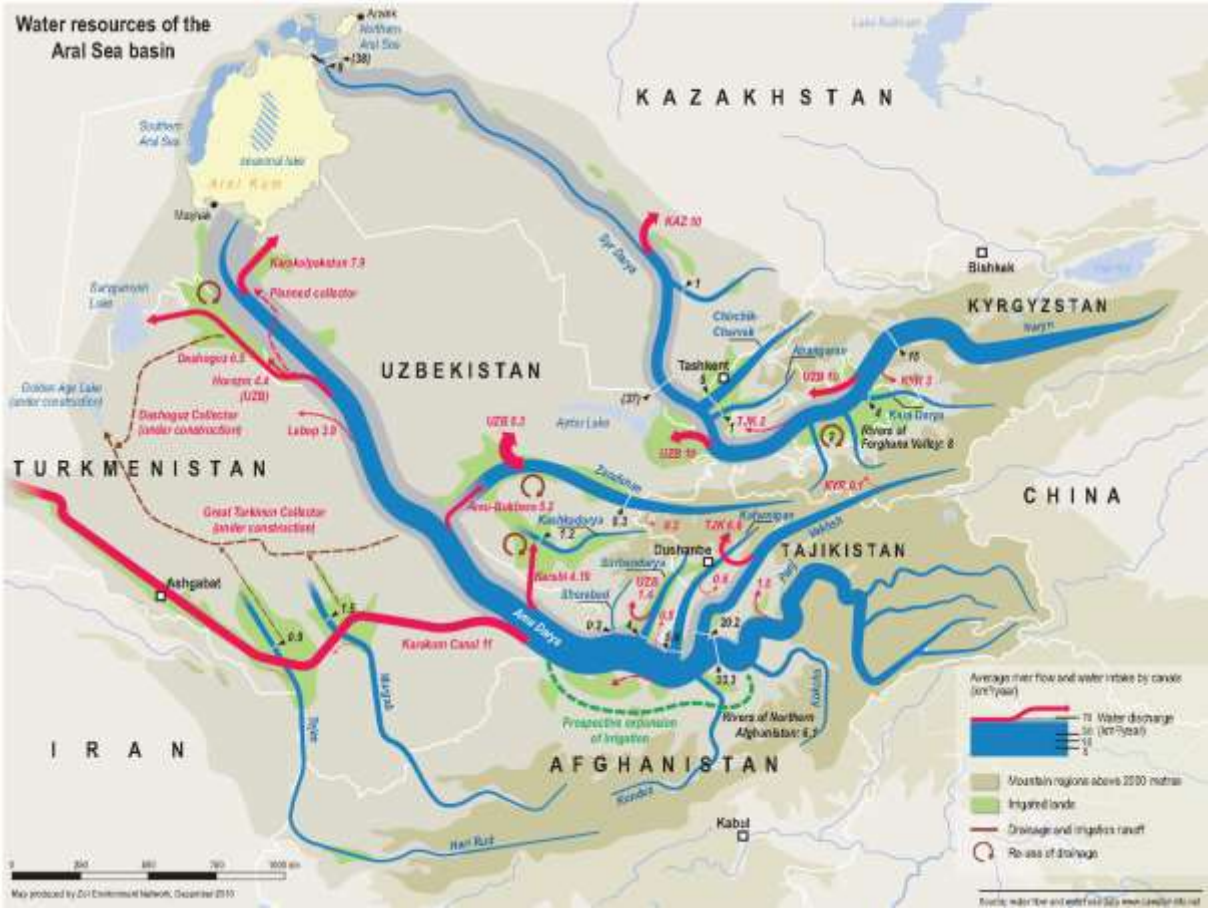
Table 28: Concentrations of major ions recorded in on-site boreholes, 2017

Ion	HCO^{-}_{3} (mg/L)	Cl^{-} (mg/L)	$SO4^{2-}$ (mg/L)	Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	$Na^{+}+K^{+}$ (mg/L)	pH	Hardness as $CaCO_3$ (mg/L)
Minimum concentrations	151	1687	2499	490	72	1489	7.2	1716
Maximum concentrations	397	8015	3852	830	390	5419	7.7	3674.5

Groundwater within the proximity of the project cannot be considered as a source for water supply due to the low permeability of the strata and generally poor water quality.

7.5.5 Water Resources

The average available surface water resource of the Amu Dayra is estimated as 78 billion m^3/year and varies between 58 and 109 billion m^3/year, depending on annual climatic patterns. The Amu Dayra is well regulated with 20 billion cubic metres of SGCC live storage constructed along its length. A number of the storages are hydro-power schemes (Golders, 2014). The major water allocations are for irrigation to the downstream states of Uzbekistan and Turkmenistan. The water diverted from the Amu Darya to Uzbekistan in 2016-2017 was 21.8 km^3 (Cawater, 2017). The distribution of surface waters is summarised in Figure 22.

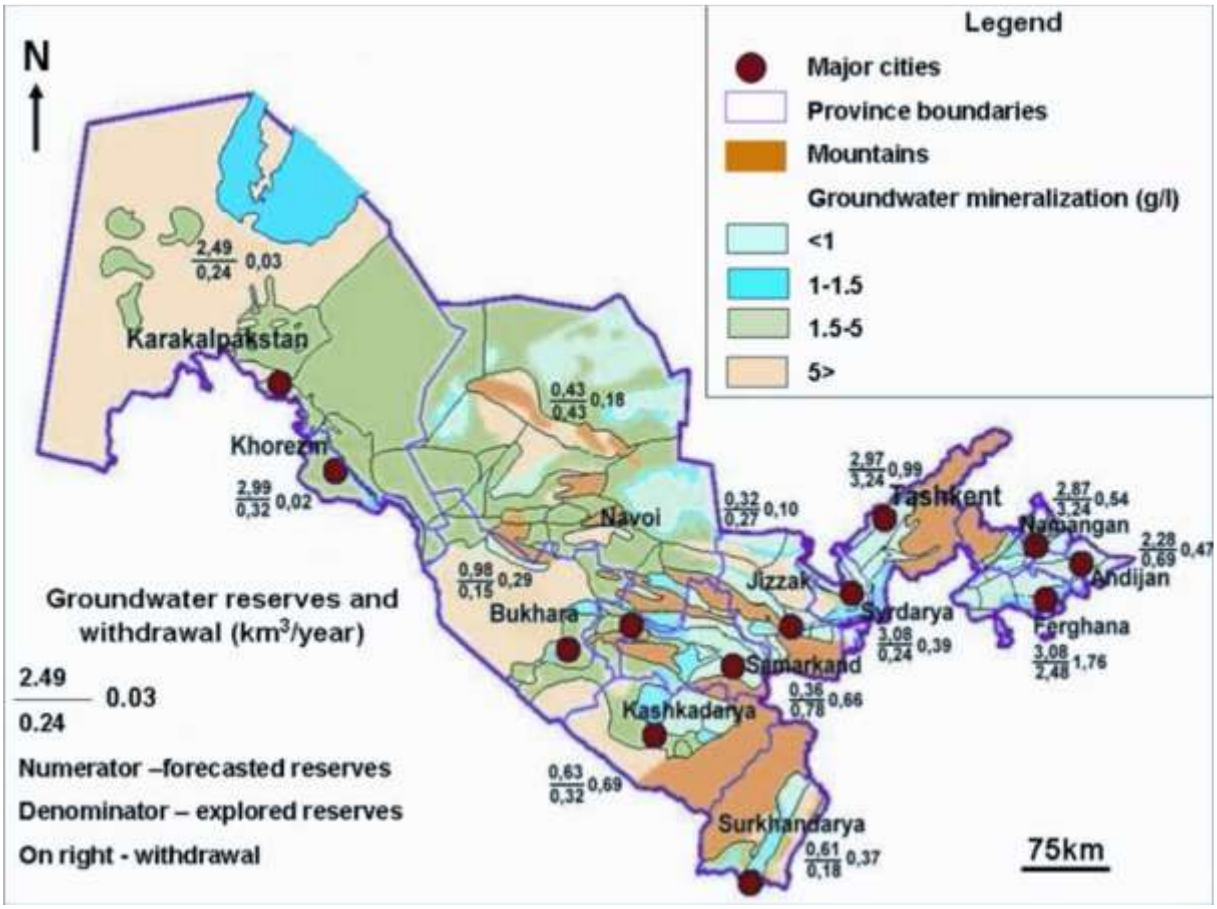


22. Surface water resources of the Aral Sea basin (Envsec, 2010)

Groundwater constitutes approximately 10% of the total water resources in Uzbekistan with 60% of its use for potable supply, domestic use, and irrigation (Rakhmatullaev et al, 2012).

The groundwater resources of Uzbekistan are estimated to be approximately 25 km^3/yr (Rakhmatullaev et al, 2012). Approximately 75% of the groundwater resources are associated with alluvial and proluvial deposits and is predominantly recharged by surface water flows or canals (Rakhmatullaev et al, 2012). Approximately 80% of the identified groundwater resources are located in the Ferghana valley and Tashkent and Samarkand Provinces (Rakhmatullaev et al, 2012).

There are five defined groundwater resources in the Kashkadarya province with a total available supply of 0.63 km^3/yr (3% of the total Uzbekistan resources) of which 0.32 km^3/yr is approved for abstraction. Actual abstraction is estimated to be 0.69 km^3/yr and exceeds the available resource (Rakhmatullaev et al, 2012). Figure 23 summarises the groundwater resources of Uzbekistan.



23. Groundwater resources of Uzbekistan (Rakhmatullaev et al. 2012)

7.5.5.1. WATER DEMAND

Water is currently required to meet production and domestic requirements. The current production water use is 21,600 m^3/day (250 L/s) (SGCC 4, 2016). Most water is used in the cooling tower within a circulation system and only requires top-up water to account for evaporative losses (SGCC (4), 2016). The remaining water is used in the process facilities, for producing demineralised water, and for flushing of filters and preparation of solutions (approximately 25%). Domestic water demand is 1204 m^3/d (14 L/s).

It should be noted that Golder 2014 identify the SGCC reservoir as the greatest water user due to evaporative loss (56% of total) followed by local irrigation (36%) with SGCC production using only 5% of the total.

It is estimated that the planned Project site will require a production water supply of approximately 24,000 m^3/day (275 L/s) during operation.

An additional 10 m^3/hr (2.5 L/s) is required for domestic use to meet GOST 2874-82 - Drinking water. Hygienic requirements and quality control and will be sourced from the existing plant. Re-use of

wastewater streams is being considered to provide approximately 150 L/s, 55%, of the production demand.

The pump station on the KMC currently has capacity for 96,000 m^3/day, which is in excess of the combined SGCC water supply demand, utilising 57% of the pump capacity. However, the Oltin Yo'l GTL project is also utilising the pump station, as a back-up to its main supply (the SGCC reservoir). To meet the Oltin Yo'l GTL project the pump station requires modification to increase capacity to meet the project needs (Golder, 2014).

The current and future water usage for the project requires clarification, together with the confirmation of the facilities intended lifespan and decommissioning proposals.

7.5.5.2. WATER USERS

Groundwater

Groundwater is not typical used as a water source in the area, due to:

- Shallow strata being unproductive (low yield);
- Poor water quality of accessible groundwater; and
- Depths to deeper more productive hydrogeological strata being uneconomical to drill and abstract water from.

The SGCC does not use groundwater and has no wells.

The nearest settlement, excluding the SGCC residency, is 6 km away at Otkuduk village to the west from the site. This is known to have had one well with a water level at 60 m bgl and brackish water quality (Golders, 2014).

Surface Water

The SGCC has a permit to abstract 79,700 m^3/day (922.5 L/s) from the KMC. This is undertaken by a pumping station and 25 km pipeline (1020 mm diameter) to a second pumping station for distribution to the facility and also for irrigation of forestry in the sanitary zone. A second water abstraction from the KMC is distributed to the artificial SGCC reservoir. The reservoir provides two winter months back-up water supply for the project and is fed via a pumping station and 13 km pipeline. The Project site would increase the abstraction to approximately 57% of the permit amount, excluding any additional allowance for storage within the SGCC reservoir.

Oltin Yo'l GTL water use is on average 167 m3/hr (46 L/s) (Golders, 2014). This is to be fed in part from the SGCC Reservoir but also from the KMC off-take.

The cumulative water demand for the GTL, SGCC and Project site is 62% of the permit amount and less than 0.5% of the average flow in the KMC. The SGCC full permit amount is only 1% of the average flow in the KMC.

The KMC supplies water for irrigation of 226,000 ha which uses 1582 mm^3/yr (50 m^3/s) with water losses estimated at 554 mm^3/yr (17 m^3/s) (Golders, 2014).

7.6 Noise and Vibration

7.6.1 General Overview

Review of the available documents and maps indicates the existing SGCC facilities are the main sources of anthropogenic noise in the project area. A noise monitoring was carried out in 2010 as part of the proposed Oltin Yo'l GTL ESIA studies in the project area. Due to the close proximity of the GTL plant to the proposed Polymer and Naphtha plants the result of above-mentioned monitoring found to be applicable to the current ESIA. No industrial development other than the existing facilities that can significantly change the 2010 baseline situation has been reported.

The project construction site is on the east site of the project and includes part of the existing plant site since the project is a brownfield development. Initial calculations of the noise propagation from the plant location indicate that the construction site and about 1000 m radius from the construction site can be exposed to high level construction noise. During the normal operations of the plant, the area of noise influence could be only a few hundred meters from the source because the noise level at a distance of 1 m from the equipment should not exceed 85 dBA.

7.6.2 Baseline Survey & Data Collection

As detailed above the results of 2010 Oltin Yo'l GTL noise monitoring are applicable as the baseline noise data for the current ESIA. Therefore, no additional noise monitoring was carried out as part of the baseline studies.

7.6.3 Noise

The results of GTL noise monitoring indicate that the baseline day and night times noise levels at key residential and industrial receptors comply with IFC ambient noise standards. Table 29 presents the noise levels at key receptors and IFC noise standards.

Table 29: Base noise levels at key receptors compared to the IFC noise standards

Receptor description		Noise level dBA	
Name	Distance from SGCC (km)	Day (07:00-23:00)	Night (23:00-07:00)
Otkuduk Village	6.5	40.4	34.5
SGCC Staff Accommodation Complex	2.6	45.4	41.7
SGCC / OLTIN YO'L GTL Construction Camp	2.5	44.9	47.1
Navbahor Village	10	49.5	34.3
IFC Standards	Residential, institutional, Educational	55	45
	Industrial, Commercial	70	70

7.6.4 Vibration

There is no information about the ambient ground vibration levels at the proposed Polymer and Naphtha plants location. However the existing SGCC facilities that are operating in the immediate area adjacent to the proposed plant can be expected to be the source of insignificant vibration. Operation of existing flare during emergency situations can generate significant transient vibration.

8. BIOLOGICAL BASELINE

8.1 Introduction

8.1.1 General Overview

The project area is located in Guzar administrative district of Kashkadarya Region of Uzbekistan 33km south of the city of Karshi. The area consists of low rolling hills of sandy soil and short grassland (Golders, 2014).

The richness of Uzbekistan natural habitat and high diversity of plant and animal species is determined by its geographical position in the Central Asia region in the edge of several biogeographical provinces. The territory is represented by variety of ecosystems, including deserts, mountain steppes, mountain forests and alpine meadows, riparian gallery forests in the desert river valleys, wetlands, and oases each characterised with their flora and fauna (USAID, 2001).

8.1.2 Baseline Survey & Data Collection

The following studies have been undertaken for the project site in 2010-2011 for Golder ESHSIA:

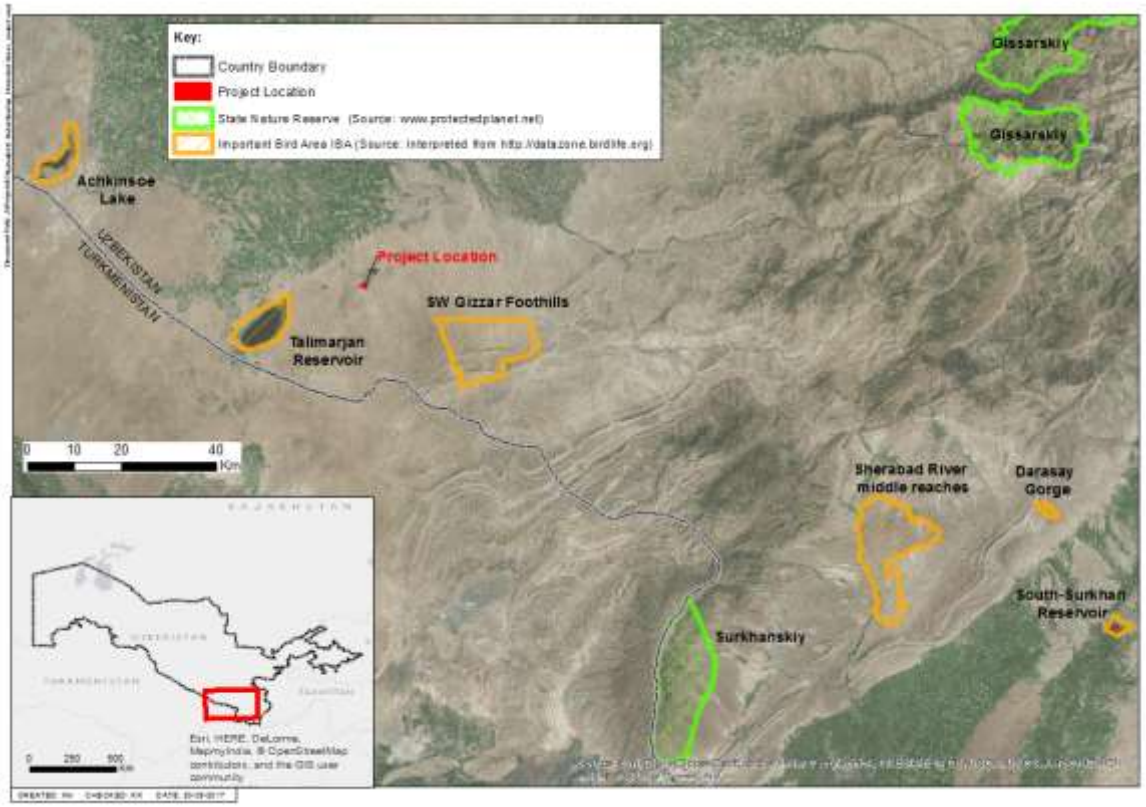
- Avifauna study: April 2010 – February 2011: The assessment of avifauna diversity was carried out through application of combination of methods, including line transects, point counts to determine presence, density and habitat use of resident and migratory species.
- Flora studies: 27 April – 4 May 2010: A flora biodiversity survey was conducted within the different definable vegetation types in the study area to assess the flora species diversity of the vegetation communities, identify species with IUCN and local threatened status.
- Mammals, reptiles and amphibians studies: 27 April – 4 May 2010: Fauna diversity was assessed using various techniques suitable to each group. Sherman traps in two trap lines, each consisting of 25 traps each, at selected sites were used for small mammals. Sightings of spoor, faeces and other markings were recorded to identify species present. Opportunistic sightings of mammals, reptiles and amphibians within the study area were registered. Any macro invertebrates observed and identified were also recorded (Golder, 2011)

Upon the completion of the review of available data by WorleyParsons as part of the Scoping Phase, additional studies were commenced due to the gaps in baseline data. The survey included a walk-over survey of the project area, invertebrates survey and aquatic ecology survey of the SGCC Lake to the north-east of the project site. The surveys were carried out from 05 May till 05 July 2017 by the research officers of Karshi State University within 5 km radius of the Shurtan SGCC. During the survey the main habitats in the survey area and flora and fauna species associated with them have been identified (Karshi State University, 2017).

8.2 Protected Areas

There are 23 protected areas in the territory of Uzbekistan: eight state reserves, one biosphere reserve, two National Parks, 12 state nature reserves. The closest to the project area are Gissar

Mountain State Reserve and Surkhanskiy Mountain Woodland State Reserve. The location of these reserves is shown in Figure 24



24. Location of Protected Areas

Gissar Mountain State Reserve is located 100 km to the North-East from the project site. The reserve covers 812 km^2 of high altitude habitat range. It provides habitats for a number of species (i.e. Himalayan brown bear (*Ursus arctos isabellinus*), Turkestan lynx (*Lynx lynx isabellinus*), snow leopard (*Uncia uncia*) – IUCN endangered (EN). The reserve is also classified as an Important Bird Area (IBA) (BirdLife International, 2017). The following bird species nest in the reserve: Cinerious vulture (*Aegypius monachus*) – IUCN Near Threatened (NT), Red Book of Uzbekistan 3NT, Saker falcon (*Falco cherrug*) – IUCN EN. Lesser Kestrel (*Falco naumanni)* - Red Book of Uzbekistan 3NT- is observed in the reserve during migration season.

Surkhanskiy Mountain Woodland State Reserve is located on the border with Turkmenistan, 100 km to the South-East from the project site. It covers the area of 250 km^2. The following species are known to inhabit the reserve: Markhor (Capra falconeri) – IUCN NT, Cinerious vulture (*Aegypius monachus*) – IUCN NT, Red Book of Uzbekistan 3NT, Bearded vulture (*Gypaetus barbatus*) – IUCN NT, Griffon vulture (*Gyps fulvus*) – IUCN Least Concern (LC).

8.2.1 Important Bird Areas

8.2.1.1. South West Gizzar Foothills IBA

This IBA covers vegetated hills and small plains of the ridges in the western part of the Pamiro-Alay mountain system. The majority of the area is not cultivated due to the IBA located far away from large settlements. The area is important for spring migration, when up to 250 species use the IBA as a breeding site. The list of species includes mainly Passeriformes, as well as *Falco naumanni, Circaetus gallicus, Aquila chrysaetos* and *Buteo rufinus*. Griffon Vulture (*Gyps fulvus*) is a resident species (BirdLife International, 2017).

Other faunal species include *Agriocnemis horsfieldi* and *Pseudopus apodus. Naja naja* and *Vipera lebetina* are observed regularly. Rodent species include *Meriones lybicus* and *Rhombomis opimus* in the lower areas. Common predators include *Vulpes vulpes, V. corsac and Felis lybica*. *Gazella subgutturosa* (IUCN VU) used to be common but has now been exterminated (BirdLife International, 2017).

8.2.1.2. Talimardzhan IBA

The site is considered to be of international importance for bird conservation. The reservoir is located 45 km southwest from Karshi, in the desert area. The length of the reservoir is 14 km and the width – 7 km at the widest point, with the average depth being 20 m. The water quality of the reservoir depends on water quality of the Amudarya river that feeds the IBA through Karshi canal. The slopes are covered with limited vegetation as a result of overgrazing by cattle (BirdLife International, 2017).

The area is important migration stop and possibly breeding site for *Chlamidotis undulata* (IUCN VU). Due to instability of hydrological regime the diversity of breeding species is low. 23 species of birds are recorded during winter months, including *Aythya nyroca* (IUCN NT), *Haliaeetus albicilla* (Red Book of Uzbekistan, 2VU:R), *Larus ichthyaetus* (Red Book of Uzbekistan, 2VU:D) (BirdLife International, 2017).

8.2.1.3. Achinskoe Lake IBA

The IBA is a water storage reservoir located 60 km from Karshi, close to the border with Turkmenistan. The site is located in the flat desert are, it has only sparse grass cover. The reservoir is 20 km long and 4 km wide. Surface vegetation comprises a narrow strip of reeds. The water is fed into the reservoir from the Southern collector canal (BirdLife International, 2017).

The number of species present in winter in the IBA varies from 38 (in 2006) to 16 (in 2004), they include *Anas platyrhynchos, Aythya ferina* (IUCN VU), *Fulica atra, Anser anser, Grus grus, Netta rufina, Pelecanus crispus* (IUCN VU, Red Book of Uzbekistan: 2VU), *Phalacrocorax carbo, Phalacrocorax pygmaeus* (Red Book of Uzbekistan: 3NT), *Ardea cinerea, Casmerodius albus, Tadorna ferruginea, Anas crecca, Aythya nyroca* (IUCN NT, Red Book of Uzbekistan: 3NT), *Mergellus albellus, Mergus merganser, Anatinae spp., Circus cyaneus, Circus aeruginosus, Haliaeetus albicilla* (Red Book of Uzbekistan: 2VU:R), *Aquila heliacal* (IUCN VU), *Aquila nipalensis* (IUCN EN), *Tachybaptus ruficollis, Anas strepera, Vanellus vanellus* (IUCN NT), *Tetrax tetrax* (IUCN NT, Red

Book of Uzbekistan: 2V:D), *Larus cachinnans, Podiceps cristatus, Podiceps nigricollis, Anser spp. Aythya fuligula, Larus ichthyaetus* (Red Book of Uzbekistan: 2V:D) (BirdLife International, 2017).

8.2.1.4. DARASAY GORGE IBA

The IBA is a limestone-gypsum gorge located to the west of the Gissar ridge, in the western part of the Pamir-Alay mountain system. Some of the species registered in the IBA are included into the Red Book of Uzbekistan, i.e. *Ciconia nigra* (Red Book of Uzbekistan: 2VU:R), *Gyps fulvus* (Red Book of Uzbekistan: 3NT), *Aquila chrysaetos* (Red Book of Uzbekistan: 2VU:R) and other species such as - *Ammomanes deserti, Oenanthe pleschanka, Cercotrichas galactotes and Monticola solitarius*. Other nesting species include - *Neophron percnopterus* (IUCN EN), *Charadrius dubius, Galerida cristata, Motacilla personata* and *Passer indicus* (BirdLife International, 2017).

8.2.1.5. MIDDLE REACHES OF SHERABAD RIVER IBA

The IBA comprises the river Sherobad and its valley: the primary and secondary terraces up to 3 km wide and the left part of the river basin. It is located in the southern part of Uzbekistan, 25 km north of Sherobad. The dominant vegetation is ephemeroid-wormwood associations, in the more hilly areas - wild acanthous almond. Some parts of the IBA are used as seasonal pastures (BirdLife International, 2017).

The IBA provides a habitat for breeding raptors. The IBA is located on a migration flyway. Migrating flocks of Common Crane and Demoiselle Crane have been observed flying north along the Sherobad valley. Other species observed in the IBA include *Coracias garrulus, Falco naumanni* (Red Book of Uzbekistan: 3NT) and *Falco cherrug* (IUCN EN, Red Book of Uzbekistan: 3NT), *Ammoperdix griseogularis, Sitta tephronota, Oenanthe finschii, Phylloscopus neglectus, Emberiza buchanani, Phylloscopus neglectus, Emberiza bruniceps, Ciconia nigra* (Red Book of Uzbekistan: 2VU:R) (BirdLife International, 2017).

8.2.1.6. SOUTH-SURKHAN RESERVOIR IBA

The IBA comprises a reservoir situated in the bed of the Surchandariya River. It is up to 6.2 km wide and 20 km long with a maximum depth of 27 m. the shores of the reservoir are mainly flat with the exception of the north eastern part, where the shore s represented by 10-15 m high cliffs. As the reservoir does not freeze, it is used by wintering birds (BirdLife International, 2017).

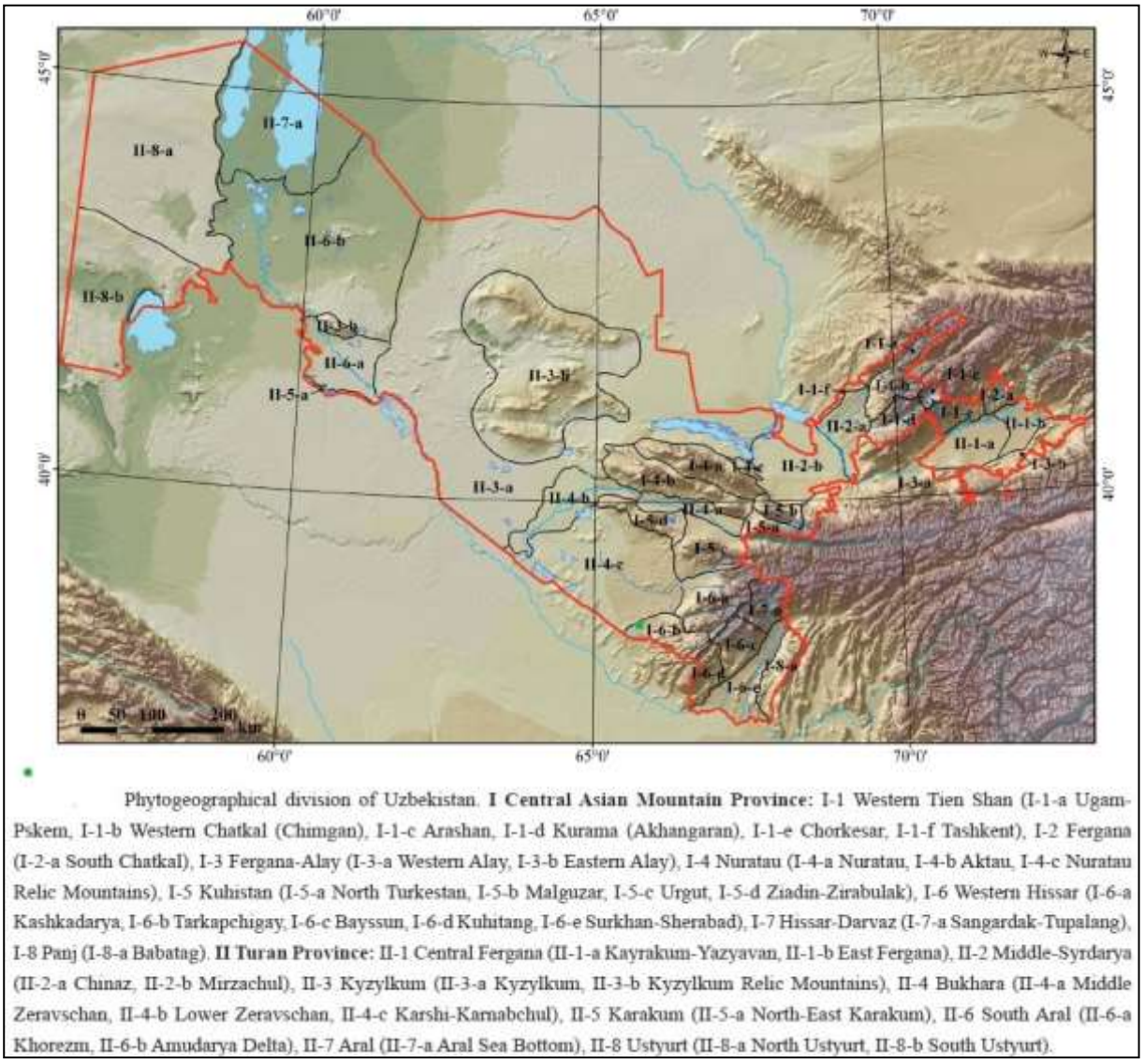
The main wintering species are *Anas platyrhynchos, Fulica atra, Phalacrocorax carbo, Anser anser, Aythya farina* (IUCN VU), *Netta rufina, Phalacrocorax pygmaeus* (Red Book of Uzbekistan: 3NT). Other species include *Branta ruficollis* (IUCN VU), *Pelecanus crispus* (IUCN VU, Red Book of Uzbekistan: 2VU), *Larus ichthyaetus* (Red Book of Uzbekistan: 2V:D), *Haliaeetus albicilla* (Red Book of Uzbekistan: 2VU:R), *Aquila nipalensis* (IUCN EN), *Sturnus vulgaris, Alauda arvensis* and *Motacilla alba* (BirdLife International, 2017).

8.3 Terrestrial Ecology

8.3.1 Vegetation and Flora

The project site is located in the South-West of Uzbekistan in Karshi Steppe of Central Asian Mountain phytogeographical Province, South-Western Hissar District, Tarkapchigay region (Figure 25).

The area of Karshi Steppe is approximately 11.7 thousand km^2, it comprises variety of landscapes from low land deserts to ephemeral steppes near mountain foothills. The project location area is characterised by semi-desert scrub lands. The vegetation cover is mostly sparse and consists of grasses and small shrubs with *Hordeum leporinum, Poa bulbosa, Vulpia persica* and *Poa sp*. being dominant species. The exception is the area surrounding water reservoir northeast of the site. The vegetation around the reservoir is represented by reeds and taller grasses (Golders, 2014).



Phytogeographical division of Uzbekistan. **I Central Asian Mountain Province:** I-1 Western Tien Shan (I-1-a Ugam-Pskem, I-1-b Western Chatkal (Chimgan), I-1-c Arashan, I-1-d Kurama (Akhangaran), I-1-e Chorkesar, I-1-f Tashkent), I-2 Fergana (I-2-a South Chatkal), I-3 Fergana-Alay (I-3-a Western Alay, I-3-b Eastern Alay), I-4 Nuratau (I-4-a Nuratau, I-4-b Aktau, I-4-c Nuratau Relic Mountains), I-5 Kuhistan (I-5-a North Turkestan, I-5-b Malguzar, I-5-c Urgut, I-5-d Ziadin-Zirabulak), I-6 Western Hissar (I-6-a Kashkadarya, I-6-b Tarkapchigay, I-6-c Bayssun, I-6-d Kuhitang, I-6-e Surkhan-Sherabad), I-7 Hissar-Darvaz (I-7-a Sangardak-Tupalang), I-8 Panj (I-8-a Babatag). **II Turan Province:** II-1 Central Fergana (II-1-a Kayrakum-Yazyavan, II-1-b East Fergana), II-2 Middle-Syrdarya (II-2-a Chinaz, II-2-b Mirzachul), II-3 Kyzylkum (II-3-a Kyzylkum, II-3-b Kyzylkum Relic Mountains), II-4 Bukhara (II-4-a Middle Zeravschan, II-4-b Lower Zeravschan, II-4-c Karshi-Karnabchul), II-5 Karakum (II-5-a North-East Karakum), II-6 South Aral (II-6-a Khorezm, II-6-b Amudarya Delta), II-7 Aral (II-7-a Aral Sea Bottom), II-8 Ustyurt (II-8-a North Ustyurt, II-8-b South Ustyurt).

25. Phytogeographical division of Uzbekistan (Source: Sennikov et al., 2016).

Vegetation in the project area display low diversity. Pioneer species have been identified in areas of ground disturbance, i.e. ditches, demolished buildings and generally dominate in the species composition (41.8% - ruderal; 16.4% - ephemeral; 12.7% - halophytes; 28.9% - other) (Golders, 2014).

Protected species that could be observed in Central Asian Mountain phytogeographical Province, South-Western Hissar District, Tarkapchigay region are presented in Table 30.

Table 30: List of protected species that could be observed in Tarkapchigay region (source: Virtual Guide to the Flora of Uzbekistan – Plant Database as Practical Approach)

Species	Endemic Status	Red Book of of Uzbekistan*	IUCN Status
Tulipa uzbekistanica Botschantz. & Scharipov	Endemic of Uzbekistan	1	Not yet assessed
Hedysarum bucharicum B. Fedtsch.	Endemic species of south-western Pamiroalaj / endemic of Uzbekistan (?)	2	Not yet assessed
Allium botschantzevii Kamelin -	Endemic species of western Pamiroalaj / endemic of Uzbekistan	0	Not yet assessed
Eversmannia botschantzevii Sarkisova	Endemic of south-western Pamiroalaj / endemic of Uzbekistan (?)	1	Not yet assessed
Phlomoides leiocalyx (Pazij et Vved.) Adylov, Kamelin et Makhm.	Endemic species of Karshy Steppe, Dehkanabad District	1	Not yet assessed
Lipskya insignis (Koso-Pol.) Nevski	Endemic species of southern Pamiroalaj, Dehkanabad District	3	Not yet assessed

**0 - Apparently disappeared species. Species that have not been for several years, but probably surviving in some inaccessible locations. 1 - Disappearing species. Species with quantity closed to the critical level. 2 - Rare species. Species that are not under direct threat of disappearance, but existing in such small numbers or in such area limited and specific places of habitation, that they can quickly disappear. They need careful monitoring. 3 - Reducing species. Species, numbers and areal of which have been reducing during a certain period of time owing to natural reasons, because of the human interference or as the result of these both factors. Regular assessment of their state is needed.*

None of the species listed above have been recorded during the vegetation survey of the area carried out from 27 April to 4 May 2010 as a part of ESHSIA developed by Golders Association in 2013 for the GTL site as well as during surveys carried out from 05 May till 05 July 2017 as part of this study. 51 plants species have been recorded in 2010 and 47 – in 2017 (Karshi State University, 2017).

The list of all species identified during the field trip carried out from 27 April to 4 May 2010 is presented in Table 31.

Table 31: List of vegetation species recorded at the site in 27.04.10-4.05.10 (Source: Golders, 2014)

Ref.	Species	Year	Ref.	Species	Year
1	*Acanthophyllum cyrtostegium*	2010	44	*Echinops karatavicus*	2017
2	*Acanthophyllum pungens*	2017	45	*Eremopyrum bonaepartis*	2010
3	*Achillia biebersteinii*	2010 2017	46	*Euclidium syriacum*	2010
4	*Acroptilon repens*	2010	47	*Garhadiolus papposus*	2010
5	*Aegilops erassa*	2010 2017	48	*Girgensohnia oppositifolia*	2010
6	*Ajuga turkestanica*	2017	49	*Haloxylon aphyllum*	2010 2017
7	*Alhagi canescens*	2010	50	*Haloxylon persicum*	2017
8	*Alhagi pseudalhagi*	2017	51	*Haplophyllum sp*	2010
9	*Alyssum turkestanicum var desertorum*	2010	52	*Heliotropium sp.*	2010
10	*Amygdalus sp.*	2010	53	*Hordeum leporinum*	2010
11	*Anabasis turkestanica*	2010	54	*Juno sp*	2017
12	*Anisantha (Bromus) sterilis*	2010	55	*Karelina caspica*	2010
13	*Astragalus campylotrichus*	2017	56	*Lallemantia royleana*	2017
14	*Astragalus filicaulis*	2010	57	*Lappula microcarpa*	2017
15	*Astragalus sp.*	2010	58	*Lathyrus cicera*	2017
16	*Astragalus turkestanus*	2017	59	*Leonurus turkestanicus*	2017
17	*Bromus oxyodon*	2010	60	*Malva sp.*	2017
18	*Boisseria squarrosa*	2010	61	*Medicago sativa*	2010

Ref.	Species	Year	Ref.	Species	Year
19	*Bunium chaerophylloides*	2017	62	*Melica hohenackeri*	2017
20	*Capparis herbacea*	2017	63	*Nigella integrifolia*	2017
21	*Cardaria repens*	2017	64	*Onopordon olgae*	2017
22	*Carex pachystylis*	2010 2017	65	*Papaver paoniinum*	2017
23	*Carthamnus oxyacanthus*	2010	66	*Peganum harmala*	2010 2017
24	*Carum carvi*	2010	67	*Poa bulbosa*	2010 2017
25	*Centaurea belangeriana*	2010 2017	68	*Poa sp.*	2010
26	*Centaurea iberica*	2017	69	*Psammogeton setifolium*	2010
27	*Centaurea squarrosa*	2017	70	*Pseudohandelia umbellifera*	2010
28	*Ceratocephala testiculata*	2010	71	*Psoralea drupacea*	2017
29	*Ceratocarpus urticulosis*	2010	72	*Rochelia aff.*	2010
30	*Chamaesyce canescens*	2010	73	*Salsola leptoclada*	2017
31	*Chenopodium album*	2010	74	*Salvia spinosa*	2017
32	*Cicer songaricum*	2017	75	*Sonchus oleraceus*	2010
33	*Cirsium alatum*	2010	76	*Strigosella arvensis*	2017
34	*Convolvulus dorycnium*	2017	77	*Strigosella africana*	2010
35	*Cousinia microcarpa*	2017	78	*Strigosella turkestanica*	2010 2017
36	*Cousinia resinosa*	2010 2017	79	*Taeniaterum crinitum*	2010

Ref.	Species	Year	Ref.	Species	Year
37	*Crepis sibirica*	2017	80	*Tamarix hispida*	2017
38	*Cynanchum sibiricum*	2017	81	*Tamarix hohenackeri*	2017
39	*Dactylis glomerata*	2017	82	*Tamarix laxa*	2010
40	*Descurainia sophia*	2010	83	*Taraxacum laxa*	2010
41	*Diarthron vesiculosum*	2010	84	*Tribulus terrestris*	2010
42	*Echinochloa crus-galli*	2017	85	*Vulpia persica*	2010
43	*Eremopyrum orientale*	2010			

Agricultural lands are located to the north and west of the study area. The following plants are being cultivated in the close proximity to the project area:

- *Amygdalus sp* - Wild almond;
- *Fraxinus excelsior* - Common ash;
- *Gleditsia cf caspica* - Caspian locust tree;
- *Ulmus parvifolia* - Chinese elm;
- *Albizia julibrissine* - Persian silk tree;
- *Rosa canina* – Dog-rose;
- *Populus sp* – Poplar;
- *Juniperus sp* – Cade;
- *Acer sp* – Maple;
- *Prunus armeniaca* – Apricot;
- *Cydonia sp* – Apple;
- *Spartium junceum* – Spanish broom.

8.3.2 Fauna

The fauna of Uzbekistan has shaped under the influence of its geographical position and geological history of the area, where apart from endemic fauna other species migrated to the area from surrounding territories in Central Asia, as well as India, China, Kazakhstan, Siberia and northern Africa. Currently the Uzbekistan fauna includes 682 of vertebrates species (108 mammals, 431 birds, 58 reptiles, two amphibians, and 83 fishes) and 15,000 of invertebrates species (USAID 2001).

8.3.3 Invertebrates

Arthropods constitute the largest group out of the invertebrates species in Uzbekistan with insects comprising the majority of species. Insects are also the most diverse group with 7 orders being identified in Uzbekistan each ranging from 400 to 3000 species. Altitude is one of the factors influencing Insecta species distribution in Uzbekistan. Thus, Orthoptera prefer mountain foothills, Coleoptera (beetles) observed in low and mid-altitude mountains. Low and mid altitude mountains are also preferred by endemic species with narrow localised habitats, i.e. Chrysomelidae (leaf beetles), Curculionidae (true weevils). Alpine meadows are preferred by Staphylinidae (rove beetles), Carabidae (ground beetles), Geotrupidae (dung beetles) and others (Golders, 2014).

Protected species that could be observed in Kashkadarya Administrative Region are presented in Table 32.

Table 32: List of protected species that could be observed in Kashkadarya administrative Region (Source: Red Book of Uzbekistan)

Species	Description	Red Book Uzbekistan*	IUCN Status
Latrodectus dahli Levi	Species with a mosaic distribution. It inhabits clay deserts and semideserts, living in holes of rodents and turtles, in soil clefts. As many as two females per 100 m^2 are recorded in local populations. Limiting factors: development of virgin lands in semideserts and deserts	3	Not yet assessed
Chlorion regale F. Smith	Relict species with a patchy distribution. It is distributed across the flatland and low-mountains of southern Uzbekistan. It inhabits sand-clay and rubbly parts of plains and low-mountains in desert regions. The numbers are low across the country; only single specimens have been observed. Limiting factors: economic development of lands in desert regions.	2	Not yet assessed
Kohlia pavlowski	Endemic species. It inhabits sandy and clay parts of plains and low-mountains in desert regions. The numbers are low across the country; only single specimens have been observed. Limiting factors: agricultural development of lands in desert zone, in particular overgrazing.	2	Not yet assessed
Laphyragogus kohlii	Inhabits sandy deserts, river valleys of southern Uzbekistan. The numbers are	2	Not yet assessed

Species	Description	Red Book Uzbekistan*	IUCN Status
	low across the country; only single specimens have been observed. Limiting factors: agricultural development of lands in desert regions, in particular overgrazing.		

**0 - Apparently disappeared species. Species that have not been for several years, but probably surviving in some inaccessible locations. 1 - Disappearing species. Species with quantity closed to the critical level. 2 - Rare species. Species that are not under direct threat of disappearance, but existing in such small numbers or in such area limited and specific places of habitation, that they can quickly disappear. They need careful monitoring. 3 - Reducing species. Species, numbers and areal of which have been reducing during a certain period of time owing to natural reasons, because of the human interference or as the result of these both factors. Regular assessment of their state is needed.*

During the survey carried out by Golders between 27 April till 4 May 2010 no Red Book species were observed, with the following invertebrates recorded:

- *Isopoda* (not specified);
- Spiders of the families *Eresidae* and *Araneidae, Solpugida* (sunspider) (not specified);
- *Coleoptera*: beetles of the families *Buprestidae* (Jewel Beetle) and *Tenebrionidae* (not specified);
- *Hymenoptera*: family *Mutilidae* (Velvet Ant);
- *Diptera*: family *Asilidae* (robber fly);
- a moth (not specified); and
- Moroccan Migratory Locusts (*Dociostaurus maroccanus*).

The species recorded during the survey in May-July 2017 are listed in Table 33.

Table 33: 1 List of invertebrate species that were observed during the survey in 2017 (Karshi State University, 2017)

Ref.	Species	Ref.	Species
1	*Acheta domesticus*	16	*Locusta migratoria*
2	*Acridida sp.*	17	*Lycosa singoriensis*
3	*Ammaphila sabulosa*	18	*Mantis religiosa*

Ref.	Species	Ref.	Species
4	*Anacanthotermes turkestanicus*	19	*Messor apalocaspius*
5	*Blaps halophile*	20	*Pieris brassicae*
6	*Bolivariana brachyptera*	21	*Planorbis planorbis*
7	*Buthus eupeus*	22	*Polyommalus icarus*
8	*Dasyhira pudibunda*	23	*Pplyphaga saussurei*
9	*Dociostaurus marocanus*	24	*Scotia segetum*
10	*Eurygaster intericeps*	25	*Searabaeus sacer*
11	*Galeodes cuspicus*	26	*Sphingidae*
12	*Glaucopsyche charibdis*	27	*Tabanus bovinus*
13	*Gryllus campestris*	28	*Tettigonia cantans*
14	*Hierodula tenuidentata*	29	*Zabrus tenebrioides*
15	*Lethus rosmarus*		

No IUCN listed species have been observed. *Glaucopsyche charibdis* - Uzbekistan Red Book, status 2VU:D – was registered.

8.3.4 Reptiles

According to literature review, overall in desert areas of the Karshi steppe 26 species of reptiles have been recorded. In the Karshi steppe landscapes with variety of habitats show higher diversity of species than landscapes with one habitat. Thus, sandy loam plain with sand dunes which is typical for western and southern areas of Karshi steppe shows highest diversity of species (Bondarenko 1994).

Species that have been recorded in Karshi Steppe according to the literature review are presented in Table 34.

Table 34: List of reptile species that have been recorded in Karshi Steppe

Ref.	Species	Red Book of Uzbekistan+	IUCN Status**	Recorded onsite during Survey
1	*Testudo horsfieldii* – Central Asian tortoise	-	VU	Golder Survey 27/04/10-4/05/10 Karshi State University 05/05/17-05/07/17
2	*Teratoscincus scincus* – Frog-eyed gecko	-	Not Assessed	-
3	*Crossobamon eversmanni*	-	Not assessed	-
4	*Tenuidactylus caspius* - Caspian Bent-toed Gecko	-	LC	-
5	*Cyrtopodion fedtschenkoi* - Turkestan Rock Gecko	-	Not Assessed	Golder Survey 27/04/10-4/05/10
6	*Trapelus sanguinolentus*	-	Not Assessed	-
7	*Phrynocephalus helioscopus* - Sunwatcher	-	LC	Karshi State University 05/05/17-05/07/17
8	*Phrynocephalus interscapularis*	-	Not Assessed	Golder Survey 27/04/10-4/05/10
9	*Phrynocephalus mystaceus*	-	Not Assessed	-
10	*Varanus griseus caspius* - Caspian Monitor	2 (VU:D)	Not Assessed	Golder Survey 27/04/10-4/05/10

Ref.	Species	Red Book of Uzbekistan+	IUCN Status**	Recorded onsite during Survey
				Karshi State University 05/05/17-05/07/17
11	*Pseudopus apodus* - European legless lizard	-	Not Assessed	-
12	*Eumeces schneideri*	-	Not Assessed	-
13	*Ablepharus deserti* - Desert lidless skink	-	LC	-
14	*Eremias velox* - Rapid fringe-toed lizard	-	Not Assessed	Golder Survey 27/04/10-4/05/10
15	*Eremias arguta* – Steppe-runner	-	Not Assessed	-
16	*Eremias intermedia*	-	Not Assessed	-
17	*Eremias lineolate* - Striped racerunner	-	Not Assessed	-
18	*Eremias grammica* – Reticulate racerunner	-	Not Assessed	-
19	*Eryx tataricus* - Tartar sand boa	-	Not Assessed	-
20	*Natrix tessellata* - Tessellated Water Snake	-	LC	-
21	*Platyceps karelini*	-	Not Assessed	-
22	*Hemorrhois nummifer* - Coin-marked snake	-	Not Assessed	-

Ref.	Species	Red Book of Uzbekistan+	IUCN Status**	Recorded onsite during Survey
23	*Spalerosophis diadema* – Diadem snake	-	Not Assessed	-
24	*Lytorhynchus ridgewayi* - Derafshi Snake	2 (VU:R)	LC	-
25	*Psammophis lineolatus*	-	Not Assessed	-
26	*Naja oxiana* – Central Asian cobra	3	DD	Karshi State University 05/05/17-05/07/17

**Red Book of Uzbekistan: 2 - species could be assessed as Vulnerable: Declining (VU:D) when their vital parameters decline or fluctuate widely and rapidly, and also as Vulnerable: Naturally Rare (VU:R) =VU D, E criteria of IUCN), if their vital parameters are restricted. A species is Vulnerable when its vital parameters are not so far from the critical levels (or might be not so far to them in the uncertain future with a medium probability) and it is therefore considered to be facing a medium risk of extinction in the wild. 3 - Near Threatened. A species is Near Threatened when its vital parameters are relatively far from the critical levels now, but might approach them in near or uncertain future with some probability and it is therefore considered to be facing a potential risk of extinction in the wild.*

***IUCN (International Union for Conservation of Nature): LC – Least Concern. VU – Vulnerable. DD – Data Deficient*

Two listed species (*Testudo horsfieldii* – Central Asian tortoise and *Varanus griseus caspius* - Caspian Monitor) have been recorded on site during the survey undertaken by Golders from 27 April till 4 May 2010. *Testudo horsfieldii* (Central Asian tortoise) and *Varanus griseus caspius* (Caspian Monitor) were recorded again during the survey undertaken by Karshi State University in 2017, as well as *Naja oxiana* (Central Asian Cobra) and *Phrynocephalus helioscopus* (Sunwatcher).

The population of *Varanus griseus* is declining and showing a patchy distribution. Species observations are reported from arid flat regions. *Varanus griseus* inhabits sandy and clayey desert areas in the plains and foothills. In 1970s the numbers were reported to be 3-6 individual animals per 1 ha in local populations. In 1990s, the total number was reported to be 45,000 individuals and about 200 in an isolated Ferghana population. Currently the species has disappeared from many habitats, while in others the numbers are very low. The factors that could be contributing to the reduction of population numbers are agricultural destruction of natural habitats in the desert zone (especially ploughing and irrigation), disturbance by humans, road traffic. *Varanus griseus* is included in Appendix I of CITES (Red Book of Uzbekistan, 2009)

Testudo horsfieldii's typical habitat would comprise arid rocky deserts and hillsides, as well as sandy steppes and grassy areas close to water sources. Winters in these environments can be particularly

harsh and cold, with temperatures in much of the tortoise's range well below freezing. Testudo horsfieldii is classified as Vulnerable (VU) on the IUCN Red List and is listed on Appendix II of CITES. The factors that could be contributing to the decline to the numbers of these species are habitat destruction and degradation due to farming, livestock grazing and industrial development. (Anderson-Cohen 1994)

8.3.5 Avifauna

Due to its size and its central position between Europe and Asia and the transition zone between the Western and Eastern Palearctic, Uzbekistan hosts a rich avifauna, with an estimated total of about than 500 species with a high number of endemics and subspecies. Forty eight species (with 51 subspecies) of birds are included in the Uzbekistan Red data book, some of them breeding or wintering in the south-western part of the country.

Several bird migration routes lie through Uzbekistan, Kazakhstan and Turkmenistan, i.e. the Black Sea-Mediterranean, West Asian-East African, and Central Asian-South Asian flyway. Large numbers of birds (especially wildfowl, raptors and cranes) use favourable habitats for stop overs during migration. The list of migratory birds comprises about 240-250 species. There 47 IBA identified in the territory of Uzbekistan. Talimardzhan reservoir and South West Guzor Foothills are located in the close proximity to the Project (16 km and 24 km respectively).

In recent decades several water reservoirs were created in the Karshi Steppe. Those reservoirs provide good stop overs for migratory birds. Some species also use those areas for breeding.

It was observed that some waterbirds moved into the southern region following the ecological crisis in the Aral Sea area. This increased the importance of the wetlands in the south of Uzbekistan (Golders, 2014).

The list of Red Listed species that were observed in Karshi Steppe during the surveys in 2010 is presented in the Table 35. A single individual of a Red Listed species (*Phalacrocorax pygmaeus*) was recorded during the survey in 2017 near SGCC Reservoir (Karshi State University, 2017).

Table 35: List of protected bird species that have been observed in Karshi Steppe during 2010 surveys (Source: Golders, 2014)

Ref.	Species		Red Book of Uzbekistan*	IUCN Status**	Observation Season
1	*Aegypius monachus*	Cinereous Vulture	3 NT	NT	Spring
2	*Anser erythropus*	Lesser White-fronted Goose	2 VU:R	VU	Winter
3	*Aquila clanga*	Greater Spotted Eagle	2 VU:R	VU	Winter
4	*Aquila chrysaetos*	Golden Eagle	2 VU:R	LC	Winter / Autumn / Spring

Ref.	Species		Red Book of Uzbekistan*	IUCN Status**	Observation Season
5	*Aquila nipalensis*	Steppe Eagle	3 NT	EN	Winter / Autumn / Spring
6	*Aythya ferina*	Common Pochard	-	VU	Winter
7	*Aythya nyroca*	Ferruginous Duck	3 NT	NT	Winter
8	*Ciconia ciconia*	White Stork	3 NT	LC	Autumn
9	*Circaetus gallicus*	Short-toed Snake-eagle	2 VU:D	LC	Spring / Autumn
10	*Circus macrourus*	Pallid Harrier	3 NT	NT	Autumn / Spring
11	*Egretta garzetta*	Little Egret	2 VU:D	LC	Spring
12	*Falco naumanni*	Lesser Kestrel	3 NT	LC	Spring
13	*Falco peregrinus*	Peregrine Falcon	2 VU:R	LC	Autumn / Spring
14	*Haliaeetus albicilla*	White-tailed Sea-eagle	2 VU:R	LC	Winter
15	*Hieraaetus pennatus (Aquila pennata)*	Booted Eagle	2 VU:D	LC	Spring
16	*Larus ichthyaetus*	Pallas's Gull	2 VU:R	LC	Winter
17	*Neophron percnopterus*	Egyptian Vulture	-	EN	Spring
18	*Pandion haliaetus*	Osprey	2 VU:R	LC	Spring
19	*Phalacrocorax pygmaeus*	Pygmy Cormorant	3 NT	LC	Winter / Ear
20	*Podiceps auritus*	Horned Grebe	-	VU	Winter
21	*Streptopelia turtur*	European Turtle-dove	-	VU	Spring
22	*Vanellus vanellus*	Northern Lapwing	-	NT	Winter / Spring

Ref.	Species		Red Book of Uzbekistan*	IUCN Status**	Observation Season
23	*Vanellus (Chettusia) gregaria*	Sociable Lapwing	2 VU:R	CR	Autumn

**Red Book of Uzbekistan: 2 - species could be assessed as Vulnerable: Declining (VU:D) when their vital parameters decline or fluctuate widely and rapidly, and also as Vulnerable: Naturally Rare (VU:R) =VU D, E criteria of IUCN), if their vital parameters are restricted. A species is Vulnerable when its vital parameters are not so far from the critical levels (or might be not so far to them in the uncertain future with a medium probability) and it is therefore considered to be facing a medium risk of extinction in the wild. 3 - Near Threatened. A species is Near Threatened when its vital parameters are relatively far from the critical levels now, but might approach them in near or uncertain future with some probability and it is therefore considered to be facing a potential risk of extinction in the wild.*

***IUCN: CR – Critically Endangered. EN – Endangered. VU – Vulnerable. NT- Near Threatened. LC – Least Concern. DD – Data Deficient.*

8.3.5.1. AEGYPIUS MONACHUS (CINEREOUS VULTURE)

Resident species of Uzbekistan with mosaic distribution. It can be observed in mountain areas and plains, including agricultural lands. Breeding habitat comprises mountain areas of 500- 2500m above sea level. In 1980s about 80 breeding pairs were recorded, as well as 75-80 individuals. At present numbers are gradually decreasing. *Aegypius monachus* is included in the IUCN Red List [NT], Appendix II of CITES. Red Book of Uzbekistan status is Near Threatened 3(NT).The factors that could be contributing to the decline of the population of *Aegypius monachus* are drop of numbers of wild ungulates, poaching (Red Book of Uzbekistan, 2009). The species were recorded in spring 2010 to the south and east of the project site in semi-desert and grass-steppe habitats.

8.3.5.2. ANSER ERYTHROPUS (LESSER WHITE-FRONTED GOOSE)

This is a migratory species. *Anser erythropus* have been observed near water-reservoirs of the Amu darya and Syrdarya River basins, southern Aral region, on lakes Dengizkul and Aydarkul, Chardara and Surkhan reservoirs (migration, wintering). The species prefer well-developed submerged and littoral vegetation. About 200 to 2.000 individuals recorded during migration and wintering season. *Anser erythropus* is included in the IUCN Red List [VU] and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R). Destruction of habitats as a result of changes of water regime in the basin of the Aral Sea region could be the contributing factor to the decline of *Anser erythropus* population in Uzbekistan (Red Book of Uzbekistan, 2009). The species were recorded in winter 2010-2011 resting and feeding on the Talimardzhan Reservoir and SGCC Water Reservoir next to the project area.

8.3.5.3. AQUILA CLANGA (GREATER SPOTTED EAGLE)

Aquila clanga is a migratory species. Single birds and small groups are observed in plain and low mountain regions of Uzbekistan during migration. *Aquila clanga* is included in the IUCN Red List [VU], Appendix II of CITES and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R). Factors contributing to the decline of the population numbers are destruction of natural habitat, mortality due to power lines (Red Book of Uzbekistan, 2009). One bird was recorded during migration in September 2010 near Talimardzhan reservoir.

8.3.5.4. AQUILA CHRYSAETOS (GOLDEN EAGLE)

Aquila chrysaetos is a resident species. Two subspecies (South-European (1) and Central Asian (2)) are locally distributed across Plateau Ustyurt, in southern Aral region, the desert Kyzylkum (1) and in mountain regions (2). It inhabits sandy areas and low mountains in the deserts, loess precipices of foothills, rocks of the mid and high altitude of the mountains. In 1970-80s, 80-100 breeding pairs were recorded. *Aquila chrysaetos* is included in Appendix II of CITES and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R). Destruction of habitats and nests and poaching are considered to be contributing factors to the decline of the population numbers (Red Book of Uzbekistan, 2009). *Aquila chrysaetos* were observed around the project site, near Talimardzhan Reservoir, cattle farm on site, hills during all seasons in 2010. *Aquila chrysaetos* also breed in the area.

8.3.5.5. AQUILA NIPALENSIS (STEPPE EAGLE)

Aquila nipalensis is a migratory species. Two subspecies are recorded in Uzbekistan: European (2) and eastern (1). They are distributed across Plateu Ustyurt (1 - breeding, roaming); plains and low mountain regions (1 - roaming, 2 - migration, wintering). Breeding was last recorded in 1948. Single individuals and groups are recorded during migration (up to 100 birds per day). Single birds winter irregularly in southern regions. *Aquila nipalensis* is included in the IUCN Red List [EN], Appendix II of CITES and in Red Book of Uzbekistan as Near Threatened 3(NT). Destruction of natural habitat, mortality due to power lines are considered to be contributing factors to the decline of the population numbers (Red Book of Uzbekistan, 2009). *Aquila nipalensis* was observed during spring and autumn 2010 migration near water reservoirs and a single bird was observed in February 2010.

8.3.5.6. AYTHYA FERINA (COMMON POCHARD)

*Aythya ferina i*s a migratory species. It breeds from Western Europe through central Asia to south-central Siberia and northern China. This species prefers well-vegetated eutrophic to neutral swamps, marshes, lakes and slow-flowing rivers with areas of open water and abundant emergent fringing vegetation. It also breeds on saline, brackish and soda lakes and occasionally even in sheltered coastal bays. During the winter the species occupies similar habitats to breeding habitats, including large lakes, slow-flowing rivers, reservoirs, brackish waters, marshes and flooded gravel pits (BirdLife International, 2016). *Aythya farina* is included in the IUCN Red List [VU]. *Aythya farina* was observed on site in winter 2010 near Talimardzhan Reservoir.

8.3.5.7. AYTHYA NYROCA (FERRUGINOUS DUCK)

Aythya nyroca is migratory species. It is distributed in the basin of the rivers Amudarya, Syrdarya, Zaravshan (breeding, migration, wintering). It inhabits reservoirs with well-developed submerged littoral vegetation in flat areas. Until 1960s the numbers were abundant. Currently it has disappeared from many habitats, especially in eastern parts of Uzbekistan. From 3.000 to 4.000 breeding pairs and 7.000 wintering individuals are recorded. *Aythya nyroca* is included in the IUCN Red List [NT] and Red Book of Uzbekistan as Near Threatened 3(NT). Destruction of habitats as a result of the changes of water regime in the basins of the Syrdarya and Amudarya rivers and poaching are considered to be main contributing factors to the decrease of population numbers (Red Book of Uzbekistan, 2009). *Aythya nyroca* was observed in Talimardzhan Reservoir in January 2011.

8.3.5.8. CICONIA CICONIA (WHITE STORK)

Ciconia ciconia is Turkestanian subspecies of migratory species. It is observed from the area of the mid-stream of the River Syrdarya, in the Ferhgana valley, foothills of Turkestan Range, south of Uzbekistan (breeding, wintering). It inhabits oases, irrigated fields, marshes and banks of rivers. In 1960-80s this subspecies was observed regularly in central and south-western Uzbekistan. Currently only eastern population remains. There are about 1500 breeding pairs (95% in the Ferghana valley) and several hundred wintering birds. It is included in the Red Book of Uzbekistan as Near Threatened 3(NT). Destruction of habitats as a result of the changes of water regime of plain rivers and drying up of the marshes are considered to be main contributing factors to the decrease of population numbers (Red Book of Uzbekistan, 2009). Two birds were observed in October 2010 close to a pond along the R-89 road to Talimardzhan Reservoir.

8.3.5.9. CIRCAETUS GALLICUS (SHORT-TOED SNAKE-EAGLE)

Circaetus gallicus is a migratory Turkestanian subspecies. It inhabits sandy deserts, gallery river forests, small mountains, arid foothills and mid-belts of the mountains. In the breeding season it avoids high mountains and agricultural lands. In 1970-80s about 20 breeding pairs and 50 single birds were recorded in breeding season. Currently the recorded numbers have dropped. *Circaetus gallicus* is included in Appendix II of CITES and Red Book of Uzbekistan as Vulnerable, declining 2(VU:D). Destruction of natural habitats is considered the main factor contributing to the numbers decrease (Red Book of Uzbekistan, 2009). *Circaetus gallicus* was observed during spring and autumn migration in 2010 in the project area.

8.3.5.10. CIRCUS MACROURUS (PALLID HARRIER)

Circus macrourus is a migratory species. It is recorded in the Kyzylkum desert, in the Amudarya, Syrdarya, Zaravshan, Surkhandarya valleys and inhabits flat regions. Comparing to 1970-80s data. *Circus macrourus* numbers have dropped across the country. Several hundred individuals are recorded during migration. *Circus macrourus* is included in the IUCN Red List [NT] in Appendix II of CITES and Red Book of Uzbekistan as Near Threatened 3(NT). Destruction of natural habitats in desert and semi-desert zones is considered to be the main contributing factor to the population

decrease (Red Book of Uzbekistan, 2009). *Circus macrourus* was observed during spring and autumn migration in 2010 in the project area.

8.3.5.11. EGRETTA GARZETTA (LITTLE EGRET)

Egretta garzetta is a migratory species. Its areal includes southern Aral region and the basin of the Amudarya River (breeding), basin of Syrdarya River (wintering). It inhabits saline flat reservoirs with reeds. Comparing to the data obtained in 1960s, *Egretta garzetta* disappeared from many habitats. *Egretta garzetta* is included in the Red Book of Uzbekistan as Vulnerable, declining 2(VU:D) Destruction of habitats as a result of the changes of water regime in the basins of the Amudarya river is considered to be the main contributing factor to the decrease of population numbers (Red Book of Uzbekistan, 2009). *Egretta garzetta* was recorded in feeding in a small pond on the way to the Talimardzhan Reservoir in April and migration over the site in October 2010.

8.3.5.12. FALCO NAUMANNI (LESSER KESTREL)

Falco naumanni is a migratory species. The areal includes western Tien-Shan, western Pamir-Alay, low mountains of the Kyzylkum desert, lower reaches of the Amudarya River, the valley of the Zaravshan River (breeding); all regions of Uzbekistan (migration). It inhabits plains and foothill regions. In 1970-80s 50-300 breeding pairs were recorded in southern regions. Since then the numbers have decreased. *Falco naumanni* is included in the IUCN Red List [VU], Appendix II of CITES and Red Book of Uzbekistan as Near Threatened 3(NT). Destruction of natural habitats is considered to be the main contributing factor to the population decrease (Red Book of Uzbekistan, 2009). *Falco naumanni* was observed in migration in spring 2010.

8.3.5.13. FALCO PEREGRINUS (PEREGRINE FALCON)

Falco peregrinus is a migratory species. The areal includes plains and foothill regions (migration, wintering). During migration and wintering single birds and small groups (2-5) are recorded. It is included in Appendix II of CITES and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R) Illegal trapping is considered to be the main contributing factor to the population decrease (Red Book of Uzbekistan, 2009). *Falco peregrinus* was observed in Spring and Autumn 2010 around the project site in grass-steppe habitat and Talimardzhan Reservoir.

8.3.5.14. HALIAEETUS ALBICILLA (WHITE-TAILED SEA-EAGLE)

Haliaeetus albicilla is a migratory subspecies. The areal includes southern Aral region (breeding); migration and wintering almost elsewhere in Uzbekistan except in high mountains and the Ferghana Valley. It inhabits large plains and foothill water reservoirs. The numbers were always low. During the migration, single birds, pairs and groups of birds are recorded. Nesting is irregular. *Haliaeetus albicilla* included in Appendix I of CITES and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R). Destruction of habitats as a result of changes of water regime in the basin of the Aral Sea region and poaching are considered to be the contributing factors to the decline of *Haliaeetus albicilla* population in Uzbekistan (Red Book of Uzbekistan, 2009). High numbers of Haliaeetus albicilla were

observed during winter 2010-2011 near the SGCC Reservoir next to the project site and Talimardzhan Reservoir.

8.3.5.15. HIERAAETUS PENNATUS (BOOTED EAGLE)

Hieraaetus pennatus is a migratory Central Asian subspecies. The species' areal includes western Tien-Shan, western Pamir-Alay, low mountains of the Kyzylkum desert, the Syrdarya River basin (breeding) and all regions of Uzbekistan during migration. It inhabits mountain, plains and forests. Historic data shows that *Hieraaetus pennatus* was abundant before 1950s. Currently the numbers are sharply decreased. *Hieraaetus pennatus* is included in Appendix II of CITES and Red Book of Uzbekistan as Vulnerable, declining 2(VU:D). Destruction of habitats by cutting the gallery river forests and disturbance by human activities in mountain valleys are considered to be the contributing factors to the decline of *Haliaeetus pennatus* population in Uzbekistan (Red Book of Uzbekistan, 2009). The species were recorded in spring 2010 to the south and east of the project site in grass-steppe habitat and Tlimardzhan Reservoir.

8.3.5.16. LARUS ICHTHYAETUS (PALLAS'S GULL)

*Larus ichthyaetus i*s a migratory species. The areal includes the islands of the Aral Sea, southern Aral region (breeding), water reservoirs (migration), mid-stream of the Syrdarya and Amudarya rivers (wintering). It inhabits the islands and shores of saline lakes (breeding), large reservoirs and fishing ponds (migration, wintering). *Larus ichthyaetus* breeding colonies on the islands of the Aral Sea used to reach about 3000 individuals. Currently nesting *Larus ichthyaetus* are not observed, with only migrating and wintering birds recorded. *Larus ichthyaetus* is included in Red Book of Uzbekistan as Vulnerable declining 2(VU:D). Destruction of habitats as a result of water regime changes in the Aral Sea region and poaching are the main factors contributing to the decrease of the population numbers (Red Book of Uzbekistan, 2009). The species were recorded in winter 2010-2011 at the Talimardzhan Reservoir.

8.3.5.17. NEOPHRON PERCNOPTERUS (EGYPTIAN VULTURE)

This species occupies a large range. Migratory birds breed in northernmost Africa, southern Europe, from Spain in the west, through the Mediterranean, Turkey, the Caucasus and central Asia to northern Iran, Pakistan, northern India and Nepal. These birds winter within the resident range, and in addition throughout the Sahel region of Africa. Global population estimates for the species are crude, but <2,000 pairs are estimated in central Asia. It typically nests on ledges or in caves on cliffs, crags and rocky outcrops, but occasionally also in large trees, electricity posts and rarely on the ground. *Neophron percnopterus* forages in lowland and montane regions over open, often arid, country, it is known to scavenge at human settlements. *Neophron percnopterus* is included in the IUCN Red List [EN] (BirdLife International, 2016). *Neophron percnopterus* were observed around the project site and near Talimardzhan Reservoir during Spring and Summer 2010. *Neophron percnopterus* breed in the Gizzar Hills area to the east of the project site.

8.3.5.18. PANDION HALIAETUS (OSPREY)

Pandion haliaetus is a migratory subspecies of a cosmopolitan species. The areal includes Khoresm region for nesting. Migrating birds could be observed almost everywhere in Uzbekistan. It inhabits plains and foothill reservoirs with clear water. *Pandion haliaetus* is included in Appendix II of CITES and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R). Destruction of habitats as a result of the changes of water regime and effect of power lines are considered to be contributing factor to the decline of the population numbers (Red Book of Uzbekistan, 2009). *Pandion haliaetus* was observed near Talimardzhan Redervoir and grass-steppe habitat close to the project site.

8.3.5.19. PHALACROCORAX PYGMAEUS (PYGMY CORMORANT)

Phalacrocorax pygmaeus is a migratory species. It has been observed from the basins of the Amudarya, Zaravshan and Kashkadarya rivers, the midcourse of the Syrdarya River and the south of Uzbekistan (breeding, wintering and migration). It inhabits large lakes and reservoirs in flat territories. It used to breed on the islands of the Aral Sea. *Phalacrocorax pygmaeus* now occupies new habitats in the Amudarya and Syrdarya basins. About 10,000 to 12,000 breeding pairs and about 10,000 wintering birds are recorded. Destruction of habitats as a result of the changes of water regime in the the Aral Sea region is considered to be the main factor for population decline (Red Book of Uzbekistan, 2009). *Phalacrocorax pygmaeus* is included in Red Book of Uzbekistan as Near Threatened 3(NT). High numbers of *Phalacrocorax pygmaeus* were observed in winter 2010-2011 at the Talimardzhan Reservoir and SGCC Reservoir next to the project site. In 2017 a single individual was observed in early summer near SGCC Reservoir.

8.3.5.20. PODICEPS AURITUS (HORNED GREBE)

This species is found in the Palearctic and Nearctic. It breeds from Iceland and the Baltic to Kamchatka, Russia, wintering from the North Sea to the Caspian Sea and off Japan to China. The species breeds on small, shallow waters with rich floating vegetation. Habitats include small pools, marshes with patches of open water and sheltered sections of larger lakes and rivers. In its wintering range the species prefer coastal inshore waters including sheltered bays, lagoons and estuaries, but may also occur on large lake and river systems south of its breeding range (BirdLife International 2016). *Podiceps auritus* is included in the IUCN Red List [VU]. Large numbers of *Podiceps auritus* were observed in Talimardzhan reservoir in winter 2010-2011.

8.3.5.21. STREPTOPELIA TURTUR (EUROPEAN TURTLE-DOVE)

Streptopelia turtur is a widespread migrant breeder across much of central and southern Europe, Central Asia, the Middle East and North Africa, wintering mainly in the Sahel zone of Africa. The species prefers a wide variety of woodland types, as well as steppe and semi-desert. It uses hedges, borders of forest, groves, young tree plantations, scrubby wasteland, woody marshes, scrub, all with agricultural areas nearby for feeding. *Streptopelia turtur* tolerates humans but does not breed close to towns or villages. It generally breeds at low altitudes (BirdLife International 2016). *Streptopelia turtur*

is included in the IUCN Red List [VU]. The species have been observed during spring migration near Talimardzhan reservoir in 2010.

8.3.5.22. VANELLUS (CHETTUSIA) GREGARIA (SOCIABLE LAPWING)

Vanellus gregaria is a migratory species. The areal includes southern Aral region, Kattakurgan, Chardara water reservoir, Lake Aydar, mid-stream of the River Syrdarya (migration). It is reported to occupy banks of reservoirs and marshes in the flat wetlands. Historic data from 1970 -80s shows that flocks of 10-20 individuals were recorded on migration, currently single birds or small groups of 3-5 birds are recorded on migration. *Vanellus gregaria* is included in the IUCN Red List [CR] and Red Book of Uzbekistan as Vulnerable, naturally rare 2(VU:R). Destruction of habitats as a result of water regime changes in southern Aral region and reclamation of steppes in Kazakhstan are considered to be the main factors contributing to the decline of population numbers. About 200 *Vanellus gregaria* were observed moving and feeding on migratory stopover in steppe habitat near the project site area in October 2010.

8.3.5.23. VANELLUS VANELLUS (NORTHERN LAPWING)

The species breeds from Europe, Turkey and north-west Iran through western Russia and Kazakhstan to southern and eastern Siberia, Mongolia and northern China. It winters from Western Europe, the east Atlantic islands and North Africa through the Mediterranean, Middle East and Iran across northern India to south-east China, the Korean peninsula and southern Japan. The species shows a preference for breeding on wet natural grasslands with short swards and patches of bare soil at low altitudes (less than 1,000 m). It will also breed on grassy moors, swampy heaths, bogs and arable fields. During the winter the species uses large open pastures for roosting and forages on grassland, irrigated land, stubble and ploughed fields, riverbanks, lake shores, marshes, drainage ditches (BirdLife International, 2016). *Vanellus vanellus* is included in the IUCN Red List [NT]. One occasional observation was registered around the project area in spring 2010.

8.3.5.24. SURVEY SUMMARY

The data collected confirms that the surveyed area may be considered important for the biodiversity of predatory birds. The survey data confirmed that *Neophron percnopterus* is breeding in the Gizzar foothills and spread over the surveyed area during post-breeding period. *Aquila chrysaetos* is regularly observed in the area, which points at presence of the breeding territories in the area. The SGCC Reservoir next to the project area is used by *Circus aeruginosus* during breeding season and roosting for the rest of the year. The species tend to move between the water reservoirs and steppe habitats during the day. Area to the west of the existing plant is being used by *Falco tinnunculus* and *Athene noctua*. During spring migration birds of prey are regularly seen, but rarely make a stop-over, while stop-overs during autumn migration are regular close to the main road and east to the site (Golder Association ESHSIA 2013).

A few other species of conservation concern were observed during the surveys, including *Egretta garzetta, Ciconia ciconia, Anser erythropus, Phalacrocorax pygmaeus*, and *Vanellus* (Chettusia) *gregaria*. The importance of the area for Passerine migrants was confirmed for spring and autumn. In

April 2010 a large roost of *Pastor roseus* was observed in the SGCC Reservoir next to the project site, where the estimate of birds was 200,000 - 400,000 birds (Golders, 2014).

8.3.6 Mammals

Species of fauna found in Uzbekistan include groups which in the historical past have migrated here from other regions, including Central Asian deserts and mountains, Indo-China, grasslands of Kazakhstan, Siberia, South Europe and North Africa. Currently there are 108 species of mammals in Uzbekistan. Out of 108 species 23 species could be observed in Karshi Steppe and particular the project area and surrounded territory. Those 23 species are presented in Table 36.

Table 36: List of mammal species that could be observed in Karshi Steppe (Source: Golders, 2014)

Ref.	Species		Red Book of Uzbekistan*	IUCN Status**
1	*Allactaga elater*	Small Five-toed Jerboa	-	LC
2	*Allactaga severtzovi*	Severtzov's Jerboa	-	LC
3	*Cricetulus migratorius*	Gray Dwarf Hamster	-	LC
4	*Crocidura suaveolens*	Lesser White-toothed Shrew	-	LC
5	*Ellobius tancrei*	Eastern Mole Vole	-	LC
6	*Eptesicus bottae*	Botta's Serotine	-	LC
7	*Felis silvestris*	Wildcat	-	LC
8	*Gazella subgutturosa*	Goitered Gazelle	2 VU:D	VU
9	*Hemiechinus auritus*	Long-eared Hedgehog	-	LC
10	*Hemiechinus hypomelas*	Brandt's Hedgehog	3 NT	LC
11	*Lepus tolai*	Tolai Hare	-	LC
12	*Meriones libycus*	Libyan Jird	-	LC
13	*Miniopertus fuliginosus*		-	LC
14	*Mus musculus*	House Mouse	-	LC
15	*Pipistrellus pipistrellus*	Common Pipistrelle	-	LC
16	*Pygeretmus pumilio*	Dwarf Fat-tailed Jerboa	-	LC
17	*Rattus norvegicus*	Brown Rat	-	LC

Ref.	Species		Red Book of Uzbekistan*	IUCN Status**
18	*Rhombomys opimus*	Great Gerbil	-	LC
19	*Spermophilopsis leptodactylus*	Long-clawed Ground Squirrel	-	LC
20	*Spermophilus fulvus*	Yellow Ground Squirrel	-	LC
21	*Vormela peregusna*	Marbled Polecat	-	VU
22	*Vulpes corsac*	Corsac Fox	-	LC
23	*Vulpes vulpes*	Red Fox	-	LC

**Red Book of Uzbekistan: 2 - species could be assessed as Vulnerable: Declining (VU:D) when their vital parameters decline or fluctuate widely and rapidly, and also as Vulnerable: Naturally Rare (VU:R) =VU D, E criteria of IUCN), if their vital parameters are restricted. A species is Vulnerable when its vital parameters are not so far from the critical levels (or might be not so far to them in the uncertain future with a medium probability) and it is therefore considered to be facing a medium risk of extinction in the wild. 3 - Near Threatened. A species is Near Threatened when its vital parameters are relatively far from the critical levels now, but might approach them in near or uncertain future with some probability and it is therefore considered to be facing a potential risk of extinction in the wild.*

***IUCN: VU – Vulnerable. LC – Least Concern.*

During the survey in the project area and adjacent territories only the following species listed in Table 36 have been observed: *Spermophilus fulvus* (Yellow Ground Squirrel), *Lepus tolai* (Tolai Hare), *Vulpes corsac* (Corsac Fox) and *Hemiechinus auritus* (Long-eared Hedgehog). In addition to that a Kangaroo Rat was observed (*Dipodomys sp* - species not identified) and evidence of presence of large carnivore, probably stripped hyena (*Hyaena hyaena*). *Hyaena hyaena* is locally distributed subspecies. It has been observed in Kugitang and Babatag ranges, in the upper part floodplain of the Amudarya River. Main habitats are arid hilly foothills, dry riverbeds and rare tree-shrub vegetation. Historic data shows that in 1980s-1990s about 10 animals have been recorded. *Hyaena hyaena* is included in the IUCN Red List [NT] and Red Book of Uzbekistan as Critically Endangered. Main threats are considered to be destruction of habitats as a result of water-regime changes in the river valleys, disturbance from human activities in mountain valleys and poaching (Red Book of Uzbekistan, 2009).

During the survey in May-July 2017 the following mammal species have been observed: Small Five-toed Jerboa (*Allactaga elater*), Libyan Jird (*Meriones libycus*), Cape Hare (*Lepus capensis*), Golden Jackal (*Canis aureus*), Tolai Hare (*Lepus capensis spp tolai*), Long-eared Hedgehog (*Hemiechinus auritus*), Fox (*Vulpes vulpes*), Muskrat (*Ondatra zibethicus*).

8.4 Aquatic Ecology

8.4.1 Overview

Uzbekistan is a country of predominately arid desert climate. In the north it is occupied by the Ust-Ert plateau, in the north-east by sandy desert Kyzylkum, and in the south-east by mountain ranges. Most of the countries' water is coming from rainfall and snowmelt from the mountains. The reservoirs normally start being filled in March-April time and reach the highest level in 40-80 days. The reservoirs are drained for irrigation during the summer and reach minimum water level by September (Kamilov & Urchinov, accessed on 9/12/2016).

The hydrological pattern and water chemical composition are satisfactory for fish, even though water salinity gradually increases from foothills to lowlands.

It was estimated that there are 819 (561 species – littoral, 132 – semi-submersed, 128 – submersed) species of aquatic and wetland plants in Central Asia, of which 39 belong to Chara genus, 62 – mosses, 17 – ferns and 701 are vascular flowering plants. Many of these macrophytes are present in Uzbekistan. Rotifers, cladocerans and copepods dominate amongst zooplankton species. Composition of benthos species is various depending on a water body and season (Kamilov & Urchinov, accessed on 9/12/2016).

The closest water bodies located to the project site is the SGCC Reservoir in the northern border of the site and irrigation canals. The water level in the reservoir is determined by precipitation and water uptake for plant needs, if required.

8.4.2 Plankton and Benthos

By the type of consumption of mineral elements and skeleton structure, the plankton consists of silicon organisms (diatom algae and radiolarian), calcareous organisms (Coccolithaceae algae) and the archaeal foraminiferas. In the SGCC Reservoir the phytoplankton is represented by green and blue-green algae.

Among floating and benthic algae the following were registered:

- Charophyta, Charophyceae, *Chara fragilis Desvaux* (sinker);
- Charophyta, Charophyceae, *Ceratophyllum demersum* (morass-weed);
- Charophyta, Charophyceae, *Chara vulgaris* (stonewort);
- Chlorophyta, *Potamogeton crispus* (curly-leaved pondweed);
- Chlorophyta (Chlorella), green algae;
- Cladophora, green algae (capillary form Chlorophyta).

The zooplankton is represented by Daphnia, Cladocera, Copepoda, Rotifera (rotifers) and Pandalus shrimp. Transparency of plankton reaches up to 1.5-3 meters.

Benthos is represented by *Dreissena polymorpha* and *Adacna minima*. *Cardium edule* was also recorded. Oligochaetes, nematodes (1—2 g/m^2) and larva of chironomids and larva of tendepedidae were registered on silts.

8.4.3 Fish

According to Red Book of Uzbekistan, there are endangered aquatic invertebrates species in the Kashkadarya river basin. Red listed fish species that could be observed in Kashkadarya river basin are presented in Table 37.

Table 37: List of protected fish species in Kashkadarya river basin (Source: Red Book of Uzbekistan, 2009)

Ref.	Species		Red Book of Uzbekistan*	IUCN Status**
1	*Aspiolucius esocinus*	Pike Asp	1 (EN)	VU
2	*Barbus brachycephalus ssp. brachycephalus*	Aral Barbel	1 (EN)	Not assessed
3	*Barbus capito ssp. conocephalus*	Turkestan Barbel	2 (VU:D)	Not assessed
4	*Capoetobrama kuschakewitschi*	Ostroluchka (Chu Sharpray)	2 (VU:D)	DD
5	*Pseudoscaphirhynchus hermanni*	Dwarf Sturgeon	1 (CR)	CR
6	*Pseudoscaphirhynchus kaufmanni*	False Shovelnose Sturgeon	1 CR	CR
7	*Sabanejewia aurata ssp. aralensis*	Aral Goldside Loach	3 (NT)	Not assessed

**Red Book of Uzbekistan: 1 - species could be assessed as Critically Endangered (CR) or Endangered (EN). A species is Critically Endangered when its vital parameters reached the critical levels (or might reach them in the immediate future with the highest probability) and it is therefore considered to be facing an extremely high risk of extinction in the wild. A species is Endangered when its vital parameters are close to the critical levels (or might be close to them in the near future with a high probability) and it is therefore considered to be facing a high risk of extinction in the wild. 2 - species could be assessed as Vulnerable: Declining (VU:D) when their vital parameters decline or fluctuate widely and rapidly, and also as Vulnerable: Naturally Rare (VU:R) =VU D, E criteria of IUCN), if their vital parameters are restricted. A species is Vulnerable when its vital parameters are not so far from the critical levels (or might be not so far to them in the uncertain future with a medium probability) and it is therefore considered to be facing a medium risk of extinction in the wild. 3 - Near Threatened. A species is Near Threatened when its vital parameters are relatively far from the critical*

levels now, but might approach them in near or uncertain future with some probability and it is therefore considered to be facing a potential risk of extinction in the wild.

***IUCN: CR – Critically Endangered. VU – Vulnerable. NT- Near Threatened. DD – Data Deficient*

8.4.3.1. ASPIOLUCIUS ESOCINUS (PIKE ASP)

Aspiolucius esocinus is a locally distributed Turkestan endemic relict species. It was registered in flat land reservoirs, rivers with sandy and stony bottom (2-3 m deep). Typical habitat includes muddy waters, occasionally stagnant waters. The population number sharply decreased in the last decades. *Aspiolucius esocinus* is included in the IUCN Red List [VU] and Red Book of Uzbekistan as Endangered. Main threats are considered to be destruction of natural regime of river flows as a result of work of hydro power stations, land reclamation, pollution of rivers with run-off waters from agricultural fields.

8.4.3.2. BARBUS BRACHYCEPHALUS SSP. BRACHYCEPHALUS (ARAL BARBEL)

Barbus brachycephalus ssp. brachycephalus is a locally distributed Aral endemic subspecies. It has been recorded in the basin of lower reaches and mid-stream of the River Amudarya, in the past, the Aral Sea and Syrdarya, Zaravshan, Kashkadarya river basins. Typical habitat comprises deep sections (2-4 m) of the rivers with sandy and stony bottom, muddy streams, occasionally stagnant waters. The population number sharply decreased in the last decades. *Barbus brachycephalus ssp. brachycephalus* is included in The Red Book of Uzbekistan as Endangered. Destruction of natural regime of river flows as a result of hydro power stations work and land-reclamation, pollution of rivers with run-off from agricultural fields and poaching are considered to be the main factors contributing to the decline of population numbers.

8.4.3.3. BARBUS CAPITO SSP. CONOCEPHALUS (TURKESTAN BARBEL)

Barbus capito ssp. conocephalus is an Aral endemic subspecies. It has been registered mid-stream of the Amudarya, Syrdarya, Zaravshan, Kashkadarya and Surkhandarya rivers and Aral Sea in the past. Typical habitat comprises deep (2-3 m) sections of water reservoirs with sandy stony or sandy-pebble bottom. Population numbers sharply decreased in the last decade. *Barbus capito ssp. conocephalus* is included in the Red Data Book of Uzbekistan as Vulnerable, declining 2(VU:D). Main factors contributing to the decline of population numbers include destruction of natural regime of river flows as a result of land-reclamation measures, pollution of rivers with run off from agricultural field, destruction of breeding grounds, competition with invasive fish species, and poaching.

8.4.3.4. CAPOETOBRAMA KUSCHAKEWITSCHI (OSTROLUCHKA (CHU SHARPRAY))

Capoetobrama kuschakewitschi is a Turkestan endemic relict species. It has been recorded in the Kashkadarya and Surkhandarya rivers, reservoirs of the mid-stream and lower reaches of the Zaravshan River and from the Syrdarya River in the past. Typical habitat comprises reservoirs with

sandy and stony bottom and muddy streams. The population numbers dropped in the last decade. *Capoetobrama kuschakewitschi* is included in the IUCN Red List [DD] and Red Book of Uzbekistan as Vulnerable, declining 2(VU:D). Main factors contributing to the decline of population numbers include destruction of natural regime of river flows as a result of land-reclamation measures, pollution of rivers with run-off from agricultural fields, destruction of breeding grounds, and competition with invasive fish species.

8.4.3.5. PSEUDOSCAPHIRHYNCHUS HERMANNI (DWARF STURGEON)

Pseudoscaphirhynchus hermanni is a local Amudarya endemic relict species. It has been recorded in the Amudarya River, Kashkadarya basin, Bukhara and Surkhandarya regions. It prefers deep (2-3 m) section of the river with sandy and stony bottom in muddy waters. The last individual was caught in 2002. It is included in the IUCN Red Data List [CR], Appendix II of CITES and Red Book of Uzbekistan as Critically Endangered. Destruction of natural regime of the River Amudarya as a result of construction and work of hydro power stations and land-reclamation, pollution of rivers with run-off are considered to be main factors contributing to the population decline.

8.4.3.6. PSEUDOSCAPHIRHYNCHUS KAUFMANNI (FALSE SHOVELNOSE STURGEON)

Pseudoscaphirhynchus kaufmanni is an Amudarya endemic relict species. It is recorded in the River Amudarya, Kashkadarya, Zarafshan. Latest data shows records in Khoresm, Bukhara and Surkhandarya regions. It prefers deep sections (2-3 m) of the river with sandy and clayey soils in muddy waters. *Pseudoscaphirhynchus kaufmanni* is included in the IUCN Red List [CR], Appendix II of CITES and in the Red Book of Uzbekistan as Critically Endangered. Destruction of natural regime of the River Amudarya as a result of hydro power plants construction and land-reclamation measures, pollution of rivers with run-off are considered to be main factors contributing to the population decline.

8.4.3.7. SABANEJEWIA AURATA SSP. ARALENSIS (ARAL GOLDSIDE LOACH)

Sabanejewia aurata ssp. aralensis is an Aral endemic subspecies. It has been recorded in the basin of the Amudarya, Syrdarya, Kashkadarya and Zarafshan rivers. Typical habitat comprises shallow bays of rivers and lakes, springs, preferable sandy-silt bottoms. In the last decade the numbers have been decreasing in the basins of the Syrdarya and Zarafshan rivers and in reservoirs in the south of Uzbekistan. *Sabanejewia aurata ssp. aralensis* is included in the Red Book of Uzbekistan as Near Threatened. Destruction of the natural regime of river flows as a result of hydro power plant construction and land-reclamation measures, pollution of rivers with run-off from agricultural fields, competition with invasive fish species are considered to be factors contributing to the population decline.

8.4.3.8. SURVEY SUMMARY

The following species were registered during the survey in 2017 on SGCC Reservoir:

- *Cyprinus carpio* (common carp);

- *Carassius carassius* (crucian carp);
- *Sander lucioperca* (zander);
- *Sirilus glanis* (catfish).

The size and mass of fish varies, e.g. *Cyprinus carpio* (2.5 – 3.5 kg), *Sirilus glanis* (5 – 25 kg). This indicates high productivity of plankton for *Cyprinus carpio, Carassius carassius* and benthos for *Sirilus glanis*.

No Red Book species of aquatic flora and fauna were observed in SGCC Reservoir.

8.5 Presence of Critical Habitats

The survey undertaken by the research staff of Karshi State University from May 05 to July 05 2017 confirmed the presence of three main habitats in the area:

- Desert habitat;
- Steppe habitat; and
- The SGCC Reservoir.

Desert habitat is characterised by mostly sandy, sometimes saline soils. The diversity of flora is poor. The main communities are represented by white haloxylon (saxaul) - *Poa pratensis* (meadow grass), *Carex rostrata* (beaked sedge). Other species recorded include: *Peganum harmala, Alhagi camelorum, Galinsoga parviflora, Cirsium, Eremopýrum bonaopartis, Echinops leiopolyceras, Carthamus oxyacanthus, Astragalus Carthamus oxyacanthus, Capparis herbacea, Cuminum cyminum.*

8.5.1 Desert Habitat

The following species were recorded in the desert habitat in the Study Area:

Mammals:

- *Allactaga eiater* (Small five-toedjerboa);
- *Citellus fulvus* (Yellow ground squirrel); and
- *Meriones libycus* (Lybian jirt).

Reptiles:

- *Agrionemys horsfleldi* (Central Asian tortoise);
- *Phrynocephalus helioscopus* (Sunwacther);
- *Varanus griseus* (Gray monitor) – Red Book of Uzbekistan Category 2VU:D; and
- *Naja oxiana* (Asian cobra) – Red Book of Uzbekistan Category 3, IUCN DD.

Birds:

- *Delichon urbicum* (Common house martin);
- *Passer montanus* (tree sparrow);
- *Pica pica* (Magpie);
- *Accipiter nisus* (Eurasian sparrow-hawk);
- *Upupa epops* (Hoopoe);
- *Galerida cristata* (Crested lark); and
- *Circus macrourus* (Pale harrier), Red Book of Uzbekistan Category 3, IUCN NT.

Invertebrates:

- *Eleodes* (pinacate beetle);
- *Carabus* (ground beetle);
- *Scorpionida* (scorpion);
- *Noctuidae* (noctuid);
- *Sphecidae* (dauber);
- *Isoptera* (termite);
- *Polyphaga aegyptica*;
- *Solifugae*;
- *Tarantulidae fam* (tarantula); and
- *Glaucopsyche charibdis* (Blue tugay).

Desert habitat within the Study Area is not considered to be Critical Habitat according to the PS6 Critical Habitat assessment presented in Table 38.

Table 38: Critical Habitat Assessment for Desert Habitat

Criterion	Definition	Assessment
1	Habitat of significant importance to CR and/or EN species.	No Critically Endangered and/or Endangered flora or fauna species were recorded in the Study Area.
2	Habitat of significant importance to endemic and/or restricted-range species	No endemic and/or restricted-range flora or fauna species were recorded in the Study Area.
3	Habitat supporting globally significant concentrations of migratory species and/or congregatory species	No potential migratory or congregatory species were observed in the Study Area.

Criterion	Definition	Assessment
4	Highly threatened and/or unique ecosystems	This vegetation type is common over large areas of the southern Uzbekistan steppe (Golders, 2014).
5	Areas associated with key evolutionary processes	The area is not associated with key evolutionary processes. The area is characterised by uniform landscape. No endemic and/or restricted-range flora or fauna species were recorded in the area.

8.5.2 Steppe Habitat

Steppe habitat is characterised by light grey soil. The main vegetation communities are represented by *Pseudohandelia umbellifera - Poa pratensis*, cumin and white haloxylon (saxaul). Other dominant species include *Peganum, Alhagi camelorum (alhagi), Lappula microcarpa, Eremopýrum bonaopartis, Echinops leiopolyceras, Papaver pavoninum, Arnebia*. The condition of vegetation community is considered to be satisfactory. The following species were recorded in the desert habitat:

Mammals:

- *Vulpes vulpes* (fox);
- *Hemiechinus* (eared hedgehog);
- *Allactaga elater* (little jerboa);
- *Citellus fulvus* (Aral yellow souslik); and
- *Meroines libycus* (Libyan jird).

Reptiles:

- *Agrionemys horsfleldi* (Central Asian tortoise);
- *Pseudopus apodus* (glass-lizard); and
- *Phrynocephalus helioscopus* (sunwacther).

Birds:

- *Delichon urbicum* (Common house martin);
- *Passer montanus* (Tree sparrow);
- *Acrydoteres* (Myna);
- *Streptopelia senegalensis* (Laughing dove);
- *Pica pica* (Magpie);
- *Apus apus* (Common swift);

- *Accipiter nisus* (Eurasian sparrow-hawk);
- *Upupa epops* (Hoopoe);
- *Coturnix coturnix* (Quail); and
- *Galerida cristata* (Crested lark).

Invertebrates:

- *Eleodes sp*. (Pinacate beetle);
- *Carabus sp*. (Ground beetle);
- *Scorpionida* (Scorpion);
- *Noctuidae* (Noctuid);
- *Sphecidae* (Mud dauber);
- Isoptera (Termite);
- *Polyphaga aegiptiaca*;
- Solifugae; and
- Tarantulidae (tarantula).

Steppe habitat within the Study Area is not considered to be Critical Habitat according to the PS6 Critical Habitat assessment presented in Table 39.

Table 39: Critical Habitat Assessment for Steppe Habitat

Criterion	Definition	Assessment
1	Habitat of significant importance to CR and/or EN species.	No Critically Endangered and/or Endangered flora or fauna species were recorded in the Study Area.
2	Habitat of significant importance to endemic and/or restricted-range species	No endemic and/or restricted-range flora or fauna species were recorded in the Study Area.
3	Habitat supporting globally significant concentrations of migratory species and/or congregatory species	No potential migratory or congregatory species were observed in the Study Area.
4	Highly threatened and/or unique ecosystems	This vegetation type is common over large areas of the southern Uzbekistan steppe (Golders, 2014).

Criterion	Definition	Assessment
5	Areas associated with key evolutionary processes	The area is not associated with key evolutionary processes. The area is characterised by uniform landscape. No endemic and/or restricted-range flora or fauna species were recorded in the area.

8.5.3 The SGCC Reservoir

The reservoir is covered by candle brushes 3-4.5 m high. The reservoir provides habitat for one species of amphibians *Bufo veridis* (green toad), and reptiles *Natrix tesselata* (dice snake) and mammals *Myocastor coypus* (nutria).

The following species of birds have been observed around the reservoir:

- *Anthropoides virgo* (Demoiselle crane);
- *Oriolus* (Oriole);
- *Gallinula chloropus* (Grey moorphen);
- *Ardea cinerea* (Common heron);
- *Alcedo atthis* (Kingfisher);
- *Sterna hirundo* (Common tern);
- *Motacilla personata* (Masked wagtail);
- *Fulica atra* (Eurasian coot); and
- *Phoenicurus erythronotus* (Eversmann's redstart).

Single bird of Uzbekistan Red Book species: *Phalacrocorax pygmaeus* (little cormorant) has been observed once on the SGCC Reservoir during the survey in 2017.

The SGCC Reservoir is not considered to be Critical Habitat according to the PS6 Critical Habitat assessment presented in Table 40.

Table 40: Critical Habitat Assessment for the SGCC Reservoir Habitat

Criterion	Definition	Assessment
1	Habitat of significant importance to CR and/or EN species.	No IUCN Critically Endangered and/or Endangered flora or fauna species were recorded in the Study Area.

Criterion	Definition	Assessment
2	Habitat of significant importance to endemic and/or restricted-range species	No endemic and/or restricted-range flora or fauna species were recorded in the Study Area.
3	Habitat supporting globally significant concentrations of migratory species and/or congregatory species	No potential migratory or congregatory species were observed in the Study Area.
4	Highly threatened and/or unique ecosystems	This type of habitat is not unique
5	Areas associated with key evolutionary processes	The area is not associated with key evolutionary processes. The area is characterised by uniform landscape. No endemic and/or restricted-range flora or fauna species were recorded in the area.

8.6 Ecosystem Services

HOLD: Awaiting inputs from socio-econonic assessment

The definition of Ecosystem Services (ES) provided in IFC PS6 is taken from the Millennium Ecosystem Assessment (MEA 2005). This identified ES as “Humankind benefits from a multitude of resources and processes that are supplied by ecosystems”. In this study, ES are discussed in three categories:

- Provisioning services;
- Regulating services; and
- Cultural services.

The environment provides food, water and air that are essential to life, and the minerals and raw materials for consumption and industry. ES also include the processes that purify air and water, provide clean drinking water and sequester and break down wastes. The environment also provides recreational, health and cultural benefits to mankind.

A fourth category known as ‘Supporting’ services, are the services that are necessary for the production of all other ES, such as photosynthesis, soil formation and nutrient cycling (MEA 2005). For the purposes of this study, supporting services are considered integrated within the other three categories and are not assessed separately. Priority ES within the Project area of influence (AoI) have been identified in accordance with IFC PS6. There are two priority types of ES:

- Services in which project construction, operation and decommissioning are most likely to impact, and therefore, result in adverse impacts to affected communities; and

- Services in which the project is directly dependent upon for its construction, operation and decommissioning, for example freshwater.

8.6.1 Provisioning services

Provisioning services are the products obtained from an ecosystem (MEA, 2005). The variety of provisioning services relevant to the Project AoI is displayed in and discussed below.

Table 41: Provisioning ecosystem services within the Project AoI

Provisioning	Relevance to the Study Area
Agriculture	Cultivating crops
Livestock	Grazing by cattle
Wild foods	Wild plants
Hunting	Hunting for food
Freshwater	Freshwater used by grazing cattle and local people Freshwater provision to facility
Bio-chemicals, natural medicines, and pharmaceuticals	Collection of medicinal plants

8.6.2 Agriculture

The region where the Project is located is one of the largest agricultural areas in the country (Golders, 2014). The agricultural products include cotton, wheat, fodder crops, fruits, and vegetables. The Karshi province has about 514,000 ha of farmland. The population is about 3 million, of which about 60% live in rural areas and depend on agriculture (Golders, 2014).

HOLD: Awaiting inputs from Social Baseline Assessment

8.6.3 Livestock

The adjacent lands to the project site are used by local people as pastures for grazing cattle and sheep. The economy of the closest settlements to the Project in the region, are largely based on raising animals. Currently, the only employment opportunity that pays salaries to its employees in the villages is the SGCC (Golders, 2014).

HOLD: Awaiting inputs from Social Baseline Assessment

8.6.4 Edible Plants

HOLD: Awaiting inputs from Social Baseline Assessment

8.6.5 Hunting

HOLD: Awaiting inputs from Social Baseline Assessment

8.6.6 Freshwater

The major water consumer in Kashkadarya is agriculture, with 514,000 ha of farmland under irrigation. Freshwater resources are utilized by local populations, the cattle herders along their migration routes. Freshwater will also have great importance to the proposed facility for drinking and process usage.

The available surface water resource in the Amu Darya River is estimated at an average 78 billion m3/year, and varies between 58 and 108 billion m^3/year (Golder, 2014). The project water supply will be provided from the Karshi Main Canal. The Karshi Main Canal supplies irrigation water to extensive agricultural areas around Karshi in Uzbekistan, via the Talimardzhan Reservoir (Golders, 2014).

8.6.7 Biochemicals, natural medicines and pharmaceuticals

HOLD: Awaiting inputs from Social Baseline Assessment

8.7 Regulating services

Regulating services are the benefits obtained from the regulation of ecosystem processes (MEA 2005). The variety of regulating Ecosystem Services operating within the Project AoI is presented in Table 42.

Table 42:Regulating Ecosystem Services relating to the Project AoI

Regulating	Relevance to the Study Area
Air quality regulation	Clean air
Regional/local climate regulation	Microclimates
Water regulation	Hydrology and water tables.

Regulating	Relevance to the Study Area
Erosion regulation	Vegetation cover reducing erosion due to disturbance
Water purification and waste treatment	Disposal of plant waste
Disease regulation	Naturally functioning ecosystems generally self-regulating against disease / pathogens
Pest regulation	Naturally functioning ecosystems generally self-regulating against pests.
Pollination	Pollination important for wild food production
Natural hazard regulation	Vegetation cover, un-impacted soils and natural drainage

8.7.1 Air quality regulation

Ecosystems interact directly with the atmosphere. They emit chemicals to the atmosphere i.e. by acting as a source, or extract chemicals from the atmosphere i.e. acting as a sink. Any widespread alterations in vegetation composition and cover can have an adverse impact on its climate regulating function.

8.7.2 Global climate regulation

Ecosystems regulate climate by controlling the flux of greenhouse gases (principally carbon dioxide, but also methane and nitrous oxide), sources of aerosols and the transfer of heat and moisture, into and out of the earth's atmosphere.

8.7.3 Regional/local climate regulation

Ecosystems can influence local and regional climate through a variety of different processes. These include:

- The rates of photosynthesis;
- Evapotranspiration and water vapour entering the atmosphere;
- Changes in albedo; and
- The production of aerosols by soil erosion and vegetation.

8.7.4 Water regulation

Ecosystems can influence the magnitude and timing of flooding, aquifer recharge and water runoff, particularly in terms of the water storage potential of the landscape or ecosystem.

8.7.5 Erosion regulation

The integrity of ecosystems and in particular its plant cover can retain the structure of soils, and replenish soil and sand deposits.

8.7.6 Water purification and waste treatment

Water purification is a key service provided by ecosystems. Pollutants such as excess nutrients, metals, oils and viruses are processed and filtered out as water moves through wetland areas, forests and riparian zones. This purification process provides clean drinking water and water suitable for wildlife habitat, recreation and industrial uses.

8.7.7 Pollination

Many species of insect, birds and mammals provide key pollination services. Pollinators play a critical role in maintaining natural plant communities, crop production and ensuring the production of seeds in most flowering plants. The use of wild food and medicinal plants can be affected by changes in the levels of pollination as well as the availability of certain plants used by reindeer herders for fodder.

8.7.8 Natural hazard regulation

The integrity and dynamics of an ecosystem has the ability to reduce the damage caused by natural events such as floods, storms, fires and landslides.

8.8 Cultural services

Cultural Ecosystem Services can be defined as the ‘nonmaterial benefits people obtain from ecosystems through spiritual enrichment, reflection, recreation, aesthetic experiences and cognitive development’ (MEA, 2005). Table 43 lists the elements that are classified as cultural services including their relevance.

Table 43: Cultural ecosystem services relating to the Project AoI

Cultural	Relevance to the Study Area
Sacred or spiritual sites	Sacred sites present

Cultural	Relevance to the Study Area
Areas used for religious purposes	Area used for religious purposes
Recreational value	Area currently not used for recreational purposes
Ecotourism areas	Area currently not used for tourism, but new infrastructure could be used in future for eco-tourism
Aesthetic value	Area appreciated by local people

8.8.1 Sacred or worshipped sites

The Gulshan Mosque (1730), a monument in the Guzar district, is the closest site of cultural significance. However, it falls outside of the zone of influence of the Project. Site inspections conducted for the baseline study in 2010 confirmed the absence of in situ cultural layers, building materials or other indicators of settled human activity. (Golders, 2014)

8.8.2 Recreational value

The importance of natural environments for maintaining physical and mental health is highly recognized. However, the area is not currently utilized for recreational purposes, and there is very limited scope for change during the project lifetime due to the lack of transport and infrastructure.

8.8.3 Ecotourism areas

Ecotourism has the potential to provide economic benefits to regional and local economies. However within the Study Area, there are currently no established practices in ecotourism within the Study Area.

8.8.4 Aesthetic value

Ecosystems are important for educational and scientific purposes, personal meaning and sentimental value, as well as informing art and culture. The aesthetic value of the area can be enjoyed by both the local peoples and project workers.

9. SOCIO-ECONOMIC BASELINE

9.1 Introduction

Chapter 9 presents a summary of the socioeconomic baseline for the SGCCUP and surrounding region, covering administrative structure, population and demography, economic outputs, employment structure and livelihoods, education and literacy, community health, regional landuse, infrastructure, transportation and cultural heritage.

9.1.1 General Overview

The Project site is located in the territory of the Nishan District in the Kashkadarya Region. The site lies approximately 430 km from Tashkent and 33 km south west of the City of Karshi. The area of the Project site is undeveloped and non-agricultural at present (Golders, 2014). The closest formal agricultural activity (primarily cotton cultivation) is within the Navbahor Village, located approximately 7 km from the Project (Golders, 2014).

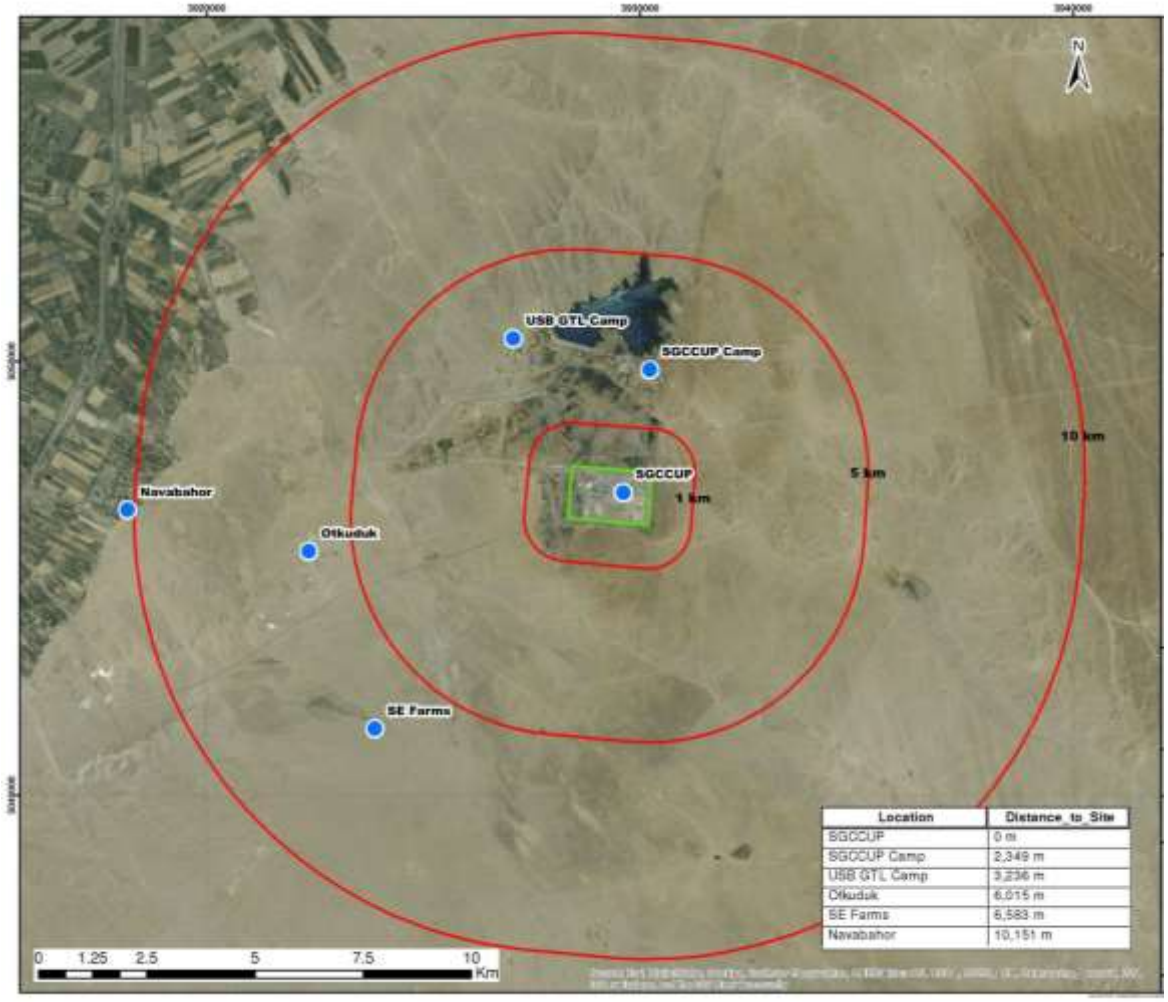
Existing services and infrastructure available to the proposed Project include a serviced railway and the national power grid. Water is supplied directly from the KMC with back-up water supply from the SGCC Reservoir located less than 4 km away from the site.

There are several settlements within a 10km radius of the project site (Figure 26). The settlement of Otkuduk is located within the Nishon District and is located approximately 6 km from the project site. The village of Navbahor also lies within the Nishon District and is located just over 10 km from the project site.

Two work camps are within close proximity to the Project site. The SGCC workers camp lies 2.4 km north-east of the project and the GTL workers camp approximately 3.2 km north-west of the project. Arable farmland lies 6.6 km south-west of the project site.

The regional area of influence of the project within the Kashkadarya Region, is currently underdeveloped, with the highest poverty rate and proportion of the population considered to be ‘disadvantaged’ of all regions in Uzbekistan. The livelihoods of the communities within the regional area of influence of the project rely primarily on livestock farming. However, unemployment rates within the region are lower than the national average in Uzbekistan. The transport, health, water and energy infrastructure within the region are limited and prove a limiting factor to development within the region.

The Kashkadarya Region is known for its wealth of natural resources with the largest fields of hydrocarbons in the country with two of the largest enterprises in Uzbekistan, the SGCC and the Muburak Gas Processing Plant (Golders, 2014). There is currently a shortage of people with qualifications to work within industrial facilities within the region.



26. Settlements within the proximity of the site (Based on Golders, 2014)

9.1.2 Baseline Survey & Data Collection

The socio-economic environment information provided herein is referenced directly from the Oltin Yo'l Gas to Liquids Project Environmental, Social, Health and Safety Impact Assessment (Golders, 2014), and relied upon in this baseline assessment. WorleyParsons have not conducted any in-country stakeholder engagement or disclosure activities to obtain data for use in the ESIA.

A dedicated socio-economic study was undertaken by Golders in 2010-2014. The study consisted of primary data collection involving fieldwork surveys and interviews and secondary data collection in the form of desktop studies and literature review. Secondary data collection was further carried out by Advisian in 2016-2017 in order to update current information.

Primary data on the socioeconomic setting of the SGCC was collected by Golders (2014) using the following methods:

- Interviews: structured and semi-structured, expert/key informant; and

- Personal histories and case studies collected through interviews.

Golder (2014) conducted interviews with 70 stakeholders, including permitting officials, regional and local government authorities, international and Uzbekistan NGOs, and residents in the settlements closest to the project site.

Individual household surveys within nearby settlements were not considered necessary by Golders, with the exception of a single household, of which two individuals were living who were using the buildings of the project area as part of their employment duties with the Forestry Department.

The following secondary data and qualitative information collected during surveys has been considered to be sufficient for understanding the existing conditions and trends.

Secondary data sources utilised in this report include:

- World Bank Group Reports;
- United Nations Human Development Index;
- United Nations reports, Development Frameworks and the Welfare Improvement Strategy of the Republic of Uzbekistan;
- NGO reports and information;
- National and regional statistical agencies, as available;
- National, regional or local development plans, as available; and
- Governance papers.

9.2 Administrative Structure

The Project is located in the Kashkadarya Region, one of 12 Regions (or Oblasts in Russian) in Uzbekistan (Golders, 2014). The executive branch of the Province is the Hakimat, which is overseen by a governor or Hakim. Each region is further subdivided into Regional Hakimats, which are governed by regional Hakims (Golders, 2014).

Kashkadarya is divided into 14 administrative districts and the project is physically located within the Guzor district and is on the border of the Nishon district (Golders, 2014). Each district is further divided into areas that are overseen by Village Councils, locally known as Mahallah. The four settlements closest to the Project are organised into two different Mahalls (Golders, 2014). Otkuduk, located in Nishon and the closest settlement approximately three kilometres from the project site, is a Mahallah itself. The Mahallah of Eshonkuduk, located in Guzor approximately 20 km from the project site, includes the settlements of Kengsoy and Abduhamit (Golders, 2014).

9.3 Population and Demography

9.3.1 Population

As of July 2016 the population of the republic of Uzbekistan was approximately 31.80 million people and has increased from the beginning of 2016 by 0.7% (Basic E&S Indicators, 2016). A total of 50.6% of this total population was living in urban areas, while the remaining 49.4% residing in rural areas (Basic E&S Indicators, 2016).

9.3.1.1. NATIONAL DEMOGRAPHICS

Birth Rate

The Birth rate of the country is increasing. In 2016, between the months of January-June the number of registered births was 318 thousand, in comparison with the 311.7 thousand births registered between January-June 2015 (Basic E&S Indicators, 2016).

Mortality Rate

The Death rate of the country is also increasing and in January-June 2016 the number of deaths was recorded at 73.9 thousand, in comparison with the 73.0 thousand deaths registered between January-June 2015 (Basic E&S Indicators, 2016). However, the increasing death rate is likely attributed to an increasing population. Of the total deaths registered, cardiovascular diseases comprise the greatest contributing factor of 59.7% (Basic E&S Indicators, 2016).

Public Health Indicators

Public health indicators for Uzbekistan between the years 2012 to 2015 are displayed in Table 40 below. The information displays Uzbekistan's overall improvement in key demographic indicators. Uzbekistan is one of the few countries in Eurasia that has seen a population increase in recent years and life expectancy is higher than neighbouring Central Asian countries (UNECE, 2010).

Table 44: National Demographic and Health Indicators 2012 – 2015 (Source: World Bank Database, 2017)

Demographic Indicator	2012	2013	2014	2015
Population (millions)	29.77	30.23	30.76	31.30
Total Fertility Rate	2.19	2.35	2.46	2.49
Male Life Expectancy	67.86	68.12	68.33	68.47

Demographic Indicator	2012	2013	2014	2015
Female Life Expectancy	73.40	73.61	73.79	73.95
Infant Mortality	25,469	24,751	23,837	22,771

Migration

According to the preliminary data in January-June 2016 a total of 72 thousand people immigrated to Uzbekistan and a total of 84.4 thousand people emigrated from the country. This totals a loss of 12.4 thousand people in 2016 from Uzbekistan, compared to the 13.4 thousand people who left in the corresponding period of 2015 (Basic E&S Indicators, 2016).

Ethnicity / Religion

According to the 1989 population census of Uzbekistan (the latest available), the ethnic composition of Uzbekistan is comprised of people of the following percentages: 71% Uzbek, 6% Russian, 2% Khowar, 5% Tajik, 4% Kazakh, 3% Tatar, 2% Karakalpak and 7% of other origins (Index Mundi, 2016).

The Embassy of Uzbekistan estimates that there are more than 2.2 thousand religious organisations representing 16 religions legally registered within Uzbekistan (Uzbek Embassy, 2016). The majority of the organisations registered, at 92% are of Muslim faith, and approximately 88% of the population of Uzbekistan are followers of Islam. The remaining registrations include 164 Christian organisations, 8 Jewish communities, 6 Bahai communities, 1 Krishna society and 1 Buddist temple are represented within the country (Uzbek Embassy, 2016).

9.3.1.2. REGIONAL AND LOCAL DEMOGRAPHICS

The total population of Kashkadarya is 2.5 million people, the majority concentrated within the capital city of Karshi (Golders, 2014). The districts of Nishon and Guzor have populations of 106,400 and 157,900 respectively (Golders, 2014).

The population of Otkuduk, is located within 3 km of the project site and located within the district of Nishon, has a population of 400 people (Golders, 2014). Eshonkduk, approximately 20 km from the project site, includes the settlements of Kengsoy and Adbuhamit. The Mahallah (village council) of Enshonkduk has a population of 2,836 people (Golders, 2014).

Despite the presence of some of the largest industrial facilities, Kashkadarya does not compare well with other regions when addressing poverty (Golders, 2014). Of all territories/Oblasts in Uzbekistan, the region has the highest poverty rate and proportion of the population considered ‘disadvantaged’ (State Statistics Committee, Republic of Uzbekistan, 2007). Engagement with local leaders indicates

that the most vulnerable groups are rural residents with lower educational levels, particularly women (Golders, 2014).

Birth Rate

The number of births in Kashkadarya has increased from 70,988 in 1991 to 78,543 in 2015 (Tashkent, 2016).

Mortality Rate

The number of deaths per annum in the region has increased in the past 24 years, from 9166 persons in 1991 to 11,954 persons in 2015 (Tashkent, 2016a), however this is likely in conjunction with an increasing population.

Public Health Indicators

Public health indicators for Guzar district between the years 2014 to 2016 are displayed in Table 45 below. The information displays the district's overall improvement in key demographic indicators. According to data for 2016, cardiovascular diseases, infectious and parasitic diseases, diseases of the kidneys and urinary tract and respiratory diseases are among the main dominant forms of diseases in Guzar district.

Table 45 Public health indicators within the Guzar District, Uzbekistan (Source: SGCC2017

Demographic Indicator	2014	2015	2016
Population	146,605	137,671	136,412
Total Fertility Rate	51,697	53,914	54,572
Male Life Expectancy	68.3	69.0	74.5
Female Life Expectancy	69.0	72.2	75.8
Infant Mortality per 1000	8.1	7.6	7.7

Migration

The rate of emigration from Kashkadarya has decreased over the past 24 years. In 2015 the number of both internal and external emigrants totalled 11,489 persons, compared to the 21,163 persons in 1991 (Indicators of Development, 2012-2015). Though no official statistics are available, discussions with stakeholders indicate that the current trends show young people leaving villages for larger towns and cities (Golder Interview, 2010 and 2013). Rates of immigration from Kashkadarya also decreased between 1991-2015, from 20,639 persons entering the region in 1991, to 11,598 persons entering in 2015 (Indicators of Development, 2012-2015).

Ethnicity / Religion

The people in the local area of influence are primarily of Uzbek origin (Golders, 2014). Key informants and focus group discussions did not indicate any cases of ethnic tension between minorities. However, according to the Hakim of the Nishon region, there are many ethnic minorities in the area (Golder Interview, 2010).

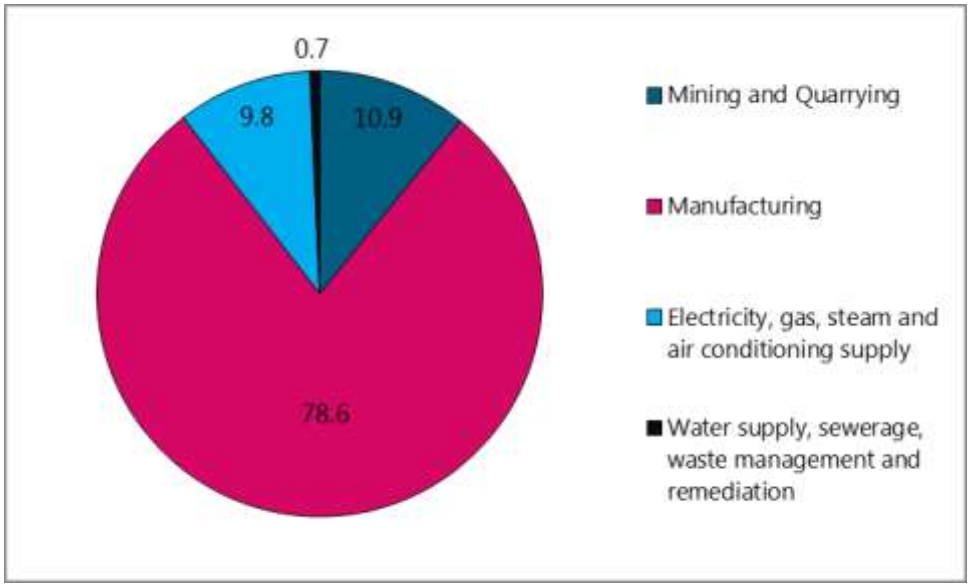
9.4 Economic Outputs

9.4.1 National Economic Profile

Within the year of 2016 the GDP of Uzbekistan demonstrated a 7.6% annual increase compared to 2015, indicating the rapid economic development of Uzbekistan (Basic E&S Indicators, 2016).

In 2015 the industrial sector produced the greatest economic output, generating 41,531 billion soums a year, with ‘other’ services generating the second greatest output (40,457.8 billion soums), and agriculture the third most profitable sector (28,544.3 billion soums) (Indicators of Development, 2012-2015).

Transport (including logistical) is the most profitable of services in Uzbekistan, generating 23,563.3 billion soums a year in 2015 (Indicators of Development, 2012-2015). Services which are becoming more profitable over the past five years include Public Health (1088.1 billion soums), which demonstrated a 116.4% increase since 2014, as well as trade and catering (21,051.1 billion soums) (Indicators of Development, 2012-2015). Figure 27 presents the industrial output of economic activities in January-June 2016 across the different sectors.

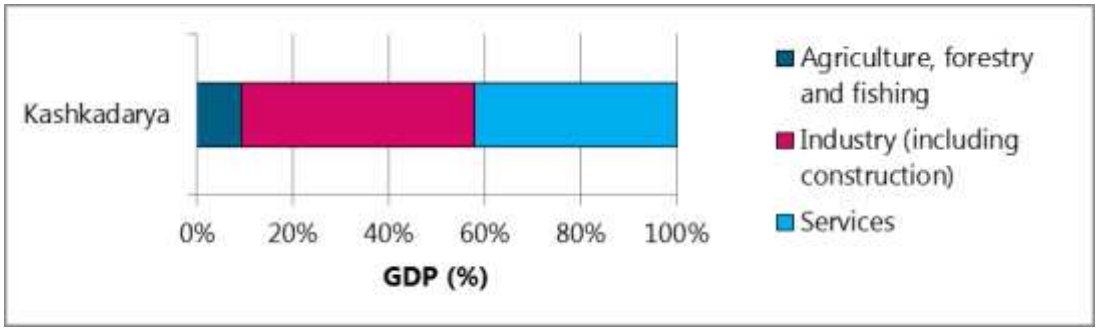


27. Industrial outputs of economic activities in 2016, based upon percentage totals (Basic E&S Indicators, 2016)

9.4.2 Regional Economic Profile

Kashkadarya as is a region is widely known for its natural resources with the largest fields of hydrocarbons in the country with two of the largest enterprises in Uzbekistan, the SGCC and the Muburak Gas Processing Plant (Golders, 2014). The region also has substantial agricultural resources (Golders, 2014).

The structure of the Gross Regional Product (GDP) within the region of Kashkadarya in January – June 2016 is characterised by Figure 28. Agriculture accounts for a total of 9.1% of the GDP for the region, Industry (including construction) accounts for 48.8% GDP and Services for 42.1% GDP (Basic E&S Indicators, 2016).

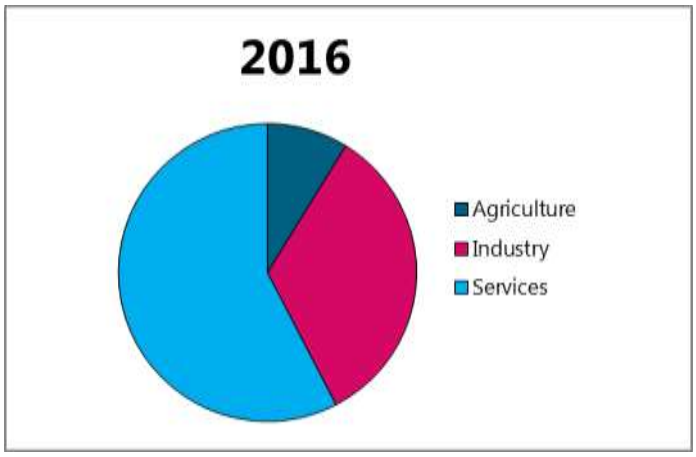


28. Structure of Gross Regional Produce in Kashkadarya 2016 (Source, Basic E&S Indicators, 2016)

9.5 Employment Structure and Livelihoods

9.5.1 National Livelihoods

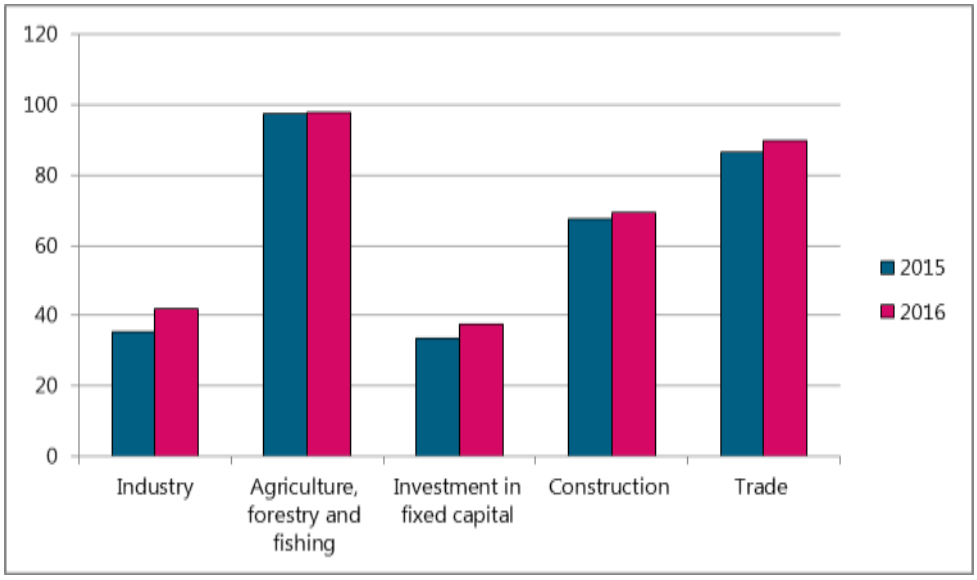
Within the year of 2016, the value of gross domestic product (GDP) within Uzbekistan amounted to 83,966.3 billion soums (approximately 66.73 billion USD) (Basic E&S Indicators, 2016). Figure 29 below presents the structure of the GDP across Uzbekistan's industries. GDP values increased by 7.8% in comparison to January-June 2015 values (Basic E&S Indicators, 2016).



29. The structure of GDP by branch January-June 2016 (Basic E&S Indicators, 2016).

In January-June 2016 government measures were taken to build the business environment in Uzbekistan (Basic E&S Indicators, 2016). Comprehensive support to further stimulate the development of small and private business contributed to the creation of more than 16.4 thousand new small business entities (8.1 percent more than in the corresponding period of 2015) (Basic E&S Indicators, 2016).

In January-June 2016 small business entities provided employment to 10,250 persons (77.7% of total persons employed in the economy (Basic E&S Indicators, 2016). The proportions of small businesses invested across different industries are presented in Figure 30 below.



The structure of GDP by branch January-June 2016 (Basic E&S Indicators, 2016).

30. Small business industries 2016 (Basic E&S Indicators, 2016).

9.5.2 Regional Livelihoods

The livelihoods of the people of the settlements closest to the Proposed Development, Otkuduk in the Nishon district, and Enshonkuduk, Kangsoy and Abduhamit in the Guzor district are very similar and largely based on livestock farming (Golders, 2014). Due to the climate, most farmers raise sheep and goats, which are less expensive to feed. Most animals are taken to markets in Guzor or Karshi. Many families also raise chickens and turkeys for personal consumption (Golder Interview, 2010).

9.5.3 National Employment Structure

The number of economically active people within the population of Uzbekistan equalled 13,916 thousand people, or 43.9% of the population between the months January-June 2016, a 1.8% increase compared to 2015 values (Basic E&S indicators, 2016). The significant growth in the number of employed persons is marked in transportation and storage industries (by 3.8%), accommodation and food services (3.7%), information and communication (3.4%) and construction (3.3%) (Basic E&S indicators, 2016).

9.5.3.1. Unemployment Rate

The number of citizens of Uzbekistan registered through labour agencies as those who seeking employment job was 5.8 thousand persons as of the end of June 2016, which is 12.8% more than as of the end of June 2015 (5.2 thousand persons) (Basic E&S indicators, 2016).

9.5.4 Regional Employment Structure

Representatives of the Regional Government state that it is common for people to work outside their given field of training, and a frequently cited problem is a shortage of people with qualifications to work in industrial facilities (Golders, 2014). Interviews with residents in rural villages indicated that there are few employment opportunities in villages, causing people to migrate to larger towns and cities for work (Golder Interview, 2010). The only salaried positions with business in the rural villages of the region are with the SGCC (Golders, 2014).

9.5.4.1. UNEMPLOYMENT RATE

Official statistics at the Region level estimated levels of unemployment within the region in 2010 at 4.9%, which is considered lower than other Provinces (Golder Interview, 2010).

9.6 Education and Literacy

9.6.1 National Education

The Uzbekistan law on Education was established in 1997 and states that all citizens have the right to education. Since the passing of the law, free compulsory education is available to all children, as well as over 60 schools of higher learning (National Review, 2015). Citizens are required to attend nine years of primary and secondary schooling, with a following three years of education or vocational training to prepare children for a specific career path (National Review, 2015).

The Ministry of Public Education and the Ministry of Higher and Secondary Specialised Education are responsible for all school, higher learning establishments and vocational education (National Review, 2015). The net enrolment rate for primary school is 97%, compared to a lesser 92% average of other Central Asian countries (National Review, 2015). Rates of attendance are lower for children from rural areas, compared to those in developed areas (National Review, 2015). There is limited access to schooling for children with disabilities (approximately 130,000 children in 2014) as there are few schools with the resources and training to teach children with severe disabilities and learning difficulties (National Review, 2015).

9.6.2 National Literacy Rates

The Adult literacy rate within Uzbekistan is 99.4% of the total population (Unicef Uzbekistan Statistics, 2013).

9.6.3 Regional Education

Educational facilities within the region include 73 professional colleges and three universities (Republic of Uzbekistan, 2010), as well as colleges within the Local Study Area capitals as well (Golders, 2014). Both Guzor and Nishon host colleges specialising in technical and vocational study. Children in local villages often travel to study in larger towns (Golders, 2014). In Otkuduk, the local primary school is comprised of a single classroom with the capacity for 25 children, and serves until the 4th Grade. Following 4th Grade, children will often go to the boarding school in Nishon and return

home to Otkuduk on weekends (Golders, 2014). Villages of Kensoy and Adbduhamit also have primary school through the 4th grade. In the village of Eshonkuduk, students can study until the 9th Grade (Golders, 2014).

9.6.4 Regional Literacy Rates

Despite high literacy rates throughout the country, which is considered a sign of high educational achievement, interviews with residents indicated that residents in rural villages see little opportunity for their children to receive higher education (Golders, 2014). Village leaders report that some families avoid sending their children to school so they can stay at home and support running the household (Golder Interview, 2010). Rural residents possess lower school completion rates, particularly women (Golders, 2014). The true regional literacy rate statistic for the region is currently unrecorded.

9.7 Community Health

In an interview with representatives of the Hakimat, anaemia was cited as a common problem for women in the region and local area of influence (Golders, 2014). Further health issues include increasing incident rates of cancer, but this is attributed to the introduction of improved diagnostic equipment (Golder Interview, 2010). Tuberculosis statistics reflect statistics of concern at a national level (Golders, 2014). In Guzor, statistics from 2010 indicated an increase in Tuberculosis from 43.6 to 46.5 cases per 100,000 people. In Nishon, the figures also increased from 54.9 to 57.4 cases per 100,000 people (Golders, 2014). HIV is not considered a serious problem in the regional or local project areas with only three cases reported in 2010 (Golder Interview, 2010).

9.8 Regional Landuse

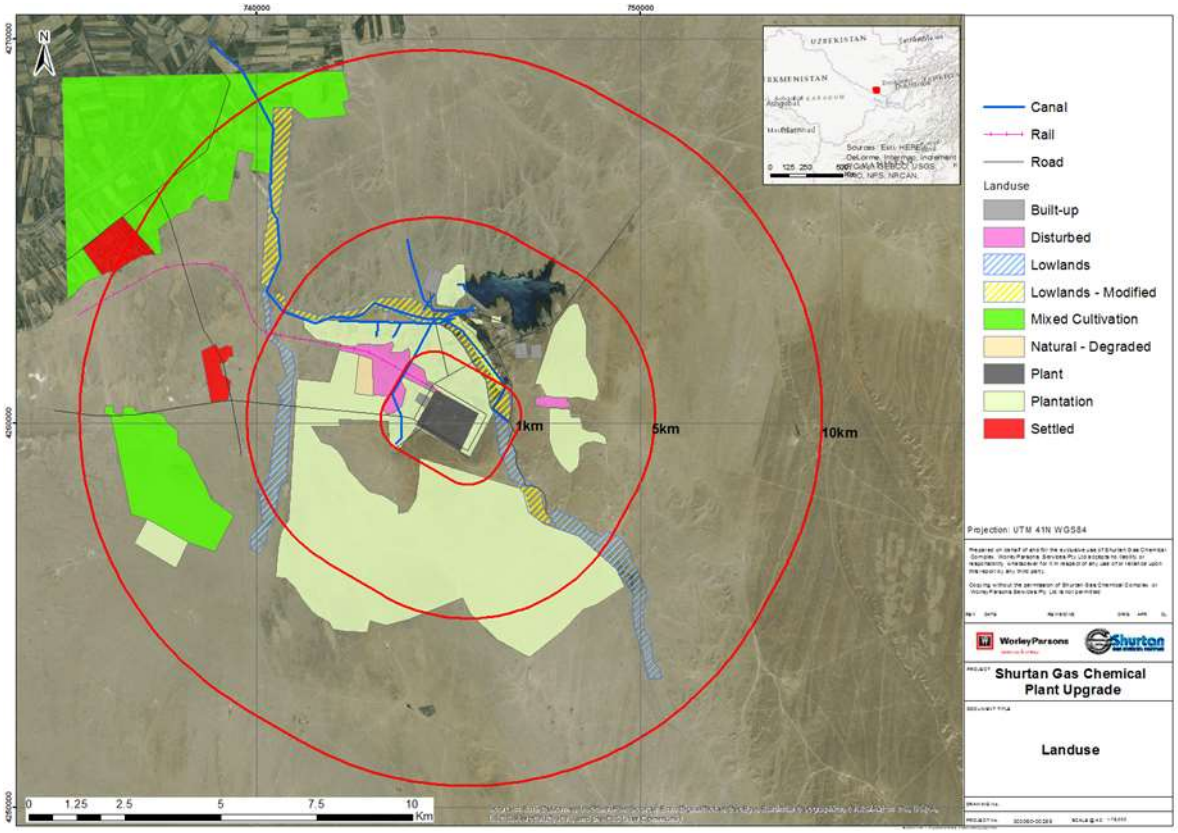
At a local level, land is owned by the Government and is rented for periods of 30 to 50 years. The land used by the SGCC project is property of the Government with no private leases within the Project footprint (Golders, 2014).

Figure 31 presents the land use within a 10 km radius of the Project site. SGCC has own fowl-farm (chicken farm) and cow barn, and has subsidiary farm land comprising of orchards, corn fields, a cotton field, and vegetable fields. These are used for the provision of animal and agricultural products to the local community and workers of SGCC. Approximately 700ha of land has been allocated to SGCC for agricultural purposes. The Shurtan Specialised Forestry is located approximately 2km north-west of the SGCC plant which the planting of *Amaranthaceae haloxylon* (saxaul) around the SGCC site covering an area of approximately 200 ha.

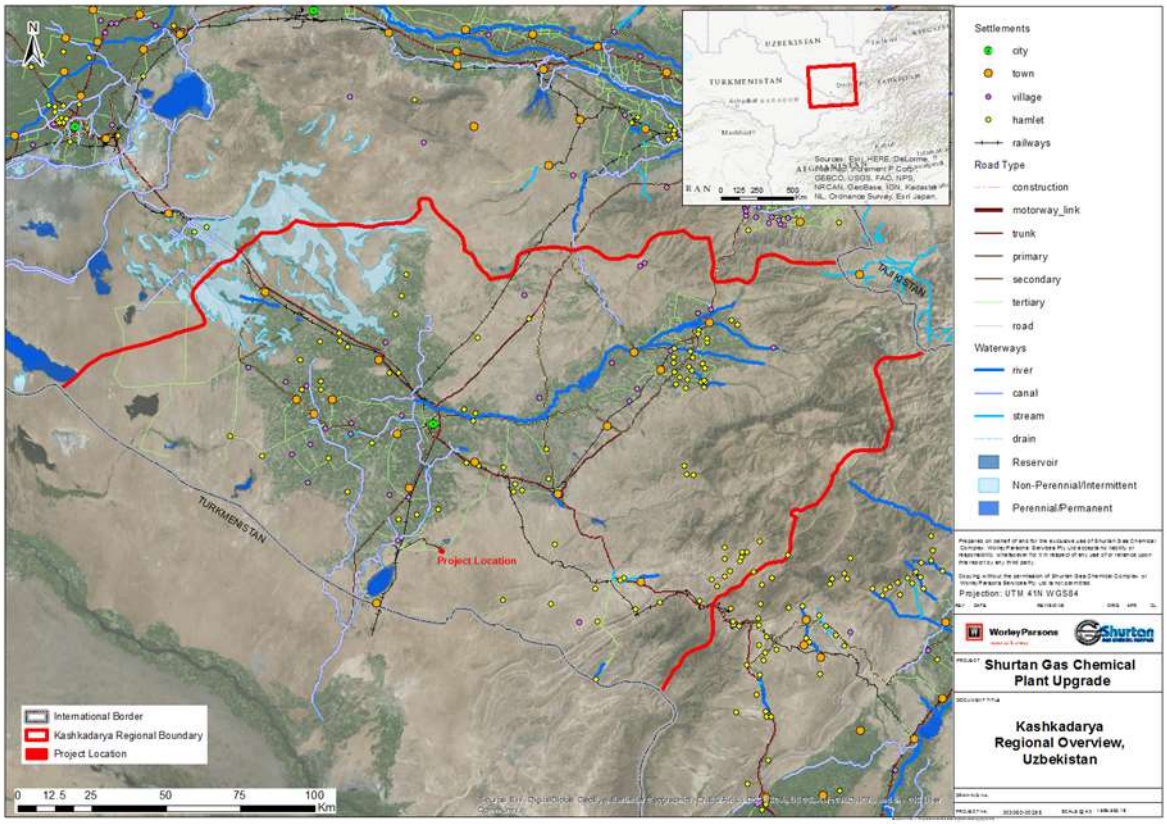
There is a network of canals within a 10 km radius of the project site, beginning within 1 km from the western and north-eastern boundary of the site. The canal flows from the north-west of the site from areas of mixed cultivation which extend past the 10 km radius of the site. A significant proportion of the land within a 10 km radius of the project site is arid desert.

Figure 32 presents the land use within the Kashkadarya region. The Project site is located within the south of the region. Within the centre of the region, mixed agriculture is prevalent and is likely attributed to the Kashkadarya river and canal network flowing through this part of the region and

acting as a water source. The majority of the population of the region live within these areas of mixed agriculture, including the main city Qarshi, as well as various towns, villages and hamlets. Transport routes extend from these areas of main population, including a railway network and a network of roads including major roads A380 and A378. Within the outskirts of the region, populations are more sparsely distributed and the land is primarily formed of arid desert.



31. Landuse within a 10 km radius of the Project site



32. Land use within the Kashkadarya region

9.9 Infrastructure

Infrastructure outside of the Province Regional and regional district towns is generally insufficient and cited by several stakeholders as a problem for residents, especially in rural areas (Golders, 2014).

9.10 Transportation

Transport is available for residents in the regional centres, with a typical cost from Nishon to Karshi costing around 5,000 UZS ($2 USD) but buses do not travel to the remote villages (Golders, 2014). In small villages like Kengsoy, there is no public transport available and residents have the option of calling a taxi or motorbike ride (Golder Interview, 2010).

9.10.1.1. ROAD

Roads within the area of influence are not well developed. Some tarmac roads are present, as the road past Otkuduk, but other villages, such as Kengsoy, are only accessible by dirt track (Golders, 2014). Markets exist in regional capitals to which residents of smaller settlements close to the Project site will travel if they wish to purchase or sell goods (Golders, 2014).

9.10.1.2. RAILWAY

A railway line is located directly north of the SGCC and OLTIN YO'L GTL sites, within the site boundaries and leads to the northwest. The railway line provides a transport link from the sites to nearby settlements and towns.

9.10.1.3. ENERGY SUPPLY

Regional centres such as Nishon have no reported shortages of gas or electricity, however, this is not the case for smaller settlements (Golders, 2014). In Enshonkuduk, electricity can be available for as little as 20 minutes a day and at night during the winter (Golders, 2014). The smallest village within the region, Kengsoy, has no gas supply available to residents (Golders, 2014).

9.10.1.4. WATER SUPPLY

Regional centres such as Nishon have no reported shortages of water supply, however, smaller settlements have reported water shortages and variable water supply (Golders, 2014).

9.10.2 Health

According to health officials at Tashkent, regional villages have health points, which have been established through a joint programme with the World Bank (Golders, 2014). By design, these points are meant to provide a doctor for every 1,500 people (Golder Interview, 2010). There is one such health point in the LSA which is a six bed facility located in Eshonkuduk, which serves residents in the closest villages (Golders, 2014). Other villages provide first aid points which are staffed only with people capable of performing first aid. Such first aid point was closed during a site visit in December 2010 (Golders, 2014).

Interviews highlighted problems such as an overall lack of quality doctors for the existing facilities and access to clean drinking water, which are both largely unavailable for settlements closest to the SGCC site (Golders, 2014). Drinking water is either brought into the settlements via trucks or collected from rainfall (Golder Interview, 2010). Sanitation and waste facilities throughout the country are not sufficient. In rural areas, only 3 to 5 percent of the population has access to municipal sewers (Republic of Uzbekistan, 2010).

9.11 Cultural Heritage

9.11.1 Tangible Cultural Heritage

The rich cultural heritage of certain areas of Uzbekistan is well documented. However, Guzar District, Kashkadarya Region is not considered rich in cultural heritage when compared with other areas of Uzbekistan (Golders, 2014). There is however, the Gulshan Mosque within the Guzar district is considered a monument of significance and dates back to 1730. This monument falls outside the zone of influence of the SGCC project site (Golders, 2014).

Within the local area of the project site, no traces of past human activity were identified during the site walkover (Golders, 2014). No in-situ cultural layers, building materials or other indicators of settled human activity were identified (Golders, 2014). Within the SGCC site a few fragments or 'sherds' of pottery were identified lying on the surface of a small number of areas and are likely to date to the middle ages. These were considered to be fragments of water-bearing vessels used by transitory shepherds who would utilise this area during the spring for their cattle to graze on the pastures to the west of the middle reaches of the Guzardarya River channel (Golders, 2014). No other cultural heritage resources were identified within the SGCC project site (Golders, 2014).

9.11.2 Intangible Cultural Heritage and Traditional Beliefs

HOLD – Awaiting Project Specific Information from in-country studies

10. ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

10.1 Introduction

This Chapter presents the findings of the environmental and social impact assessment undertaken for each of the construction, operation and decommissioning phases of the SGCCUP. As defined in Chapter 5 the overall significance of each potential impact has been completed through consideration of the impact magnitude, receptor sensitivity and the probability of the impact occurring. The assessment has been completed both pre-mitigation and post-mitigation, taking account of measures incorporated into the project design to reduce or remove impacts. Where the impact assessment has defined high or moderate significance impacts, further consideration is given to additional mitigation measures, in conjunction with the design elements, to adequately compensate for the impacts. Finally, the significance of any potential residual impact is assessed. Reference should be made to Chapter 5 where further details of the methodology and assessment criteria and definitions are outlined.

10.2 Identification of Environmental & Social Aspects / Impacts

Tables 45, 46 and 47 present the results of impact assessment for each baseline discipline for Construction (Table 45), Operations (Table 46) and Decommissioning (Table 47). The subsequent sections discuss the findings of the impact assessment where ‘Moderate’ or ‘High’ pre-mitigation significance has been determined.

Table 45 – Aspects and Impacts Table for Construction

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
CLIMATE & METEOROLOGY						
Construction : GHG emissions	Climate change	Atmosphere	CERTAIN	**MODERATE**	**LOW**	**LOW**
GEOLOGY & SOILS						
Construction : Oil and Chemical Spills outside of the plant boundary	Contamination of soils	Soils	LIKELY	**LOW**	**MODERATE**	**MODERATE**
HYDROLOGY / HYDROGEOLOGY & WATER RESOURCES						
Construction : Oil and chemical spill	Contamination of surface water course	Surface Water	LIKELY	**LOW**	**LOW**	**LOW**
Construction : Oil and chemical spill	Contamination of surface water course	Groundwater	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Surface Water	UNLIKELY	**LOW**	**HIGH**	**HIGH**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Groundwater	UNLIKELY	**LOW**	**LOW**	**LOW**
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Surface Water	UNLIKELY	**LOW**	**HIGH**	**MODERATE**
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Groundwater	UNLIKELY	**LOW**	**MODERATE**	**LOW**
Construction : Storage of oils, chemicals and fuels	Contamination of surface water course	Surface Water	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Construction : Storage of oils, chemicals and fuels	Contamination of groundwater	Groundwater	LIKELY	**LOW**	**MODERATE**	**MODERATE**
AIR & NOISE						
Construction : Atmospheric Dust Emissions	Impact on local air quality	Flora and Fauna	LIKELY	**LOW**	**LOW**	**LOW**
Construction : Atmospheric Dust Emissions	Impact on local air quality	Residential areas (including Otduk,	CERTAIN	**LOW**	**LOW**	**LOW**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
		Navabhor and residential complex)				
Construction : Atmospheric Dust Emissions	Impact on local air quality	On-site workers	CERTAIN	**HIGH**	**HIGH**	**HIGH**
Construction : Atmospheric Nox, Sox, CO Emissions	Impact on local air quality	Residential areas (including Otduk, Navabhor and residential complex)	CERTAIN	**LOW**	**LOW**	**LOW**
Construction : Atmospheric Nox, Sox, CO Emissions	Impact on local air quality	On-site workers	CERTAIN	**MODERATE**	**LOW**	**MODERATE**
Construction : VOC emissions during refuelling	Impact on local air quality	On-site workers	CERTAIN	**LOW**	**LOW**	**LOW**
Construction : Accidental releases (chemical / gas)	Impact on local air quality	On-site workers	UNLIKELY	**LOW**	**LOW**	**LOW**
NOISE & VIBRATION						
Construction : Machinery work	Increase in noise and vibration levels	On-site workers	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Machinery work	Increase in noise and vibration levels	Terrestrial fauna	CERTAIN	**LOW**	**MODERATE**	**LOW**
WASTE						
Construction : Domestic waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**HIGH**	**HIGH**
Construction : Sanitary waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	POSSIBLE	**HIGH**	**LOW**	**MODERATE**
Construction : Construction waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**HIGH**	**HIGH**
Construction : Sludge	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**MODERATE**	**HIGH**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Industrial waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**MODERATE**	**HIGH**
Construction : Odour	Impact on workforce and communities	Workforce and communities	LIKELY	**HIGH**	**LOW**	**MODERATE**
ECOLOGY						
Construction : Wildlife disturbance (light, traffic movement)	Increase accidental kills of wildlife	Terrestrial fauna	CERTAIN	**LOW**	**MODERATE**	**LOW**
Construction : Increased number of personnel on site	Uncontrolled fishing and birds hunting	Aquatic and Terrestrial Fauna	LIKELY	**LOW**	**MODERATE**	**LOW**
Construction : Additional access roads	Habitat fragmentation	Terrestrial fauna	POSSIBLE	**LOW**	**MODERATE**	**LOW**
Construction : Increased number of personnel on site	Uncontrolled fishing and birds hunting	Aquatic and Terrestrial Fauna	LIKELY	**LOW**	**MODERATE**	**LOW**
Construction : Additional access roads	Habitat fragmentation	Terrestrial fauna	POSSIBLE	**LOW**	**MODERATE**	**LOW**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Increased number of personnel on site	Decrease of protected species population through wildlife trafficking	Terrestrial fauna	POSSIBLE	**MODERATE**	**MODERATE**	**MODERATE**
Construction : Oil and chemical spill	Contamination of surface water course	Downstream users - ecology	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Construction : Aqueous discharge	Silt loading of surface water course	Downstream users - ecology	LIKELY	**LOW**	**LOW**	**LOW**
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Downstream users - ecology	UNLIKELY	**LOW**	**HIGH**	**MODERATE**
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - ecology	UNLIKELY	**LOW**	**HIGH**	**MODERATE**
Construction : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - ecology	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Construction : Atmospheric Dust Emissions	Impact on local air quality	Flora and Fauna	LIKELY	**LOW**	**LOW**	**LOW**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Machinery work	Increase in noise and vibration levels	Terrestrial fauna	CERTAIN	**LOW**	**MODERATE**	**LOW**
SOCIOECONOMIC						
Construction : Atmospheric Dust Emissions	Impact on local air quality	Residential areas (Otduk, Navabhor, Residential complex and GTL camp)	CERTAIN	**LOW**	**LOW**	**LOW**
Construction : Atmospheric Dust Emissions	Impact on local air quality	On-site workers	CERTAIN	**HIGH**	**HIGH**	**HIGH**
Construction : Atmospheric Nox, Sox, CO Emissions	Impact on local air quality	Residential areas	CERTAIN	**LOW**	**LOW**	**LOW**
Construction : Atmospheric Nox, Sox, CO Emissions	Impact on local air quality	On-site workers	CERTAIN	**MODERATE**	**LOW**	**MODERATE**
Construction : VOC emissions during refuelling	Impact on local air quality	On-site workers	CERTAIN	**LOW**	**LOW**	**LOW**
Construction : Accidental releases (chemical / gas)	Impact on local air quality	On-site workers	UNLIKELY	**LOW**	**LOW**	**LOW**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Machinery work	Increase in noise and vibration levels	On-site workers	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**
Construction : Influx of construction workers	Increased business opportunities	Communities and workforce	LIKELY	**HIGH**	**POSITIVE**	
Construction : Influx of construction workers	Incidences of prostitution and casual sexual relations	Communities and workforce	LIKELY	**HIGH**	**MODERATE**	**HIGH**
Construction : Influx of construction workers	Additional pressure on local resources outside of local communities	Communities and workforce	LIKELY	**HIGH**	**MODERATE**	**HIGH**
Construction : Influx of construction workers	Women security	Communities and workforce	LIKELY	**HIGH**	**HIGH**	**HIGH**
Construction : Influx of construction workers	Alcohol and drugs	Communities and workforce	LIKELY	**HIGH**	**HIGH**	**HIGH**
Construction : Influx of construction workers	Cultural clashes	Communities and workforce	LIKELY	**HIGH**	**LOW**	**MODERATE**
Construction : Influx of construction workers	Increase of STD rates and the capacity of local medical facilities to cope	Communities and workforce	LIKELY	**HIGH**	**HIGH**	**HIGH**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Influx of construction workers	Improvement of local infrastructure	Communities and workforce	LIKELY	**HIGH**	**POSITIVE**	
Construction : Influx of construction workers	Road traffic accidents	Communities and workforce	LIKELY	**HIGH**	**MODERATE**	**HIGH**
Construction : Influx of construction workers	Livestock loss in road accidents	Communities and workforce	LIKELY	**HIGH**	**LOW**	**MODERATE**
Construction : Influx of construction workers	Improvement of local economy	Communities and workforce	LIKELY	**HIGH**	**POSITIVE**	
Construction : Influx of construction workers	Inflation, increased prices for basic household items	Communities and workforce	LIKELY	**HIGH**	**MODERATE**	**HIGH**
Construction : Influx of construction workers	Local employment opportunities	Communities and workforce	LIKELY	**HIGH**	**POSITIVE**	
Construction : Oil and chemical spill	Contamination of surface water course	Downstream users - social	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - social	UNLIKELY	**MODERATE**	**HIGH**	**MODERATE**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Construction : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - social	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Construction : Water Supply	Increased abstraction from KMC	Downstream users - social	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**
Construction camp : Water Supply	Increased abstraction from KMC	Downstream users - social	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Downstream users - social	UNLIKELY	**MODERATE**	**HIGH**	**MODERATE**

Table 46 – Aspects and Impacts Table for Operations

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
CLIMATE & METEOROLOGY						

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : GHG emissions	Climate change	Atmosphere	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Flood and drainage management	Flood damage	Project Assets	POSSIBLE	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Water supply	Drought and localised water shortages	Project Assets	POSSIBLE	**MODERATE**	**MODERATE**	**MODERATE**
GEOLOGY & SOILS						
Operation : Deposition of N on cultivated soils	Contamination of soils	Soils	LIKELY	**LOW**	**LOW**	**LOW**
LANDSCAPE & VISUAL						
Operation : Visual Impact of Flare Stack	Visual impact	Landscape & Visual	CERTAIN	**LOW**	**LOW**	**LOW**
HYDROLOGY / HYDROGEOLOGY & WATER RESOURCES						
Operation : Oil and chemical spill	Contamination of surface water course	Surface Water	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Oil and chemical spill	Contamination of surface water course	Groundwater	LIKELY	**LOW**	**MODERATE**	**MODERATE**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Surface Water	UNLIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Groundwater	UNLIKELY	**LOW**	**MODERATE**	**LOW**
Operation : Storage of oils, chemicals and fuels	Contamination of surface water course	Surface Water	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Storage of oils, chemicals and fuels	Contamination of groundwater	Groundwater	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Flood and Drainage Management	Contamination of surface water course	Surface Water	POSSIBLE	**LOW**	**MODERATE**	**MODERATE**
Operation : Flood and Drainage Management	Contamination of groundwater	Groundwater	POSSIBLE	**LOW**	**MODERATE**	**MODERATE**
Operation : Atmospheric emissions	Contamination of surface water with air borne particulate deposition (nitrogen / sulphates)	Surface waters	LIKELY	**LOW**	**NEGLIGIBLE**	**INSIGNIFICANT**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Cooling tower water emissions	Contamination of surface water with chlorine	Surface waters	LIKELY	**LOW**	**NEGLIGIBLE**	**INSIGNIFICANT**
Operation : Deposition of N on cultivated soils	Potential release into water courses	Water courses	LIKELY	**MODERATE**	**LOW**	**LOW**
AIR & NOISE						
Operation : Flaring emissions (NOx, CO, UHC)	Impact on local air quality	Residential areas(Otduk, Navabhor, Residential complex and GTL camp)	LIKELY	**MODERATE**	**LOW**	**LOW**
Operation : Flaring emissions (NOx, CO, UHC)	Impact on local air quality	On-site workers	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	Residential areas	LIKELY	**MODERATE**	**LOW**	**MODERATE**
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	On-site workers	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Venting and fugitive emissions	Impact on local air quality	Residential areas	LIKELY	**MODERATE**	**LOW**	**MODERATE**
Operation : Venting and fugitive emissions	Impact on local air quality	On-site workers	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
NOISE & VIBRATION						
Operation : Flare noise (intermittent)	Increase in noise levels	Residential areas	CERTAIN	**MODERATE**	**LOW**	**MODERATE**
Operation : Flare noise (intermittent)	Increase in noise levels	On-site workers	CERTAIN	**HIGH**	**HIGH**	**HIGH**
Operation : Flare noise (intermittent)	Increase in noise levels	Terrestrial fauna	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**
WASTE						
Operation : Domestic waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**MODERATE**	**HIGH**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Sanitary waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	POSSIBLE	**HIGH**	**LOW**	**MODERATE**
Operation : Sludge	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**MODERATE**	**HIGH**
Operation : Industrial waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	CERTAIN	**HIGH**	**HIGH**	**HIGH**
Operation : Odour	Impact on workforce and communities	Workforce and communities	LIKELY	**HIGH**	**LOW**	**MODERATE**
ECOLOGY						
Operation : Flare noise (intermittent)	Increase in noise levels	Terrestrial fauna	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Wildlife disturbance (light)	Increase accidental kills of wildlife	Terrestrial fauna	CERTAIN	**LOW**	**MODERATE**	**LOW**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Oil and chemical spill	Contamination of surface water course	Downstream users - ecology	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Water In-take	Turbulence at intake from higher flows	Aquatic ecology of KMC	LIKELY	**LOW**	**LOW**	**LOW**
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - ecology	UNLIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - ecology	LIKELY	**LOW**	**MODERATE**	**MODERATE**
Operation : Flood and Drainage Management	Contamination of surface water course	Downstream users - ecology	POSSIBLE	**LOW**	**MODERATE**	**MODERATE**
Operation : Water Supply	Increased abstraction from KMC	Downstream users - ecology	CERTAIN	**MODERATE**	**LOW**	**MODERATE**
Operation : Reservoir evaporation (cumulative)	Salinisation of reservoir	Aquatic ecology of reservoir	LIKELY	**MODERATE**	**HIGH**	**HIGH**
Operation : Reservoir evaporation (cumulative)	Salinisation of reservoir	Terrestrial ecology	LIKELY	**MODERATE**	**HIGH**	**HIGH**
SOCIOECONOMIC						

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Flaring emissions (NOx, CO, UHC)	Impact on local air quality	Residential areas	LIKELY	**MODERATE**	**LOW**	**LOW**
Operation : Flaring emissions (NOx, CO, UHC)	Impact on local air quality	On-site workers	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	Residential areas	LIKELY	**MODERATE**	**LOW**	**MODERATE**
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	On-site workers	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Venting and fugitive emissions	Impact on local air quality	Residential areas	LIKELY	**MODERATE**	**LOW**	**MODERATE**
Operation : Venting and fugitive emissions	Impact on local air quality	On-site workers	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Flare noise (intermittent)	Increase in noise levels	Residential areas	CERTAIN	**MODERATE**	**LOW**	**MODERATE**
Operation : Flare noise (intermittent)	Increase in noise levels	On-site workers	CERTAIN	**HIGH**	**HIGH**	**HIGH**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Influx of operation workers	Increased business opportunities	Communities and workforce	CERTAIN	**HIGH**	**POSITIVE**	
Operation : Influx of operation workers	Additional pressure on local resources outside of local communities	Communities and workforce	CERTAIN	**HIGH**	**NEGLIGIBLE**	**LOW**
Operation : Influx of operation workers	Road traffic accidents	Communities and workforce	CERTAIN	**HIGH**	**NEGLIGIBLE**	**LOW**
Operation : Influx of operation workers	Livestock loss in road accidents	Communities and workforce	CERTAIN	**HIGH**	**NEGLIGIBLE**	**LOW**
Operation : Influx of operation workers	Improvement of local economy	Communities and workforce	CERTAIN	**HIGH**	**POSITIVE**	
Operation : Oil and chemical spill	Contamination of surface water course	Downstream users - social	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - social	UNLIKELY	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - social	LIKELY	**MODERATE**	**MODERATE**	**MODERATE**

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Operation : Flood and Drainage Management	Contamination of surface water course	Downstream users - social	POSSIBLE	**MODERATE**	**MODERATE**	**MODERATE**
Operation : Water Supply	Increased abstraction from KMC	Downstream users - social	CERTAIN	**MODERATE**	**MODERATE**	**MODERATE**

Table 47 – Aspects and Impacts Table for Decommissioning

PROJECT ACTIVITY / ASPECT ECOLOGY	POTENTIAL IMPACT	RECEPTOR	LIKELIHOOD / PROBABILITY	RECEPTOR SENSITIVITY	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE PRE-MITIGATION
Decommissioning : Reservoir closure	No water in reservoir	Aquatic ecology of reservoir	POSSIBLE	**MODERATE**	**HIGH**	**HIGH**
Decommissioning : Reservoir closure	No water in reservoir	Terrestrial ecology	POSSIBLE	**MODERATE**	**HIGH**	**HIGH**
Decommissioning : Plant closure and no aqueous discharge	Low flow in canals	Downstream users - ecology	POSSIBLE	**MODERATE**	**LOW**	**LOW**

SOCIOECONOMIC						
Decommissioning : Plant closure and no aqueous discharge	Low flow in canals	Downstream users - social	POSSIBLE	**MODERATE**	**LOW**	**MODERATE**

10.3 Evaluation of Significant Environmental & Social Impacts / Risks

10.3.1 Climate & Meteorology

10.3.1.1. CONSTRUCTION IMPACTS

No significant construction impacts recorded.

10.3.1.2. MITIGATION

Not applicable.

10.3.1.3. OPERATIONS IMPACTS

Impacts on climate and meteorology during the operational phase of the project are listed in Table 42. The main areas of concern relate to extreme weather events, flood and drought, resulting from predicted climate change affects impacting on the project assets. Excessive precipitation could lead to flood damage at the site. Reduced precipitation could lead to lower water availability for operational activities, workforce and irrigation. The receptor (project assets) magnitude of impact and significance are assessed as **Moderate** pre-mitigation

10.3.1.4. MITIGATION

It is proposed that the drainage design includes: an allowance for climate change to mitigate the impact against storm waters.

A drought management plan to define alternative water supply requirements or operational arrangements in the event of water restrictions is proposed to mitigate against the impact of reduced precipitation.

Following the inclusion of these mitigation measures, these impacts are assessed as **Low**.

10.3.2 Geology & Soils

10.3.2.1. CONSTRUCTION IMPACTS

The potential impacts on soils during construction phase of the project are listed in Table 41. The only area of concern relates to the spill of oils and/or chemicals (hazardous materials) during their transportation to the site, impacting soils outside of the site boundary. Soils in the area are generally

of poor quality due to salinization from irrigation practices and is subsequently assessed as having Low sensitivity.

The requirement to transport potential contaminants is unavoidable during the construction of the project. The transport of hazardous products is strictly regulated and these regulations will apply. However, during the construction period of the project site the probability of an accident taking place is likely but the quantities are likely to be small and hence the magnitude of impact is assessed as Moderate. Taking into account receptor sensitivity and magnitude of impact, the significance is assessed as **Moderate** pre-mitigation.

10.3.2.2. MITIGATION

The Construction Management Plan should include the following mitigation measures:

- Vehicles transporting hazardous materials to the construction site should be subjected to regular inspections for possible leakages and damages that could cause leaks;
- Vehicles transporting hazardous materials to and from the construction site should be maintained regularly and kept in good working order;
- Spill kits should be carried with the vehicles to deal with immediate releases;
- Material Safety Data Sheets shall be consulted prior to transportation of hazardous materials to prevent chemicals reacting with one another;
- Personnel transporting the hazardous materials should be adequately trained to deal with an spills/leaks.

10.3.2.3. OPERATIONS IMPACTS

The potential impacts on soils during operation of the project are listed in Table 42. No Moderate or High significant impacts to soil have been identified during operation of the project site.

10.3.3 Landscape and Visual

No impacts with High or Moderate significance have been identified during the impact assessment.

10.3.4 Hydrology / Hydrogeology & Water Resources

10.3.4.1. CONSTRUCTION IMPACTS

The potential impacts on surface and ground waters during construction phase of the project are listed in Table 42. The areas of concern relate to accidental spill of oils and/or chemicals (hazardous materials) or uncontrolled releases of wastewater. Groundwater in the area is generally of low quality due to salinization from irrigation practices and is subsequently assessed as having Low sensitivity. Surface waters that could be impacted are also assessed as having Low sensitivity as they are export waterways for the SGCC.

The requirement to store and use potential contaminants is unavoidable during the construction of the project. The storage of hazardous products is strictly regulated and these regulations will apply. However, during the construction period of the project site the probability of an accident taking place is likely due to vehicle and machinery movements but the quantities are likely to be small and hence the magnitude of impact is assessed as Moderate. Taking into account receptor sensitivity and magnitude of impact, the significance is assessed as **Moderate** pre-mitigation.

The failures of wastewater treatment units compromising water quality also poses a risk during construction although the probability of it occurring is unlikely. Any off-specification or uncontrolled release would be direct to surface waters and has the potential to be a High impact due to the likely volumes of wastewater generated. The significance of impact is assessed as **Moderate**.

10.3.4.2. MITIGATION

The Construction Management Plan should include the following mitigation measures:

- Acceptable standards for effluent treatment prior to discharge to be included with regular monitoring of effluent discharges to ensure compliance with the standards;
- Vehicles and machinery on the construction site should be subjected to regular inspections for possible leakages and damages that could cause leaks;
- Vehicles and machinery working on the construction site should be maintained regularly and kept in good working order. Any maintenance tasks should be restricted to designated areas off the project site;
- Spill kits should be provided at strategic locations around the construction site to deal with immediate releases;
- Material Safety Data Sheets shall be consulted prior to storage of hazardous materials to prevent chemicals reacting with one another;
- Personnel shall be adequately trained to deal with the hazardous materials or WWTP including response to spills/leaks/uncontrolled discharges.

10.3.4.3. OPERATIONS IMPACTS

The potential impacts on surface and ground waters during construction phase of the project are listed in Table 43. The areas of concern relate to accidental spill of oils and/or chemicals (hazardous materials) or uncontrolled releases of wastewater and drainage management. Groundwater in the area is generally of low quality due to salinization from irrigation practices and is subsequently assessed as having Low sensitivity. Surface waters that could be impacted from liquid discharges are also assessed as having Low sensitivity as they are export waterways for the SGCC.

The requirement to store and transport potential contaminants is unavoidable for the entire operational life of the Project. Regarding the storage of hydrocarbon products, such as diesel, this is regulated by various legislative acts. The design of the project site will ensure that these regulations are adhered to. However, the volume of hazardous materials present on-site means the probability of

an accident occurring is likely. The majority of chemicals used at the project site are volatile and will evaporate quickly leaving resulting in only a small impact and hence the magnitude of impact is assessed as Moderate. Taking into account receptor sensitivity and magnitude of impact, the significance is assessed as **Moderate** pre-mitigation.

The failures of wastewater treatment units compromising water quality also poses a risk during operation although the probability of it occurring is unlikely. Any off-specification or uncontrolled release would be direct to surface waters and has the potential to be a Moderate impact due to the likely volumes of wastewater generated. The significance of impact is assessed as **Moderate** pre-mitigation.

Flood and drainage management at the site has the potential to generate high run-off during storm events. Excessive precipitation could lead to soil erosion or scour of drainage channels, increasing silt loading and/or becoming contaminated as a result of spills of process liquids. Over the 25 year design life of the project the likelihood of a storm event is considered probable. The size of the facility and potential run-off volumes is assessed to give a magnitude of impact as Moderate. The significance of impact is assessed as **Moderate** pre-mitigation

10.3.4.4. MITIGATION

- Gas processing facilities should include secondary containment where hazardous liquids are handled (segregate contaminated and uncontaminated);
- Drainage systems should be separated for storm water from process areas that could be contaminated with hydrocarbons (closed drainage) and storm water from non-process areas (open drainage) that includes any surface runoff and flows resulting from precipitation, drainage or other sources;
- A first-flush system should be used to manage the treatment of storm water during the first 20 minutes of an event, where the majority of potential contaminants tend to be present;
- All discharge points should be equipped with a shut-off mechanisms to prevent potentially contaminated waters being released;
- Storm water drainage systems should be designed with sufficient capacity for foreseeable operating conditions;
- Any storm water retention ponds should be suitably lined to prevent pollution of ground water;
- An environmental management plan should include monitoring programme of wastewater effluents and storm water drainage water quality;
- Acceptable standards for effluent treatment prior to discharge should be included with regular monitoring of effluent discharges to ensure compliance with the standards;
- Vehicles and machinery on the construction site should be subjected to regular inspections for possible leakages and damages that could cause leaks;

- Vehicles and machinery working on the construction site should be maintained regularly and kept in good working order. Any maintenance tasks should be restricted to designated areas off the project site;
- Spill kits should be provided at strategic locations around the construction site to deal with immediate releases;
- Material Safety Data Sheets shall be consulted prior to storage of hazardous materials to prevent chemicals reacting with one another;
- Personnel shall be adequately trained to deal with the hazardous materials or WWTP including response to spills/leaks/uncontrolled discharges.

10.3.5 Air Quality

10.3.5.1. CONSTRUCTION IMPACTS

Operation of a large number of construction vehicles and equipment will result in temporary emissions of air pollutants throughout the construction of the new Polymer and Naphtha plants as well as replacing and revamp of the existing facilities. Dust will be released from land preparation and building of new facilities and from the stockpile of fine materials.

Impacts to local air quality due to NO_x, SO_x, CO and VOC emissions during the construction phase of the Project have the potential to occur during refueling of project machinery, and accidental gas/chemical releases. The assessment identified that the receptors at risk of these impacts include the project workforce.

The impact of air quality on the project workforce was classified as **Moderate** in relation to NO_x, SO_x, CO emissions and **High** for dust emissions during pre-mitigation.

10.3.5.2. MITIGATION

Project Construction Management Plan will be include the following mitigation measures to reduce the impact of dust emissions on the project force:

- Sprinkling of water to reduce dust;
- Covering of loads and stockpile of fine materials with tarps;
- Road maintenance graded road and water spraying to earth roads reduce dust;
- PPE for the project workforce.

The following mitigation measures will be included in the Construction Management Plan to reduce the impact of NOx, SOx, CO emissions, VOC emissions:

- Regular maintenance of construction machinery, vehicles and generators;
- Use of standard fuel type (low sulphur diesel - lower emissions);

- Regular vehicle checks, and inspection of construction machinery and generators before use (e.g. visual - exhaust discolouration)

10.3.5.3. OPERATIONS IMPACTS

During operation phase, emissions from the new cracking heater, steam boiler and flare as well as a number of other new emissions and vent sources will be added to the existing atmospheric emissions from the plant.

Sources of potential impacts upon local air quality during the operational phase of the Project include emissions generated by flaring (NO_x, CO, UHC), combustion sources including cracking heaters and HP boiler, as well as venting and fugitive emissions. The receptors at risk of these impacts include the Project workforce and local communities in Otkuduk and Navabahor villages.

Detailed air dispersion modelling was carried out to estimated the raise in concentration of NOx, CO, Hydrocarbon and PM_{10} in the project area. As was explained in the Section 7.3.2 the modelling domain consists of a 50km x 50km area centered to the SGCC. The domain encompasses the key residential receptors including the locations of air quality monitoring points (refer toTable 21).

The results of the air dispersion modelling indicate that concentration of all of the criteria emissions during operation phase of the project will comply with ambient air quality standards. Table 48 below presents the background concentrations and the raise in concentrations of criteria pollutants as a result of plant operation. This table presents the worst case, as such the emissions during normal operations will be even less that will provide better compliance with standards.

According to the Table concentrations of NOx seem relatively high if compared to the other emissions. At the worst case the raise in concentration of NOx at the point of maximum concentration will be around 59.6 µg/m^3 that is 24% of the standard limit value.

Table 49 presents the result of air dispersion modelling and the state of compliance with the ambient air quality standard. Figure 33 presents isoplethes of concentration of NOx over modelling domain. Maximum concentration of NOx during normal operation is estimated to be 45.9 µg/m^3 that indicates a compliance with statutory standards. During the normal operations three Cracking heater and two Steam Boiler will be operating along with flare pilots. In the worst case scenario the flare and emergency diesel generators will be operating in addition to the above equipment.

Appendix 2 includes the report of “Air Dispersion Modelling”

Table 48: Estimated concentrations of criteria emissions in different receptors during worst case scenario

Emission	Receptors	Background Concentration (monitoring result)µg/m^3	Expected Increase (model result) µg/m^3	Total µg/m^3	Raise by project as a percentage of standards %	Most stringent standard (24 hours) µg/m^3
SO_2 (24 hour)	**Point with highest concentration**		0	16.0	0.0%	20
	Navbahor	24.4	0	24.4	0.0%	
	Otkuduk	14.3	0	14.3	0.0%	
	Rail Yard	9.6	0	9.6	0.0%	
	SGCC Accommodation	10.3	0	10.3	0.0%	
	GTL Camp	9.6	0	9.6	0.0%	
NO_x (24 hour)	**Point with highest concentration**	0.4	59.6	60.0	23.8%	250
	Navbahor	0.5	4.3	4.8	1.7%	
	Otkuduk	0.4	5.2	5.6	8.7%	
	Rail Yard	0.5	16.7	17.2	2.1%	
	SGCC Accommodation	0.4	6.7	7.1	6.7%	
	GTL Camp	0.4	19.6	20.0	2.7%	
CO (24 hour)	**Point with highest concentration**	N/A	23	23.0	0.6%	4000
	Navbahor	Not available	6.8	6.8	0.2%	
	Otkuduk	Not available	10.0	10.0	0.2%	
	Rail Yard	Not available	20.7	20.7	0.5%	
	SGCC Accommodation	Not available	19.8	19.8	0.5%	
	GTL Camp	Not available	17.9	17.9	0.4%	

Emission	Receptors	Background Concentration (monitoring result)µg/m^3	Expected Increase (model result) µg/m^3	Total µg/m^3	Raise by project as a percentage of standards %	Most stringent standard (24 hours) µg/m^3
Hydrocarbon (24 hour)	point with highest concentration	102.58	58.8	161.4	5.9%	1000
	Navbahor	3.02	15.9	18.9	1.6%	
	Otkuduk	3.57	16.0	19.6	1.6%	
	Rail Yard	35.61	32.8	68.5	3.3%	
	SGCC Accommodation	11.64	31.2	42.8	3.1%	
	GTL Camp	102.58	28.1	130.7	2.8%	
PM_{10} (24 hour)	point with highest concentration	N/A	2.9	2.9	5.8%	50
	Navbahor	Not available	0.2	0.2	0.4%	
	Otkuduk	Not available	0.3	0.3	0.5%	
	Rail Yard	Not available	1.0	1.0	2.0%	
	SGCC Accommodation	Not available	0.3	0.3	0.6%	
	GTL Camp	Not available	1.0	1.0	2.1%	

Table 49: Maximum expected increase in NO_2 concentration during normal operation

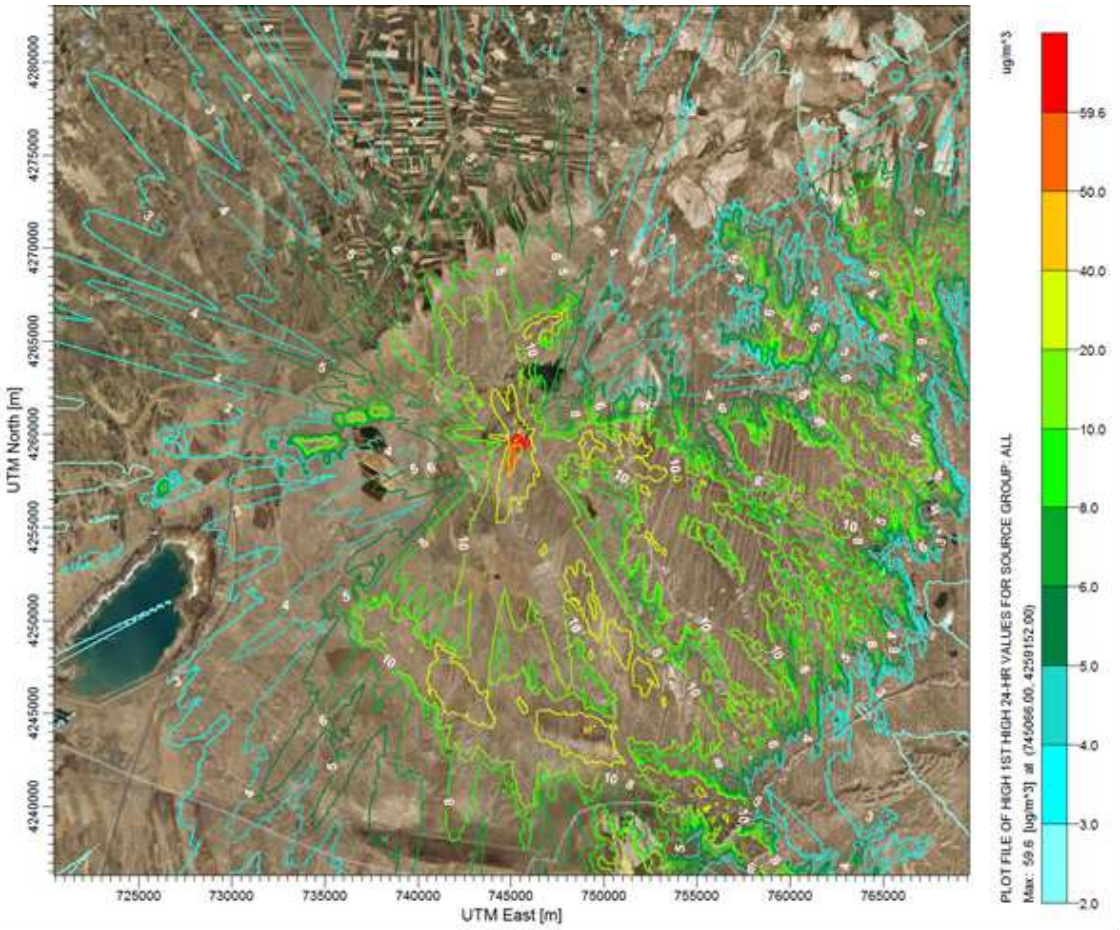
Emission	Receptors	Maximum observed (monitoring Result) µg/m3	Expected Increase (model result) µg/m3	Total µg/m4	Raise by project as a percentage of standards %	Most stringent standard (24 hours) µg/m3
NO_2 (24 hour)	**Point with highest concentration**	Not Available	45.9	45.9	76.5%	60
	Navbahor	0.6	3.55	4.2	5.9%	
	Otkuduk	0.6	4.30	4.9	7.2%	
	Rail Yard	0.9	11.93	12.8	19.9%	
	SGCC Accommodation	0.5	5.82	6.3	9.7%	
	GTL Camp	1.9	15.52	17.4	25.9%	

NOTES:

1- Human health: It should be noted that ambient air quality standard are determined by international organizations and local authorities based on the safe concentrations of the pollutants for human health. Therefore the criteria emissions a re not likely to bring about any health effect if comply with the regulatory standards.

Nonetheless, if an specific activity temporarily and inevitably result in a significant emissions (e.g. dust emissions during construction or short term NOx and SOx emissions during an emergency situation) appropriate mitigation measures with clear instructions must be identified and included in the project ESMMP.

2- Fauna and Flora:
The impact of atmospheric emissions of the industrial plants on the Fauna and Flora is less significant than its impact on human health. Therefore compliance of SGCC with the ambient air quality standards implicitly denotes no impact or insignificant impact on fauna and flora.



33. NOx concentration in the modelling domain in the worst case scenario (.

The impact of air quality on the Project workforce and local communities was generally classified as **Moderate** during pre-mitigation

10.3.5.4. MITIGATION

The flowing mitigation measures will be implemented during Operations phase of the project to reduce impacts upon air quality:

- Design to complies with permit requirements;
- Equipment procurement specifications to meet Best Available Technique as well as SGCC and Uzbekistan regulatory requirements;
- Design provides for the closed venting of all hydrocarbon systems. Floating roof tanks;
- Design for no process venting but for vented hydrocarbons to be routed into a flare system;
- Operating procedures to be in place;
- No continuous flaring by design except for safety reasons;

- Regular metering of flaring rates prior to combustion through the flare stack;
- Emission Monitoring Ports on exhausts of major combustion plant;
- CCTV to monitor Smokey-ness of flare;
- Leak detection plan to be in place.

10.3.5.5. TRANSBOUNDARY IMPACTS OF ATMOSPHERIC EMISSIONS

With the exception of GHG emissions that have global effect none of the atmospheric emissions of the SGCCUP project may have a transboundary impact. The results of the air dispersion modelling in Table 48 indicate that the raise in concentration of the atmospheric emissions during the operation of SGCCUP is insignificant. All the modelled atmospheric emissions comply with national and international standards in the modelling domain that extends to 25 km radius from the center of the SGCC. Therefore, compliance will be achieved in further distances and there should not be any concern about environmental impacts of theses emissions in the borders of the country and beyond.

SGCCUP is not exceptional regarding the GHG emissions. Like other O&G and Petrochemical plants, SGCCUP contributes to country's overall GHG emissions. Contribution of the SGCC in overall GHG emissions of the country is proportioned to its planned activities. Nevertheless, more energy efficient techniques will be considered in detailed design through conducting Best Available Technique (BAT) assessment and Energy Efficiency Value Improvement (VIP) practices.

10.3.5.6. CHANGE IN PROJECT EMISSIONS AND TRANSBOUNDARY IMPACTS IN THE FUTURE.

No intention is stated for further expansion of the plan and no information about any increase in capacity of the project in the future is available. However the result of the dispersion modelling indicated that in a worst case scenario the maximum raise in concentration of the atmospheric pollution in the ambient air is around 24%.

The raised NOx concentrations are higher than the other pollutants, however modern technologies e.g. use of low NOx burners can be adapted to reduce NOx emissions if a decision is made on further expansion of the project.

As was mentioned there should not be any concern on transboundary effects, as the project is in compliance with national and international atmospheric emissions regulations and ambient air quality standards within project area and surrounding human settlements.

Note:

It should be noted that although the impact of the SGCC on the ambient air quality of nearby villages is minimal, the role of other sources of emissions must be taken into account in any change in the ambient air quality of the villages, towns and cities. Additional sources of emissions could include new industrial plants, vehicles and transportation facilities as well as all other domestic combustion equipment. To achieve a cleaner atmosphere in the cities requires conducting cumulative impact assessments and preparing an environmental management plan at each city or location by relevant environmental or planning authorities.

10.3.6 Noise

10.3.6.1. CONSTRUCTION IMPACTS

Noise pollution and vibration is expected to be generated by machinery work undertaken during the construction phase of the project. The main receptor for this impact is expected to be the on-site project workforce. The impact of noise pollution for on-site workers was assessed as **Moderate** during pre-mitigation.

10.3.6.2. MITIGATION

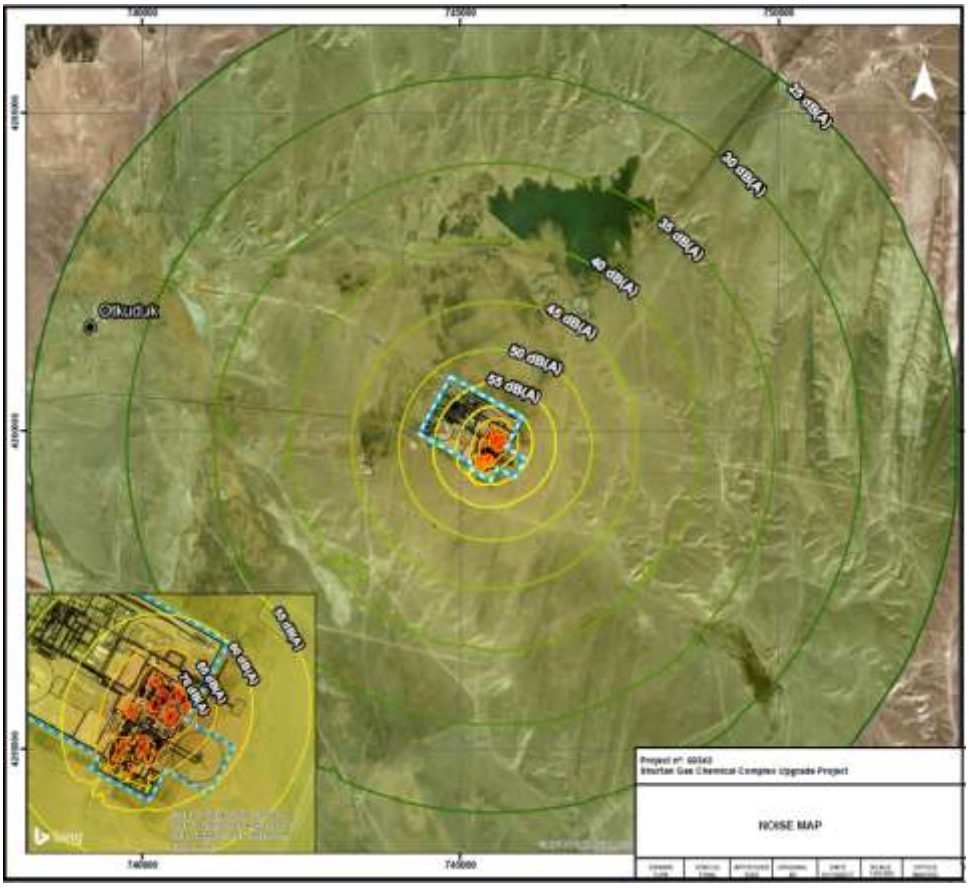
To reduce noise impact during construction phase, the following mitigation measure will be implemented:

- Camp and residential compound location will be chosen to minimise disturbance effects;
- Location for generators and other fixed equipment will be carefully selected;
- Silencers will be used where possible.

10.3.6.3. OPERATIONS IMPACTS

The plant will be located in the industrial area experiencing constant noise. Noise pollution produced from intermittent flaring has the potential to impact upon on-site workers, local communities and terrestrial fauna during the operational phase of the Project. Screening noise modelling was conducted to assess the impact of the plant noise during the operation phase. The results indicated the noise level will exceed the 70 dB(A) standard limit for industrial areas at the eastern border of the plant. Therefore the impact of noise pollution was assessed as **High** for on-site workers.

Noise model results at the nearest human settlement i.e. Otkuduk, indicate that the contribution of the project noise will be about 27 dB(A) that complies with the IFC standard for residential areas (55 dB(A) daytime and 45 dB(A) night-time). The impact of plant noise on local communities, the SGCC residential complex and GTL Camp as well as terrestrial fauna, was assessed as Moderate in a pre-mitigation situation. Figure 34 presents the noise map of the plant during operation phase.



34. Noise map of the plant during normal operation

10.3.6.4. MITIGATION

The flowing mitigation measures will be implemented during Operations phase of the project to reduce noise impacts from flaring:

- Onsite offices will be noise proof;
- The workforce will use PPE when flare is operating.

With regards to impact on terrestrial fauna, due to the flare noise being intermittent and will last only for short periods of time, a recommendation can be made to avoid flaring during nesting season if it is possible.

10.3.7 Solid Waste

10.3.7.1. CONSTRUCTION IMPACTS

The duration of the construction phase is expected to be relatively short, however, high volumes of waste are expected to accumulate. Types of waste that could cause high and moderate impacts on soil, water, landscape, communities and fauna are discussed below.

Impacts from Waste during the Construction phase of the project are listed in Table 41. Most of the impacts are classified as of High or Moderate pre-mitigation significance.

Construction Waste

Non-hazardous waste will be generated during the construction phase. These include industrial waste materials, packaging materials, scrap steel, cables, lighting bulbs, paper, containers, plastic etc.

Most of the waste streams will be sorted at source where possible and recycled to minimise the need for landfilling. The temporary storage areas will be in compliance with the sanitary norms and corresponding regulations. The pre-mitigation impact is assessed as **High**.

Domestic Waste

Food waste will be temporarily kept in sealed containers and removed on a daily basis for composting purposes. The impact of domestic waste will be for a short term and localized. Pre-mitigation it is assessed to be **High**. A waste management plan will further be implemented to mitigate this impact during construction and operational phase of the project.

Sanitary Waste

Sanitary waste might possibly generate from the site medical facility. The impact of sanitary waste is classified as **Moderate** pre-mitigation. The sanitary waste will be disposed through either specified handling facility or a local hospital or incineration.

Sludge

Sludge is a byproduct of sewage treatment from Waste Water Treatment Plant. The impact of sludge waste if not handled properly is classified as **High**.

Industrial Waste

Numerous hazardous waste materials will be produced during the construction of the plant. These include used solvents, chemical containers, fluorescent tubes, used oil and grease etc. The magnitude of the impact of the generation of industrial waste before mitigation is **High** as some of the materials used during construction are hazardous.

Odour

The odour can be generated from various types of waste, e.g. domestic, sludge. It is assessed to have a **Moderate** pre-mitigation impact on the workforce, local communities at Otkuduk and Navabahor as well as SGCC residential complex and GTL camp..

10.3.7.2. MITIGATION

Sufficient infrastructure currently exists to accommodate various types of wastes that will be generated during construction of the new project facility. Current hazardous waste management contractors will be assigned to manage hazardous waste in line with the IFC requirements, and to ensure that hazardous waste is disposed of in appropriate manner.

The following mitigation measures are suggested:

- Project to develop an integrated Waste Management System;
- Determine locations for disposal of spoils and integrate into Waste Management Plan;
- Dewatering system for sanitary sludge of construction camp;
- Develop a Waste Management Training and Development Plan which includes personal health management issues;
- Individual construction contractors to acknowledge SGCC integrated Waste Management Plan;
- SGCC to implement Environmental Management Plan;
- Local community grievance plan/procedure to be in place;
- Active odour control measures;
- Sewage treatment odour control;
- Waste accumulation/treatment area to be chosen depending on minimal effect on communities.

Post mitigation impacts are assessed from Low to Not Significant.

10.3.7.3. OPERATIONS IMPACTS

Similar types of waste are expected to be generated during the Operations of the plant with the exclusion of construction waste. It is expected that higher volumes of hazardous waste will be generated.

The significance of impacts on soil, water, landscape, communities and fauna for operations is the same as for construction.

10.3.7.4. MITIGATION

The following mitigation measures are proposed:

- Project to develop an integrated Waste Management System;
- SGCC to implement Environmental Management Plan;

- Waste accumulation/treatment area to be chosen depending on minimal effect on communities;
- Develop a Waste Management Training and Development Plan which includes personal health management issues;
- Use of specialized west handling facility or a nearby hospital for disposal/incineration of medical waste;
- Local community grievance plan/procedure;
- Active odour control measures;
- Sewage treatment odour control.

10.3.8 Ecology

10.3.8.1. CONSTRUCTION IMPACTS

Impacts on Ecology during the Construction phase of the project are listed in Table 41. Most of the impacts are classified as of low pre-mitigation significance, apart from wildlife trafficking and contamination of surface water.

Wildlife trafficking

The influx of a large number of personnel on site during construction phase may lead to additional pressure on flora and fauna species in the area, including wildlife trafficking. A number of protected species have been registered in the area, some of them are listed in CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). These include *Agrionamys (Testudo) horsfeld*i, *Varanus griseus, Eryx tataricus*. The impact of wildlife trafficking on terrestrial fauna was assessed as **Moderate** during pre-mitigation.

Contamination of surface water course

Contamination of surface watercourse could take place due to accidental release of oils and chemicals as a result of:

- Accidental spills during storage of oils, chemicals and fuels;
- Off-specification discharge from Waste Water Treatment Plant.

Impact of contamination of surface water caused by the aspects listed above on downstream users of KMC is classified as **Moderate**.

10.3.8.2. MITIGATION

Limited impacts are anticipated during the construction phase on terrestrial and aquatic flora and fauna. To mitigate the impacts on aquatic ecology the following measures will be undertaken:

- Provide sanitary facilities at the site (existing or portable) for the construction workers;

- Effluent to be treated to acceptable standard prior to discharge;
- Construction Management Plan to include monitoring of effluent discharges;
- Construction Management Plan to ensure oil/chemical storage areas are adequately bunded to prevent spills entering surface waters;
- Include spill response / kits in key areas;
- Regular vehicle maintenance.
- To control wildlife trafficking during construction phase, the Construction Management Plan will include ban on hunting and wildlife trade.

10.3.8.3. OPERATIONS IMPACTS

Impacts on Ecology during Operations are listed in Table 42. The following impacts are classified as **Moderate** or **High** prior to mitigation:

- Increase in noise levels;
- Contamination of surface water course;
- Increase abstraction from KMC;

Increase in noise level

Impact from increase in noise level on flora and fauna is classified as **Moderate**. The plant will be located in the industrial area experiencing constant noise. The noise levels during operations are expected to increase insignificantly during normal operations. However, occasional use of flare might cause disturbance to wildlife around the plant area, especially to birds breeding near the SGCC Reservoir.

Contamination of surface watercourse

Contamination of surface watercourse could take place due to accidental release of oils and chemicals as a result of:

- A potential failure of equipment;
- Inadequate drainage management;
- Accidental spills during storage of oils, chemicals and fuels;
- Off-specification discharge from Waste Water Treatment Plant.

Impact of contamination of surface water caused by the aspects listed above on downstream users of KMC is classified as **Moderate**.

Increase abstraction from KMC

The current water abstraction permit for the existing facility includes water demands for the new plant. In the event of the new facility water demand increases significantly, this could have an impact on downstream users of KMC. Currently this impact is classified as **Moderate**.

10.3.8.4. MITIGATION

Limited impacts are anticipated during the operations phase on terrestrial and aquatic flora and fauna. To mitigate the impacts on aquatic ecology the following measures will be undertaken:

- All effluents to be treated to acceptable standards prior to discharge;
- Environmental Management Plan to include guidance on monitoring of effluent discharge from Waste Water Treatment Plant;
- Recycling of wastewater for process uses to minimize water consumption and abstraction from the KMC;
- Value Engineering to assess water efficient equipment / fixings are employed;
- Irrigation to use drip fed method to conserve water and reduce abstractions;
- Water efficient measures within domestic areas;
- Environmental Management Plan to include response for extreme weather events;
- Spill kits to be located in key areas;
- Oil/chemical storage areas to be adequately bunded (110%).

With regards to noise impact, the flare noise will be intermittent and will last only for short periods of time. A recommendation can be made to try and avoid flaring during nesting season if it is possible.

All impacts expect to be of low significance after proposed mitigation measures are applied.

10.3.8.5. DECOMMISSIONING IMPACTS

Impacts on Ecology during Decommissioning are listed in Table 43. Draining or evaporation of water from the SGCC Reservoir was identified as of **High** significance prior to mitigation.

Currently the SGCC Reservoir serves as an alternative source of water for the plant in case the main water supply fails. The water level is being regulated through pumping of water from the KMC. Once the decommission phase is completed, the water level in the Reservoir will not be regulated, which will likely lead to eventual evaporation and loss of this habitat.

10.3.8.6. MITIGATION

It is proposed to include ecological assessment into the Decommissioning Plan. The assessment will allow to define ecological value of the habitat and make the decision whether the habitat should be preserved.

10.3.9 Socioeconomic

10.3.9.1. Construction Impacts

Local Air Quality

Impacts to local air quality during the construction phase of the Project have the potential to occur due to dust emissions, NO_x, SO_x, CO emissions, VOC emissions during refuelling of project machinery, and accidental gas/chemical releases. The receptors at risk of these impacts include local communities and the project workforce.

The impact of air quality on the Project workforce was classified as **Moderate** in relation to NO_x, SO_x, CO emissions and **High** for dust emissions during pre-mitigation.

Noise Pollution

Noise pollution and vibration is expected to be generated by machinery work undertaken during the construction phase of the project. The main receptor for this impact is expected to be the on-site project workforce. The impact of noise pollution for on-site workers was assessed as **Moderate** during pre-mitigation.

Surface Water Quality and Impacts upon Water Supply

Impacts to surface water quality within the area of influence of the project have the potential to occur due to accidental oil and chemical spills, off-specification effluent discharge from the waste water treatment plant (WWTP) and the storage of oils, chemicals and fuels during the construction phase of the project. The receptors at risk of these impacts include local communities and the project workforce.

Construction activities and the workforce construction camp will require an increase in water supply to the project. The KMC aquifer is one of the primary sources of water supply to the Projects and increased abstraction rates pose a potential negative impact upon the Aquifer. The impact of increased abstraction from the KMC on downstream users was assessed as **Moderate** during pre-mitigation.

Health and Community Safety

The general nature of the expansion of the SGCC plant in a rural location that is sparsely populated will mean there is a limited impact on community health. Those of high and moderate significance are discussed below.

Commercial sex work and sexually transmitted diseases are commonly a risk in industrial projects, especially for large work forces consisting primarily of men who are away from their homes for extended periods of time. Sexually transmitted diseases pose risks to both the workforce and the local community and there is potential that the local medical facilities may not have the capacity to cope. Whilst prevalence rates are relatively low throughout Uzbekistan, the issue is considered a potential negative impact. The impact of prostitution and increases in STD rates within the workforce and local communities were both assessed as **High** significance during pre-mitigation.

The use of drugs and alcohol by Project workers and the local community is a potential impact that is common within large industrial projects. This poses a risk to on-site operational health and safety as well local medical facilities which may not have the capacity to cope. The use of drugs and alcohol was assessed as **High** during pre-mitigation.

A large influx of temporary workers can put additional strain on local communities, with many workers from different cultural backgrounds and lifestyles than the host community. This potential impact needs to be assessed and managed, and local religions and culture, community structure and relationships between men and women should be observed in order to avoid any potential conflicts. In particular, with a large influx of male temporary workers, women's safety is of particular concern for the Project. The impact of cultural clashes between the Project workforce and local communities was assessed as **Moderate** during pre-mitigation, while the impact of the project on women's safety was assessed as **High**.

Travelers on the main roads within the region will experience greater volumes of traffic as a result of the construction phase of the Project. This poses a potential impact due to issues with road safety and the risks of increases accidents as well as loss of livestock from road traffic incidents. The receptors at risk of this potential impact include both local communities and the Project workforce. The impact of road traffic accidents and livestock loss in road accidents were assessed as **Moderate** to **High** during pre-mitigation.

Local Infrastructure and Resources

Large influxes of temporary workers can pose potential impacts upon local infrastructures and resources which are generally poorly developed and may not have the capacity to cope. Roads and public transport within the near regional project area are poorly developed and may not have the capacity to cope with the construction phase of the Project. Both water supply and electricity is limited within the near regional area of the Project and local communities suffer inconsistent and unreliable supplies at present. The impact of pressures on local resources outside of local communities was assessed as **High** during pre-mitigation.

Inflation

An influx of new workers, even if contained within a workers camp, can often lead to inflation within local communities. The increase in purchasing power can lead to increases in the prices of household goods and services, making it more expensive for local communities to meet their needs. The impact of inflation has been classified as **High** during pre-mitigation.

10.3.9.2. MITIGATION

Local Air Quality

As was discussed in Section 10.3.5 various mitigation measures have been proposed in order to limit any potential impacts to local air quality. Dust emissions will be controlled through road maintenance and water spraying to earth roads and surfaces. All loads and stockpiles formed of fine materials are to be covered with tarpaulin. Any Project workers working within close proximity to dust will be required to wear appropriate PPE.

In order to limit the releases of atmospheric NOx, SOx and CO Emissions, all construction machinery, vehicles and generators will undergo regular maintenance. Regular vehicle checks will be undertaken as well as inspection of construction machinery and generators before use, for example for any visual exhaust dis-colouration. All machinery will use a standard fuel type (low sulphur diesel) in order to reduce emissions. Refuelling will only be undertaken by fuel pumps in order to limit VOC emissions.

To mitigate against accidental aerial releases of chemicals or gases, bunding specifications will be prepared in the RFP for construction contractors. Inspection and auditing programmes will be considered for all bunds and tanks.

Noise Pollution

The designated locations of the camp and residential compounds have been specifically selected in order to minimise the impact of noise pollution and vibrations generated by project machinery upon the on-site workforce. Generators and any fixed equipment required for the Project will be installed in areas where they are unlikely to impact upon the workforce. In any instances where it is not possible to install equipment in areas unlikely to impact upon the workforce, silencers will be installed.

Surface Water Quality and Impacts upon Water Supply

In accordance with the Construction Management Plan (CMP), mitigation measures will be employed in order to address potential impacts to surface water quality. Mitigation measures include: provision of spill response kits across the Project site, monitoring of effluent discharges and regular vehicle maintenance. All effluents produced by the Project will be treated to acceptable standards prior to discharge. Sanitary facilities will be provided across the Project site, including existing or portable facilities for the Project workforce.

In order to mitigate against any potential impacts caused by increased abstractions from the KMZ aquifer, the CMP will include measures to minimise water usage on the Project site and within temporary camp facilities.

Health and Community Safety

A HIV/AIDs policy will be implemented as part of the Social Management Plan (SMP) in order to provide accurate information to the Project workforce and local community on HIV/AIDs and other sexually transmitted diseases, as well as the risks associated with commercial sex work. The policy will be employed by health professionals on site to raise awareness with all employees and ensure condoms are available in worker camps. The Project will further engage periodically with health and HIV/AIDs NGOs to stay informed with national efforts across Uzbekistan to raise awareness.

Large influxes in temporary workers can have negative impacts upon local communities. As part of the SMP training/orientation will be provided to the Project workforce in order to educate on local traditions, culture and religions. Educating on local women's safety will be paramount to Project workforce training. All contractors shall comply with national labour laws and international core labour standards. Without the use of well-administered human resources policies, job creation within the local area can exacerbate existing social divisions and in some cases lead to local conflict if job seekers do not trust that recruitment policies are not transparent. Regular consultations with the Community Liaison Officer (CLO) will be undertaken as part of the SMP in order to monitor any potential clashes or hostilities between the Project workforce and local community.

All project workers will be trained in road safety as part of the Health and Safety Management Plan. Any accidents or 'near misses' will be recorded and included within regular health and safety reports.

Inflation

The impacts of inflation are difficult to predict, but will primarily be localised within the workers camp as not to impact upon local communities, through provision of a shop (s) within the work camp for workers to purchase goods. A formal monitoring system will be devised in order to assess impacts of inflation, through regular consultation with the CLO. Should feedback from the CLO include comments on an increase in prices, a more formal monitoring system will be devised in order to monitor the prices of staple goods and services in local markets on a monthly basis. This will be carried out both within the Local and Regional Study Areas, in order to determine whether inflation is a localised impact.

10.3.9.3. OPERATIONAL IMPACTS

Local Air Quality

Sources of potential impacts upon local air quality during the operational phase of the Project include emissions generated by flaring (NOx, CO, UHC), combustion sources including cracking heaters and HP boiler, as well as venting and fugitive emissions. The receptors at risk of these impacts include the Project workforce and local communities. The impact of air quality on the Project workforce and local communities was classified as **Moderate** during pre-mitigation

Noise Pollution

Noise pollution produced from intermittent flaring has the potential to impact upon on-site workers and local communities during the operational phase of the Project. The impact of noise pollution was assessed as **High** for on-site workers and **Moderate** for local communities during pre-mitigation.

Surface Water Quality and Water Supply

Impacts to surface water quality have the potential to occur during the operation phase of the Project due to accidental oil and chemical spills, off-specification effluent discharge from WWTP, the storage of oils, chemicals and fuels and poor flood and drainage management.

Operational activities will require an increase in water supply to the project. The KMC aquifer is one of the primary sources of the Projects water supply and increased abstraction rates pose a potential negative impact upon the Aquifer. The impacts of surface water quality and increased abstraction rates from the KMC were assessed as **Moderate** during pre-mitigation.

10.3.9.4. MITIGATION

Local Air Quality

Various mitigation measures have been proposed in order to limit any potential impacts to local air quality. In order to mitigate against potential Nox, CO and UHC flaring emissions, the flare design is to comply with permit requirements and no continuous flaring is to be undertaken except if for safety reasons. Flare rates are to be regularly monitored by metering prior to combustion through the flare

stack, and CCTV will be employed in order to monitor the colouration and smoke composition (through observation) of the flare.

In order to control emissions from combustion sources (cracking heaters and HP boiler), all equipment procurement specifications will meet Best Available Techniques as well as SGCC and Uzbekistan regulatory requirements. Operating procedures will be in place and emission monitoring ports will be placed within the exhausts of the major combustion plant.

Venting and fugitive emissions will be controlled by design, providing for the closed venting of all hydrocarbon systems and through floating roof tanks. The design does not allow for process venting but for vented hydrocarbons to be routed into a flare system. A leak detection plan will be put into place.

Noise Pollution

In order to identify and mitigate any potential impacts due to noise pollution during the operational phase of the Project, noise modelling will be undertaken as part of the Stakeholder Engagement Programme. Modelling will identify the significance of noise pollution to receptors and preventative measures such as noise barriers will be employed if deemed necessary.

Flare operations will be intermittent, only occurring a few times a year for short durations. All onsite offices are to be noise proof and appropriate PPE to be worn by on-site workers during flare operations.

Surface Water Quality and Water Supply

In order to mitigate against impacts to surface water quality within the regional area of the Project, an Environmental Management Plan (EMP) will be implemented.

The EMP will include contingency plans for accidental / unplanned oil and chemical spills and to provide response to such accidental events. The EMP will further include plans to provide response to unplanned weather events in order to manage drainage and flooding within the project site. Monitoring of effluent discharges will be undertaken as part of the EMP to ensure compliance with international standards and emergency spill kits will be distributed across the project site. All effluents produced by the Project will be treated to acceptable standards prior to discharge and oil/chemical storage areas will be adequately bunded (110%). Drainage systems across the project site will be segregated for ‘clean’ and ‘dirty’ storm water runoff from paved areas.

In order to mitigate against potential impacts caused by increased abstractions from the KMZ aquifer, all irrigation systems will use a drip-fed method to conserve water and reduce abstractions. Value engineering will be undertaken in order to ensure water efficient equipment/fittings are employed. Wastewater will be recycled for process uses to minimise water consumption and abstraction from the KMZ.

10.3.9.5. DECOMMISSIONING IMPACTS

Plant closure during decommissioning and non-aqueous discharge has the potential to result in low flow within canals within the Regional area of the Project. This impact has the potential to impact

downstream users of the canals, as a source of water and transport. The impact of reduced flow rates within regional canals was assessed as **Moderate** during pre-mitigation.

10.3.10 Mitigation

The Decommissioning Management Plan (DMC) will aim to assess flow rates within the canals, and carry out monitoring for any reductions in flow. The DMC will further assess any alternative sources for downstream users.

10.3.10.1. Residual Impacts

Residual negative impacts have been identified following mitigation measures and include:

- Women's security within the local community and project workforce;
- The use of alcohol and drugs within the workforce and local community;
- Increases in STD rates within the workers camp and local communities;
- The risk of road traffic accidents;
- Inflation, increased prices for basic household items within local communities.

All residual impacts have been assessed as having moderate impact significance and may result in lasting and noticeable changes in baseline conditions. This conclusion will be reviewed on a regular basis and assessed against results of continued stakeholder engagement in order to identify and monitor the effects of these potential residual impacts. Mitigation measures will be included within the Social Management Plan, Health and Safety Management Plan and Construction Management Plan.

10.4 Cumulative Impacts

10.4.1 Overview

IFC defines cumulative impacts as "those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones". According to IFC, the identification and management of cumulative impacts are limited to those effects that are recognised as important on the basis of scientific concerns and/or concerns of affected communities (IFC, 2013)

10.4.1.1. CONSTRUCTION IMPACTS

No cumulative impacts have been identified for Construction phase.

10.4.1.2. OPERATIONS IMPACTS

One cumulative impact of high significance has been identified during the assessment.

Salinisation of the Reservoir

The SGCC Reservoir has been constructed as storage for the water supply to the plant in case the main water supply fails. The level of water in the Reservoir is being regulated by pumping water from KMC due to high evaporation rates. In the event that water is not pumped into the Reservoir, the salinity might potentially increase having adverse impact on aquatic terrestrial ecology of the Reservoir. This impact is classified of **High** significance.

10.4.1.3. MITIGATION

The following mitigation measures are proposed to reduce the impact of salinization of the Reservoir:

- Recycling of wastewater for process uses to minimize water consumption and abstraction from the KMC;
- Value Engineering to assess water efficient equipment / fixings are employed;
- Irrigation to use drip fed method to conserve water and reduce abstractions;

11. PRELIMINARY ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMMP)

11.1 Introduction

It is the intention of this preliminary Environmental and Social Management and Monitoring Plan (ESMMP) to capture all mitigation, required management measures, monitoring and commitments defined following the impact assessment process and any other additional requirements defined by other permitting, SGCC or lenders requirements. The preliminary ESMMP should be considered as a 'Live' document and should be further developed and updated through each project phase. The ESMMP should be utilised to maintain compliance, tracking and continual improvement against established environmental and social targets for the SGCCUP.

11.2 Preliminary Environmental and Social Management and Monitoring Plan - Construction

Table 49: Preliminary Environmental and Social Mitigation Plan – Construction

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Construction : Oil and Chemical Spills outside of the plant boundary	Contamination of soils	Soils	**MODERATE**	**LOW**	- Construction Management Plan for Transportation of chemicals/oils; - Spill kits to be carried on vehicles transporting chemicals / oils	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction : Oil and chemical spill	Contamination of surface water course	Groundwater	**MODERATE**	**LOW**	-Construction Management Plan to include spill response / kits; - Vehicle maintenance	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Surface Water	**MODERATE**	**LOW**	- Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Effluent Monitoring	Contractor	Average concentration below guideline values – Target 100%

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Surface Water	**MODERATE**	**LOW**	- Provide sanitary facilities at the site (existing or portable) for the construction workers; - Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Effluent Monitoring	Contractor	Average concentration below guideline values – Target 100%
Construction : Storage of oils, chemicals and fuels	Contamination of surface water course	Surface Water	**MODERATE**	**LOW**	- Construction Management Plan to ensure oil/chemical storage areas are adequately bunded to prevent spills entering surface waters; - Include spill response / kits in key areas	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction : Storage of oils, chemicals and fuels	Contamination of groundwater	Groundwater	**MODERATE**	**LOW**	Construction Management Plan to ensure oil/chemical storage areas are adequately bunded to prevent spills entering surface waters; - Include spill response / kits in key areas	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction : Atmospheric Dust Emissions	Impact on local air quality	On-site workers	**HIGH**	**LOW**	-Sprinkling of water to reduce dust; - Covering of loads and stockpile of fine materials with tarps;	Air Quality Monitoring	Contractor	Maximum and average concentrations of

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					- Road maintenance graded road and water spraying to earth roads reduce dust; - PPE			dust are below guidelines
Construction : Atmospheric Nox, Sox, CO Emissions	Impact on local air quality	On-site workers	**MODERATE**	**LOW**	- Maintenance of construction machinery, vehicles and generators; - Use of standard Fuel type (low sulphur diesel - lower emissions); - Vehicle checks, and inspection of construction machinery and generators before use (e.g. visual - exhaust discoloration)	Air Quality Monitoring	Contractor	Maximum and average concentrations of, PM Nox, Sox, CO emissions are below guidelines
Construction : Domestic waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**MODERATE**	- Project integrated waste management system. - All non-hazardous waste to be managed under Uzbekistan and SGCC waste management practices.	Waste mishandling incidents reported / Internal inspections	Contractor	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed
Construction : Sanitary waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**MODERATE**	**LOW**	Project integrated Waste Management System. - Develop a waste management training and development plan which includes personal health management issues. - Use of specialized west handling facility or a nearby hospital for disposal/incineration of clinical waste. - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	Contractor	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Construction : Construction waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**LOW**	- Determine locations for disposal of spoils and integrate into Waste Management Plan. - Individual construction contractors to acknowledge SGCC integrated Waste Management Plan, - SGCC to implement Environmental Management Plan; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	Contractor	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received
Construction : Sludge	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**LOW**	- Dewatering system for sanitary sludge of construction camp; - Individual construction contractors to acknowledge SGCC integrated Waste Management Plan, - SGCC to implement Environmental Management Plan; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	Contractor	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received
Construction : Industrial waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**LOW**	- Project integrated Waste management System. - Individual construction contractors to acknowledge SGCC integrated Waste Management Plan, - SGCC to implement Environmental Management Plan; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	Contractor	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Construction : Odour	Impact on workforce and communities	Workforce and communities	**MODERATE**	**LOW**	Waste accumulation/treatment area to be chosen depending on minimal effect on communities.	Waste mishandling incidents reported / Internal inspections	Contractor	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received
Construction : Increased number of personnel on site	Decrease of protected species population through wildlife trafficking	Terrestrial fauna	**MODERATE**	**LOW**	-Include ban on wildlife hunting and trade into Construction Management Plan and Site Induction Training	Incident reporting	Contractor	Percent of construction workers who completed induction training – Target 100%
Construction : Oil and chemical spill	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Construction Management Plan to include spill response / kits; - Vehicle maintenance	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Downstream users - ecology	**MODERATE**	**LOW**	- Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Effluent Monitoring	Contractor	Average concentration below guideline values – Target 100%

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Provide sanitary facilities at the site (existing or portable) for the construction workers; - Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Effluent Monitoring	Contractor	Average concentration below guideline values – Target 100%
Construction : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Construction Management Plan to ensure oil/chemical storage areas are adequately bunded to prevent spills entering surface waters; - Include spill response / kits in key areas	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction : Atmospheric Dust Emissions	Impact on local air quality	On-site workers	**HIGH**	**LOW**	- Sprinkling of water to reduce dust; - Covering of loads and stockpile of fine materials with tarps; - Road maintenance graded road and water spraying to earth roads reduce dust; - PPE	Air Quality Monitoring	Contractor	Maximum and average concentrations of dust are below guidelines
Construction : Atmospheric Nox, Sox, CO Emissions	Impact on local air quality	On-site workers	**MODERATE**	**LOW**	- Maintenance of construction machinery, vehicles and generators; - Use of standard Fuel type (low sulphur diesel - lower emissions); - Vehicle checks, and inspection of construction machinery and generators	Air Quality Monitoring	Contractor	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					before use (e.g. visual - exhaust discoloration)			
Construction : Machinery work	Increase in noise and vibration levels	On-site workers	**MODERATE**	**LOW**	- Camp and residential compound location chosen to minimise disturbance effects; - Selecting proper location for generators and other fixed equipment, use of silencers where possible	Noise Monitoring	Contractor	Noise readings are within the guidelines
Construction : Influx of construction workers	Incidences of prostitution and casual sexual relations	Communities and workforce	**HIGH**	**LOW**	The mitigation measures for this impact will be implemented as part of the Social Management Plan.	Incident reporting	Contractor	Percent of local employees hired who can live at home
Construction : Influx of construction workers	Additional pressure on local resources outside of local communities	Communities and workforce	**HIGH**	**LOW**	The mitigation measures for this impact will be implemented as per of the Construction Management Plan and the Health and Safety Management Plan. Minimize influx of job seekers to the project area through clear communication campaign of employment opportunities. Monitor the rate of expansion for in-migration	Incident reporting	Contractor	No of scheduled communication campaign of employment opportunities Percent of local employees hired who can live at home
Construction : Influx of construction workers	Women security	Communities and workforce	**HIGH**	**MODERATE**	The mitigation measures for this impact will be implemented as part of the Social Management Plan. Provide workers with an induction kit / training specifying community and company expectations of the workers behaviour. Code of Conduct will include zero tolerance and disciplinary procedures for inappropriate behaviour. Camp management policy in order to limit workforce interaction with local population	Incident reporting	Contractor / SGCC	Percent of construction workers who completed induction training – Target 100% / All personnel sign Code of Conduct / 0 incidents of inappropriate behaviour is recorded

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					Maintain grievance mechanism for communities to register issues / comments.			
Construction : Influx of construction workers	Alcohol and drugs	Communities and workforce	**HIGH**	**MODERATE**	The mitigation measures for this impact will be implemented as part of the Social Management Plan. Code of Conduct includes zero tolerance for drug and alcohol use. This information will be included in the Induction training. Camp management policy in order to limit workforce interaction with local population Random drug and alcohol tests will be conducted on the personnel. Promote alcohol free recreational activities outside working hours.	Incident reporting	Contractor	Percent of construction workers who completed induction training – Target 100% / All personnel sign Code of Conduct / 0 incidents of inappropriate behaviour is recorded / 0 positive drug and/or alcohol use results
Construction : Influx of construction workers	Cultural clashes	Communities and workforce	**MODERATE**	**LOW**	The mitigation measures for this impact will be implemented as part of the Social Management Plan. Provide workers with cultural awareness briefing during induction if required.	Incidents reporting	Contractor	Percent of local employees hired / 0 incidents of cultural clashes recorded
Construction : Influx of construction workers	Increase of STD rates and the capacity of local medical facilities to cope	Communities and workforce	**HIGH**	**MODERATE**	The mitigation measures for this impact will be implemented as part of the Social Management Plan and Health and Safety Plan including including development of a camp management policy in order to limit workforce interaction with local population; Measures to screen and test worker health to manage potential health impact related to community-worker force interactions .	Incident reporting	Contractor / SGCC	Emergency Response Procedures developed and reviewed annually / Agreements with Regional medical facilities in place/ Acceptance of Camp Management Policy by all

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					Provision of an onsite medical service for the additional workforce. Liaison with regional health / emergency services providers as part of Emergency Response Plan			personnel residing on the camp. Measures in place to scree and test workforce
Construction : Influx of construction workers	Road traffic accidents	Communities and workforce	**HIGH**	**MODERATE**	The mitigation measures for this impact will be implemented as part of the Construction Management Plan and the Health and Safety Management Plan. Traffic Management Plan will provide measures to reduce risk of accidents and Road safety awareness initiatives for personnel and residents.	Incidents reporting	Contractor	0 road traffic accidents
Construction : Influx of construction workers	Livestock loss in road accidents	Communities and workforce	**MODERATE**	**LOW**	The mitigation measures for this impact will be implemented as part of the Health and Safety Management Plan as the site workers will receive training in road safety. Traffic Management Plan will provide measures to reduce risk of accidents and Road safety awareness initiatives for personnel and residents.	Incidents reporting	Contractor	0 incidents of livestock loss in road accidents
Construction : Influx of construction workers	Inflation, increased prices for basic household items	Communities and workforce	**HIGH**	**MODERATE**	The impacts of inflation will aim to be localised within the workers camp as to not impact upon local communities, through provision of a shop (s) within the work camp for workers to purchase their goods. A formal monitoring system will be devised in order to assess inflatory impacts, through regular consultation with the Community Liaison Officer (CLO). Feedback from the CLO includes comments on an increase in prices, a more formal monitoring system will be devised in order to monitor the prices of staple goods and services in local markets on	Increased prices reporting	Contractor / SGCC	No increase in prices of staple goods and services in local markets

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					a monthly basis. This will be carried out both within the Local and Regional Study Areas, in order to determine whether inflation is a localised impact.			
Construction : Oil and chemical spill	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	Construction Management Plan to include spill response / kits; - Vehicle maintenance	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Effluent Monitoring	Contractor	Average concentration below guideline values – Target 100%
Construction : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	Provide sanitary facilities at the site (existing or portable) for the construction workers; - Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Incident reporting	Contractor	Percent of Section Engineers who have completed 'Spill response awareness' training; – Target 100% Toolbox talks on spill response – Target 100% of staff handling chemicals
Construction : Water Supply	Increased abstraction from KMC	Downstream users - social	**MODERATE**	**LOW**	Construction management plan to include measures that minimise water use	Abstraction Metering	Contractor	Water efficiency measures with consumption target top 10% of

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
								industry benchmark
Construction camp : Water Supply	Increased abstraction from KMC	Downstream users - social	**MODERATE**	**LOW**	Implement water saving measures within temporary camp facilities	Abstraction Metering	Contractor	Water efficiency target with consumption of 150 l/c/d
Construction Camp : Off-specification effluent discharge from WWTP	Contamination of surface water course from construction WWTP	Downstream users - social	**MODERATE**	**LOW**	- Effluent to be treated to acceptable standard prior to discharge; - Construction Management Plan to include monitoring of effluent discharges	Effluent Monitoring	Contractor	Average concentration below guideline values – Target 100%

11.3 Preliminary Environmental and Social Management and Monitoring Plan - Operation

Table 50: Preliminary Environmental and Social Mitigation Plan – Operation

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Operation : GHG emissions	Climate change	Atmosphere	**MODERATE**	**MODERATE**	Design in accordance with applicable standards and codes	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Flood and drainage management	Flood damage	Project Assets	**MODERATE**	**LOW**	Design to include allowance for climate change	Inspections	SGCC	No damage from upto 1 in 200 year event
Operation : Water supply	Drought and localised water shortages	Project Assets	**MODERATE**	**LOW**	Lake to be used for storage during drought conditions as part of drought management plan	Abstraction Metering	SGCC	Water efficiency target to reduce consumption 10% year-on-year

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Operation : Oil and chemical spill	Contamination of surface water course	Surface Water	**MODERATE**	**LOW**	Separate drainage systems for clean and "dirty" storm water runoff from paved areas - Environmental Management Plan for accidental / unplanned spills	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Oil and chemical spill	Contamination of surface water course	Groundwater	**MODERATE**	**LOW**	Separate drainage systems for clean and "dirty" storm water runoff from paved areas - Environmental Management Plan for accidental / unplanned spills	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Surface Water	**MODERATE**	**LOW**	Effluent to be treated to acceptable standard prior to discharge; - Environmental Management Plan to include monitoring of effluent discharges to ensure compliance	Effluent Monitoring	SGCC	Average concentration below guideline values – Target 100%
Operation : Storage of oils, chemicals and fuels	Contamination of surface water course	Surface Water	**MODERATE**	**LOW**	Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for accidental / unplanned releases	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Storage of oils, chemicals and fuels	Contamination of groundwater	Groundwater	**MODERATE**	**LOW**	- Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for accidental / unplanned releases	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Flood and Drainage Management	Contamination of surface water course	Surface Water	**MODERATE**	**LOW**	Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas;	Surface Water Monitoring	SGCC	Average concentration below guideline

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					- Environmental Management Plan to include response for extreme weather events			values – Target 100%
Operation : Flood and Drainage Management	Contamination of groundwater	Groundwater	**MODERATE**	**LOW**	- Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for extreme weather events	Surface Water Monitoring	SGCC	Average concentration below guideline values – Target 100%
Operation : Flaring emissions (NOx, CO, UHC)	Impact on local air quality	On-site workers	**MODERATE**	**NOT SIGNIFICANT**	- Design to complies with permit requirements. - No continuous operational flaring except flare purging - Regular metering of flaring rates prior to combustion through the flare stack - CCTV to monitor Smokey-ness of flare	Air Quality Monitoring	SGCC	Maximum and average concentrations of Nox, Sox, CO emissions are below guidelines
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	Residential areas	**MODERATE**	**NOT SIGNIFICANT**	- Equipment procurement specifications to meet Best Available Technique as well as SGCC and Uzbekistan regulatory requirements; - Operating procedures to be in place; - Emission Monitoring Ports on exhausts of major combustion plant	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	On-site workers	**MODERATE**	**NOT SIGNIFICANT**	- Equipment procurement specifications to meet Best Available Technique as well as SGCC and Uzbekistan regulatory requirements; - Operating procedures to be in place; - Emission Monitoring Ports on exhausts of major combustion plant	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Operation : Venting and fugitive emissions	Impact on local air quality	Residential areas	**MODERATE**	**LOW**	- Design provides for the closed venting of all hydrocarbon systems. Floating roof tanks. - Design for no process venting but for vented hydrocarbons to be routed into a flare system. - Leak detection plan to be in place	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Venting and fugitive emissions	Impact on local air quality	On-site workers	**MODERATE**	**LOW**	- Design provides for the closed venting of all hydrocarbon systems. Floating roof tanks. - Design for no process venting but for vented hydrocarbons to be routed into a flare system	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Domestic waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**NOT SIGNIFICANT**	- Project integrated Waste Management System. - SGCC to implement Environmental Management Plan; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	SGCC	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received
Operation : Sanitary waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**MODERATE**	**NOT SIGNIFICANT**	Project integrated Waste Management System; - Develop a Waste Management Training and Development Plan which includes personal health management issues; - Use of specialized west handling facility or a nearby hospital for disposal/incineration of clinical waste; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	SGCC	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Operation : Sludge	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**NOT SIGNIFICANT**	Project integrated Waste Management System; - SGCC to implement Environmental Management Plan; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	SGCC	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received
Operation : Industrial waste	Impact on soil and water quality, visual impact, social impact, impact on fauna	Soil, water, landscape, communities, fauna	**HIGH**	**LOW**	Project integrated Waste Management System; - SGCC to implement Environmental Management Plan; - Local community grievance plan/procedure.	Waste mishandling incidents reported / Internal inspections	SGCC	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received
Operation : Odour	Impact on workforce and communities	Workforce and communities	**MODERATE**	**LOW**	- Active odour control measures - Sewage treatment odour control. - Waste accumulation/treatment area to be chosen depending on minimal effect on communities.	Waste mishandling incidents reported / Internal inspections	SGCC	0 mishandling of waste incidents reported / Inspections showing Project Waste Management procedures are being followed / 0 local community grievances received

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Operation : Flare noise (intermittent)	Increase in noise levels	Terrestrial fauna	**MODERATE**	**NOT SIGNIFICANT**	The project site is already an industrial area. Habitat for Fauna is not restricted to the project site. The area of influence of noise is limited.	Noise Monitoring	Contractor	Noise readings are within the guidelines
Operation : Oil and chemical spill	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Separate drainage systems for clean and "dirty" storm water runoff from paved areas - Environmental Management Plan for accidental / unplanned spills	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Effluent to be treated to acceptable standard prior to discharge; - Environmental Management Plan to include monitoring of effluent discharges to ensure compliance	Effluent Monitoring	SGCC	Average concentration below guideline values – Target 100%
Operation : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for accidental / unplanned releases	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Flood and Drainage Management	Contamination of surface water course	Downstream users - ecology	**MODERATE**	**LOW**	- Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for extreme weather events	Surface Water Monitoring	SGCC	Average concentration below guideline values – Target 100%
Operation : Water Supply	Increased abstraction from KMC	Downstream users - ecology	**MODERATE**	**LOW**	Recycling of wastewater for process uses to minimise water consumption and abstraction from the KMC; - Value Engineering to assess water efficient equipment / fixings are employed;	Abstraction Metering	SGCC	Water efficiency target to reduce consumption 10% year-on-year &

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					- Irrigation to use drip fed method to conserve water and reduce abstractions; - Water efficient measures within domestic areas			Top 10% on industry benchmark
Operation : Reservoir evaporation (cumulative)	Salinisation of reservoir	Aquatic ecology of reservoir	**HIGH**	**MODERATE**	- Recycling of wastewater for process uses to minimise water consumption and abstraction from the KMC; - Value Engineering to assess water efficient equipment / fixings are employed; - Irrigation to use drip fed method to conserve water and reduce abstractions; - Water efficient measures within domestic areas	Surface Water Monitoring Aquatic Ecology Monitoring	SGCC SGCC	No change in salinity No change in composition of main species
Operation : Reservoir evaporation (cumulative)	Salinisation of reservoir	Terrestrial ecology	**HIGH**	**MODERATE**	- Recycling of wastewater for process uses to minimise water consumption and abstraction from the KMC; - Value Engineering to assess water efficient equipment / fixings are employed; - Irrigation to use drip fed method to conserve water and reduce abstractions; - Water efficient measures within domestic areas;	Surface Water Monitoring Terrestrial Ecology Monitoring	SGCC SGCC	No change in salinity No change in numbers of main species observed on/to the close proximity to the reservoir
Operation : Flaring emissions (NOx, CO, UHC)	Impact on local air quality	On-site workers	**MODERATE**	**NOT SIGNIFICANT**	- Design to comply with permit requirements. - No continuous operational flaring except flare purging; - Regular metering of flaring rates prior to combustion through the flare stack	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
					- CCTV to monitor Smokey-ness of flare			
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	Residential areas	**MODERATE**	**NOT SIGNIFICANT**	- Equipment procurement specifications to meet Best Available Technique as well as SGCC and Uzbekistan regulatory requirements; - Operating procedures to be in place; - Emission Monitoring Ports on exhausts of major combustion plant	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Emissions from combustion sources (cracking heaters, HP boiler)	Impact on local air quality	On-site workers	**MODERATE**	**NOT SIGNIFICANT**	Equipment procurement specifications to meet Best Available Technique as well as SGCC and Uzbekistan regulatory requirements; - Operating procedures to be in place; - Emission Monitoring Ports on exhausts of major combustion plant	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Venting and fugitive emissions	Impact on local air quality	Residential areas	**MODERATE**	**LOW**	Design provides for the closed venting of all hydrocarbon systems. Floating roof tanks. - Design for no process venting but for vented hydrocarbons to be routed into a flare system. - Leak detection plan to be in place "	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Venting and fugitive emissions	Impact on local air quality	On-site workers	**MODERATE**	**LOW**	- Design provides for the closed venting of all hydrocarbon systems. Floating roof tanks. - Design for no process venting but for vented hydrocarbons to be routed into a flare system.	Air Quality Monitoring	SGCC	Maximum and average concentrations of PM, Nox, Sox, CO emissions are below guidelines
Operation : Flare noise (intermittent)	Increase in noise levels	Residential areas	**MODERATE**	**NOT SIGNIFICANT**	Project Stakeholder Engagement Program ; Noise modelling to identify significance of noise issue to receptors and adopted measures (e.g. noise barriers) if deemed necessary. - Level of noise on sensitive receptors need to be confirmed	Noise Monitoring	SGCC	Noise readings are within the guidelines

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST - MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Operation : Flare noise (intermittent)	Increase in noise levels	On-site workers	**HIGH**	**LOW**	- Onsite offices to be noise proof; - Use of PPE when flare is operational.	Noise Monitoring	SGCC	Noise readings are within the guidelines
Operation : Oil and chemical spill	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	- Separate drainage systems for clean and "dirty" storm water runoff from paved areas - Environmental Management Plan for accidental / unplanned spills	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Off-specification effluent discharge from WWTP	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	- Effluent to be treated to acceptable standard prior to discharge; - Environmental Management Plan to include monitoring of effluent discharges to ensure compliance	Effluent Monitoring	SGCC	Average concentration below guideline values – Target 100%
Operation : Storage of oils, chemicals and fuels	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	- Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for accidental / unplanned releases	Incident reporting	SGCC	Percent of operators who have completed 'Spill response awareness' training – Target 100%
Operation : Flood and Drainage Management	Contamination of surface water course	Downstream users - social	**MODERATE**	**LOW**	- Oil/chemical storage areas to be adequately bunded (110%); - Spill kits to be located in key areas; - Environmental Management Plan to include response for extreme weather events	Surface Water Monitoring	SGCC	Average concentration below guideline values – Target 100%
Operation : Water Supply	Increased abstraction from KMC	Downstream users - social	**MODERATE**	**LOW**	Recycling of wastewater for process uses to minimise water consumption and abstraction from the KMC; - Value Engineering to assess water efficient equipment / fixings are employed; - Irrigation to use drip fed method to conserve water and reduce abstractions; - Water efficient measures within domestic areas	Abstraction Metering	SGCC	Water efficiency target to reduce consumption 10% year-on-year & Top 10% on industry benchmark

11.4 Preliminary Environmental and Social Management and Monitoring Plan – Decommissioning

Table 51: Preliminary Environmental and Social Mitigation Plan – Decommissioning

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
Decommissioning : Reservoir closure	No water in reservoir	Aquatic ecology of reservoir	**HIGH**	**MODERATE**	Decommissioning management plan to assess ecological potential	Surface Water Monitoring	SGCC	No change in salinity
						Aquatic Ecology Monitoring	SGCC	No change in composition of main species
						Abstraction Metering	SGCC	Water efficiency target to reduce consumption 10% year-on-year & Top 10% on industry benchmark
Decommissioning : Reservoir closure	No water in reservoir	Terrestrial ecology	**HIGH**	**MODERATE**	Decommissioning management plan to assess ecological potential	Surface Water Monitoring	SGCC	No change in salinity
						Terrestrial Ecology Monitoring	SGCC	No change in numbers of main species observed on/to the close proximity to the reservoir
							SGCC	Water efficiency target to reduce consumption

PROJECT ACTIVITY / ASPECT	POTENTIAL IMPACT	RECEPTOR	IMPACT SIGNIFICANCE PRE-MITIGATION	IMPACT SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURE	MONITORING / MEASUREMENT	RESPONSIBLE	PERFORMANCE INDICATOR
						Abstraction Metering		10% year-on-year & Top 10% on industry benchmark
Decommissioning : Plant closure and no aqueous discharge	Low flow in canals	Downstream users - social	**MODERATE**	**LOW**	Decommissioning management plan to assess reduced flow and alternative sources for downstream users	Abstraction and Discharges Metering	SGCC	Water efficiency target to reduce consumption 10% year-on-year Abstraction and discharges data is in line with the estimates for Decommissioning phase

11.5 Monitoring Plan

Monitoring frequency is considered through each phase of the project development based on potential vulnerabilities associated with each phase: construction, operation and decommissioning. All data should be reviewed on collection and an annual review undertaken in order to ensure QA/QC.

Table 52: Environmental and Social Monitoring Plan – All Phases

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
Construction	**Effluent discharge**	5	Monthly	Continuous WWTP monitoring at every discharge point from the workers camps into the Canal to standards in Table 23 of ESIA.
	Water use		Continuous	Metering of intake volumes to be continuously recorded and reported in line with permit but as a minimum quarterly
	Air Quality	5	Quarterly	Air quality monitoring will be carried out using approved online monitoring equipment for PM, CO, SOx NOx and unburnt HC. (1-hour and 24-hour averages) will be taken in eight points at the following locations: • Otkuduk village; • Navbahor village; • Southeast farms (about 8 km southeast of the plant); • Facilities located at 3 km northeast of the plant; • Dam and reservoir; • Oltin Yo'l GTL facilities; • Oltin Yo'l GTL residential complex; • Inside the plant (New Guard house). Alternatively the samples will be taken at the same points using diffusion tubes and analysed for PM, CO, SOx, NOx and unburnt HC. . Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate. The metadata assists in the analysis of results and can provide an explanation when comparing monitoring results from different times. Ongoing trends in air quality will be assessed each year in the annual reports.
	Noise	5	Quarterly	Noise levels will be measured in five points at the following locations: • Otkuduk Village; • SGCC Staff Accommodation Complex;

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
				• SGCC / OLTIN YO'L GTL Construction Camp; • Navbahor Village; • Inside the plant (New Guard house). Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate. The metadata assists in the analysis of results and can provide an explanation when comparing monitoring results from different times.
	Avifauna	5	Bi-annually	Monitoring of avifauna during spring and autumn migration seasons around the Man-made Reservoir. The following parameters to be recorded: • Number of species; • Species behaviour; • Number of nesting species and pairs; • Population sizes; • Density. Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate.
	Aquatic Ecology	5	Annually	Monitoring of the Reservoir to be carried out in Summer. The following parameters to be recorded: Phytoplankton and zooplankton: • Total number of species; • Dominant species; • Total count; • Total biomass; • Saprobity index; and • Water quality class. Zoobenthos: • Total number of species; • Dominant species; • Total biomass; • Number of species groups; • Biomass of the main groups. Aquatic plants: • Total number of species; • Dominant species; • Cover area %. Fish: • Total number of species; • Dominant species. Metadata must accompany all field recordings, e.g. time of day, weather, aspect as appropriate.

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
	Vegetation	5	Annually	Monitoring to be carried out in Spring. Locations of plot points as per Baseline monitoring carried out by Karshi State University in May –July 2017 (Plots 1-4) The following data to be collected: • % plant cover • Plant diversity • Change in dominant species • Presence of invasive species and their abudance Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate.
Operation	**Effluent discharge**	25	Annual[5]	Continuous WWTP monitoring to meet standards in Table 23 of ESIA at three locations: • two discharge points into the Canal (mineral flow outfall and outfall from treatment ponds, figure 19 in ESIA Vol II); and • the accommodation block outfall.
	Water use		Continuous	Metering of intake volumes to be continuously recorded and reported in line with permit but as a minimum annually
	Air Quality	25	Quarterly	Air quality monitoring will be carried out using approved online monitoring equipment for PM, CO, SOx NOx and unburnt HC (1-hour and 24-hour averages) will be taken in eight points at the following locations: • Otkuduk village; • Navbahor village; • Southeast farms (about 8 km southeast of the plant); • Facilities located at 3 km northeast of the plant; • Dam and reservoir; • Oltin Yo'l GTL facilities; • Oltin Yo'l GTL residential complex; • Inside the plant (New Guard house).

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
				Alternatively the samples will be taken at the same points using diffusion tubes and analysed for PM, CO, SOx, NOx and unburnt HC. Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate. The metadata assists in the analysis of results and can provide an explanation when comparing monitoring results from different times. Ongoing trends in air quality will be assessed each year in the annual reports.
	Noise	25	Quarterly	Noise levels will be measured in five points at the following locations: • Otkuduk Village; • SGCC Staff Accommodation Complex; • SGCC / OLTIN YO'L GTL Construction Camp; • Navbahor Village; • Inside the plant (New Guard house). Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate. The metadata assists in the analysis of results and can provide an explanation when comparing monitoring results from different times.
	Avifauna	25	Bi-annually	Monitoring of avifauna during spring and autumn migration seasons around the Man-made Reservoir. The following parameters to be recorded: • Number of species; • Species behaviour; • Number of nesting species and pairs; • Population sizes; • Density. Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate.
	Aquatic Ecology	25	Annually	Monitoring of the Reservoir to be carried out in Summer. The following parameters to be recorded: Phytoplankton and zooplankton: • Total number of species; • Dominant species;

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
				• Total count; • Total biomass; • Saprobity index; and • Water quality class. Zoobenthos: • Total number of species; • Dominant species; • Total biomass; • Number of species groups; • Biomass of the main groups. Aquatic plants: • Total number of species; • Dominant species; • Cover area %. Fish: • Total number of species; • Dominant species. Metadata must accompany all field recordings, e.g. time of day, weather, aspect as appropriate.
	Vegetation	25	Annually	Monitoring to be carried out in Spring. Locations of plot points as per Baseline monitoring carried out by Karshi State University in May –July 2017 (Plots 1-4) The following data to be collected: • % plant cover • Plant diversity • Change in dominant species • Presence of invasive species and their abudance Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate.
Decommissioning	**Effluent discharge**	5	Annual[5]	Continuous WWTP to standards in Table 23 of ESIA and at • the two discharge points into the Canal (mineral flow outfall and outfall from treatment ponds, figure 19 in ESIA Vol II) ; and • workers camp outfall
	Water use		Continuous	Metering of intake volumes to be continuously recorded and reported in line with permit but as a minimum quarterly
	Soil sampling		Single	Soil sampling plan to be devised based on decommissioning

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
	Air Quality	5	Quarterly (or monthly if decommissioning period is short)	Air quality monitoring will be carried out using approved online monitoring equipment for PM, CO, SOx NOx and unburnt HC. (1-hour and 24-hour averages) will be taken in eight points at the following locations: • Otkuduk village; • Navbahor village; • Southeast farms (about 8 km southeast of the plant); • Facilities located at 3 km northeast of the plant; • Dam and reservoir; • Oltin Yo'l GTL facilities; • Oltin Yo'l GTL residential complex; • Inside the plant (New Guard house). Alternatively the samples will be taken at the same points using diffusion tubes and analysed for PM, CO, SOx, NOx and unburnt HC Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate. The metadata assists in the analysis of results and can provide an explanation when comparing monitoring results from different times. Ongoing trends in air quality will be assessed each year in the annual reports.
	Noise	5	Quarterly (or monthly if decommissioning period is short)	Noise levels will be measured in five points at the following locations: • .Otkuduk Village; • SGCC Staff Accommodation Complex; • SGCC / OLTIN YO'L GTL Construction Camp; • Navbahor Village; • Inside the plant (New Guard house).

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
				Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate. The metadata assists in the analysis of results and can provide an explanation when comparing monitoring results from different times.
	Avifauna	5	Bi-annually	Monitoring of avifauna during spring and autumn migration seasons around the Man-made Reservoir. The following parameters to be recorded: • Number of species; • Species behaviour; • Number of nesting species and pairs; • Population sizes; • Density. Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate.
	Aquatic Ecology	5	Annually	Monitoring of the Reservoir to be carried out in Summer. The following parameters to be recorded: Phytoplankton and zooplankton: • Total number of species; • Dominant species; • Total count; • Total biomass; • Saprobity index; and • Water quality class. Zoobenthos: • Total number of species; • Dominant species; • Total biomass; • Number of species groups; • Biomass of the main groups. Aquatic plants: • Total number of species; • Dominant species; • Cover area %. Fish: • Total number of species; • Dominant species. Metadata must accompany all field recordings, e.g. time of day, weather, aspect as appropriate.

PROJECT PHASE	ENVIRONMENTAL MEASUREMENT	TIME (YEARS)	SAMPLING FREQUENCY	COMMENTS
	Vegetation	5	Annually	Monitoring to be carried out in Spring. Locations of plot points as per Baseline monitoring carried out by Karshi State University in May –July 2017 (Plots 1-4) The following data to be collected: • % plant cover • Plant diversity • Change in dominant species • Presence of invasive species and their abundance Metadata must accompany all field recordings, e.g. time of day, weather, substrate, aspect as appropriate.

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