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REPUBLIC OF UZBEKISTAN

MINISTRY OF AGRICULTURE AND WATER RESOUCES

SOUTH KARAKALPAKSTAN WATER RESOURCES MANAGEMENT IMPROVEMENT PROJECT

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT PLAN

March, 2013
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1 INTRODUCTION

The purpose of this report is an environmental impact assessment of the South Karakalpakstan Water Resources Management Improvement Project.

Irrigation is the basis of agriculture in Uzbekistan, where majority of the existing irrigation and drainage infrastructure have been built in 60s-70s of the last century. The deterioration of the irrigation and drainage system as well as luck of operation and maintenance financial support have led to the decreased efficiency of the system and continued soil salinization due to the raise of ground water level. The Ministry of Agriculture and Water Resources of the Republic of Uzbekistan (MAWR) has adopted a policy aiming at modernization and sustainable development of agriculture; improvement and introduction of modern agrotechnologies in agricultural production; coordination of activities of different sub-sectors, sections and organizations serving agricultural commodity producers on the basis of market principles and mechanisms; transition from administrative-territorial to basin principle of irrigation systems management, and also introduction of market principles to irrigation water use at all levels. The Republic of Karakalpakstan constituting about 40% of the territory of the country is one of the priority areas where improved agricultural and irrigation and drainage practices are heavily promoted.

Karakalpakstan is located in the lower reaches of the Amudarya River, in the south-east corner of the Usturt plateau, the southern part of the Aral Sea and the Amudarya delta, and the western part of the Kyzyl-Kum desert. The current inefficient agricultural practices have caused a great drop in the Amudarya and Syrdarya flows into the Aral Sea. The total area of land resources of Southern Karakalpakstan is 1,682,411 hectares, out of which about 250,650 hectares are considered suitable for irrigation and 97,917 hectares are currently irrigated by MAWR. However, recently the considerable part of those lands has become infertile. Amudarya is the main source for the irrigation water; natural drainage is limited in the irrigated area, hence artificial drainage is required. The irrigated area is being served by a system of canals taking water directly from the Tuyamuyun reservoir either via the Right Bank Canal (RBC) or by pump stations located along the Amudarya. Further, irrigation water intake from the river is done trough the main canals along the river; in the downstream of Amudarya water is taken from the Takhiatash dam, and below the river flows into the Aral Sea.

The Government of the Republic of Uzbekistan (GoU), with the assistance of the World Bank, is preparing the South Karakalpakstan Water Resources Management Improvement Project (SKWRMIP).

- Almost the whole drainage network of the SKRB system has been successfully reconstructed under the DIWIP using the WB financing of about 60 million US dollars. DIWIP focused mainly on improvement of the drainage system which depended mostly on pump stations and was affected by clogging and inadequate hydraulic gradients. The DIWIP has essentially contributed to the improvement of drainage and ground water conditions in this area, and also starts to influence some institutional issues. Currently, water intake from the SKRB is being done by gravity through the newly built main drainage collector and the reconstructed network of on-farm and inter-farm drainage (performed under DIWIP), which has resulted in significant reduction of areas of lands with high groundwater level. Nevertheless, the remaining two issues preventing from establishing an efficient control over the use of water resources, are as follows: Limited capacity of personnel of water resource management agencies;
- Unreliable water supply, which does not allow for proper planning and distribution of water resources. Resulting form that, there is a low motivation for involved stakeholders (water management agencies) to introduce efficient water use practices.

Unsatisfactory condition of irrigation network (the overwhelming majority of earthen canals) and water supply system are the main reasons for irretrievable water losses.

Building on DIWIP's achievements, the SKWRMIP will emphasize the improved water resources management of the combined system of irrigation and drainage in general and irrigation aspects of the system in particular. Further increase in the crop yields in total and per hectare will depend on the improved water resources management.

The proposed project interventions will generate long-term positive environmental implications through improved irrigation network, such as reliable irrigation water supply, more efficient use of water resources, decreased water turbidity, reduced water losses due to reconstruction of canal lining, decreased energy consumption due to switch to the gravity water supply vs. currently used pumping stations to be decommissioned as a result of the project.

In recent years, a number of surveys and investigations of the irrigation and drainage system in South Karakalpakstan has been conducted, and possible ways of its improvement explored. The proposed project will also directly benefit from the achievements under the previously implemented DIWIP and RESP.

Arable and livestock farming is prevailing type of farming in the economic structure of the Republic of Karakalpakstan. The main crops are cotton, wheat, and rice. Among other crops are cucurbits and fodder crops. Arable lands, haylands, and pastures for Karakul sheep make over 22% of the land area.

South Karakalpakstan Water Resources Management Improvement Project (SKWRMIP) is aimed at overcoming obstacles to productivity of agriculture in the region of South Karakalpakstan (SK), – in particular, on the area of about 100,000 ha located in Beruni, Ellikkala and Turtkul districts.

The irrigated area is being served by a system of canals taking water directly from the Tuyamuyun reservoir either via the Right Bank Canal (RBC) or by pump stations located along the Amudarya. Further, irrigation water intake from the river is done trough the main canals along the river; in the downstream of Amudarya water is taken from the Takhiatash dam, and below the river flows into the Aral Sea.

The main purpose of SKWRMIP is to improve the management of irrigation water resources in SKRB zone. Of primary importance is provision of agricultural benefits as a result of improvement of water resources management.

The improvement of sanitary and environmental state of the lower reaches of Sub-Aral area directly depends on the availability and quality of water in the Amudarya River. The only used water resource in the Project zone is the Amudarya River. Supply of water to South Karakalpakstan depends exclusively on the consumption in Amudarya which fluctuates every year. Consumption depends significantly on decisions on water intake and outflow, as well as on the quality of water in the river.

The Project covers the area of (approximately) 100,000 ha, the same as DIWIP, which is approximately 6% of the total area of the three Project districts.

The northern border of the Project zone is on the edge of the desert that lies to the east of the Amudarya. The eastern border is along the line of the collector VST-2 and the Yanbash canal, and the borders in the south and west are formed by the Amudarya.

The Project zone is considered to comprise the following:

- Direct gravity from Tuyamuyun water reservoir through the Right Bank Canal.
- Direct gravity from the river to Pakhta-Arna Canal.
- The flow supplied by pumping station Kilchinak (30 m^3/s).
- The flow supplied by pumping station Nayman-Beshtam (22.5 m^3/s).

The improvement of operation and maintenance system to be supported under the project will increase the irrigated area form current 85,000 ha up to 100,000 ha. This Environmental Impact Assessment has been carried out to identify the key environmental issues in the Project zone, to estimate potential impact of the proposed Project compared to the current state of the environmental in the project area, suggest mitigation measures and monitoring program as well as identify the implementation arrangements to ensure environmental compliance of the proposed Project.

As part of the environmental analysis, the following studies have been conducted:

- Analysis of baseline environment conditions before reconstruction;
- Analysis of existing condition of irrigation network;
- Environmental analysis of design decision in terms of environmental impact and sufficiency of mitigation measures proposed by the project;

- Analysis of alternative options;
- Analysis of possible emergency conditions and prevention measures;
- Forecast and analysis of environmental change as a result of foreseen activity.

The main problems in the Project area are the inefficient use of water resources due to seepage and evaporation losses, erosion of Amudarya River right bank, and increased level of ground waters occurrence.

For preparation of this report the Decree of the Cabinet of Ministers of the Republic of Uzbekistan of 31 December 2001 "Regulation for state ecological expertise in the Republic of Uzbekistan" and Decree of the Cabinet of Ministers of the Republic of Uzbekistan № 152 dd.5.06.2009, according to which reconstruction and ameliorative improvement of old irrigated lands at the areas of more than 1,000 ha is concerned to the II category of environmental impact with the middle degree of environmental risk (cl.44) were considered.

The South Karakalpakstan Water Resources Management Improvement Project (SKWRMIP) has been devised to address constraints on agricultural productivity within the South Karakalpakstan (SK) region, specifically at approximately 100 000 ha located within Beruni, Ellikkala and Turtkul tumans. These tumans are all on the right bank of the river and lie in the south of the Autonomous Republic of Karakalpakstan (**Figure 1**).

The Project Area covers the same 100 000 ha (approximately) area as DIWIP. This is some 6% of the total area of the three project tumans. The boundary to the north of the project area follows the desert edge running eastward from the Amudarya. The eastern boundary follows the line of collector VST-2 and the Yanbash Canal, while the Amudarya forms the boundary to the south and west.

The project area will include (i) canals which take water from Amudarya, either by gravity from Tuyamuyun Reservoir or from the 24 or so pumping stations which lift water from the Amudarya (**Figure 2**); and (ii) complementary drainage system to the above area, to the connection with SKMD (South Karakalpakstan Main Drain) (**Figure 3**).

Figure 1: General Layout of the Project Area

Figure 2: Irrigation Network in the Project Area

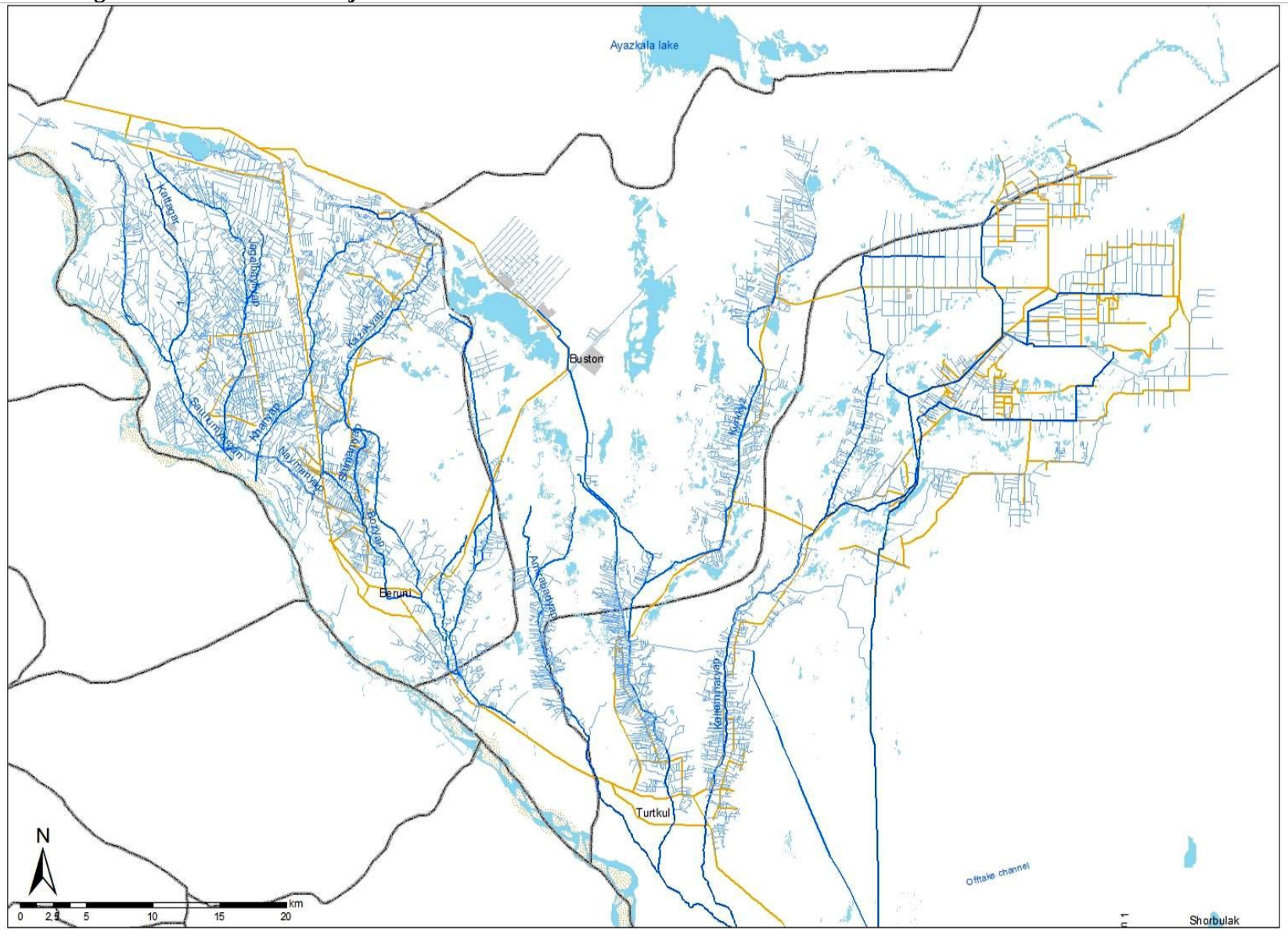
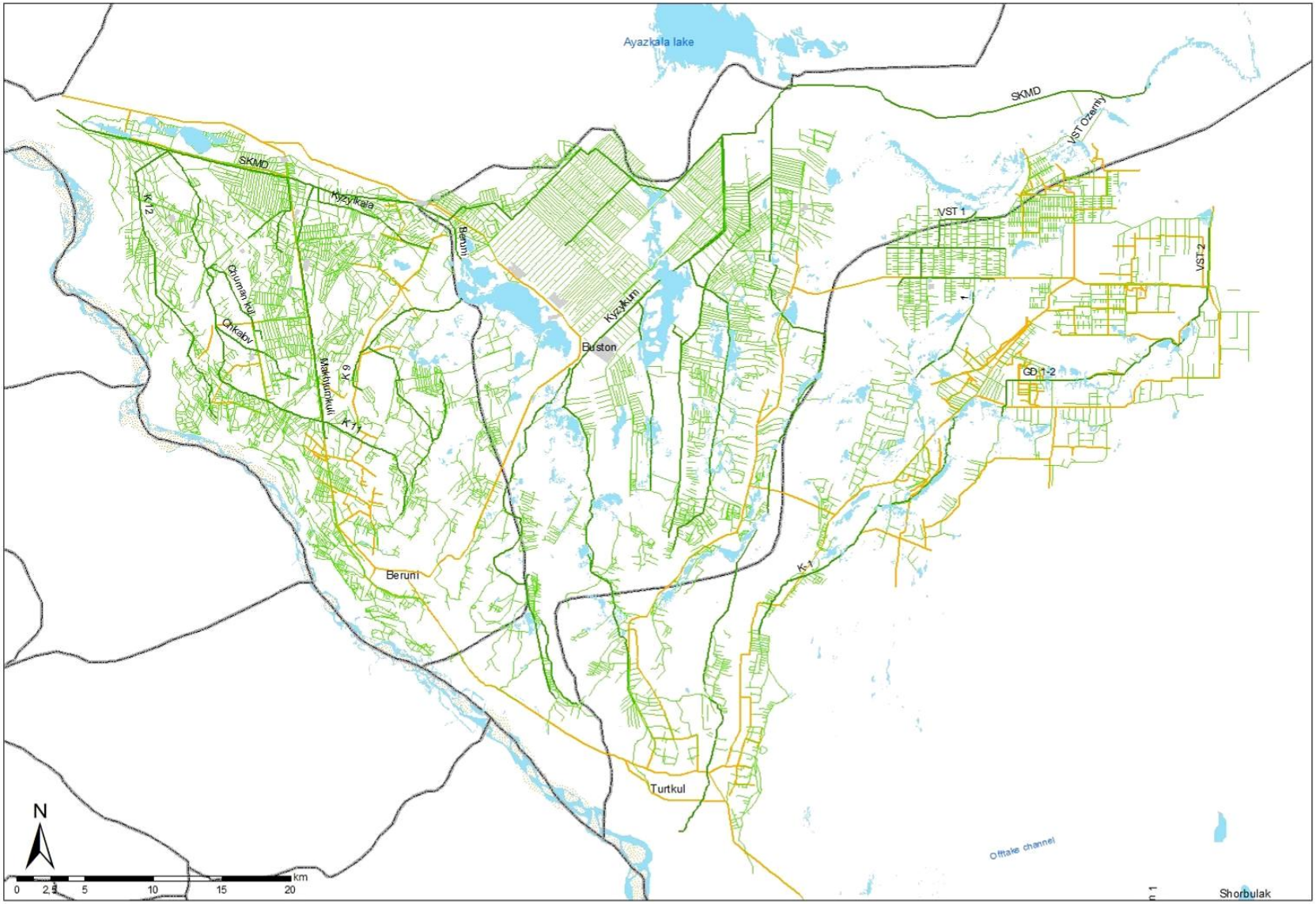


Figure 3: Drainage Network in the Project Area



The overwhelming focus of SKWRMIP is the system of canals and its operation. Selective improvements to the drainage system have been considered where crucial for the improvement in water management, and which are not due for rectification under DIWIP, or are a matter of deferred maintenance.

The focus of SKWRMIP is an improvement of the irrigation water management in the SKRB area, which shall bring condiefrable agricultural benefits.

Besides that, the project will be directly aimed at solution of institutional and operational problems which Water Users' Associations (WUAs) face in present, by provision of financial and technical support to them in the districts covered by the project. Implementation of the project will promote improvement of environmental conditions in the project rayons.

The total area of project rayons (Beruni, Ellikkala, Turtkul) – 1,682,411 hectares, 97,917 hectares of which are irrigated lands, including 33,115 hectares of the Beruni district, 33,051 hectares of the Ellikkala district, and 31,751 hectares of the Turtkul district.

Districts of SKWRMIP project are located in the south of Karakalpakstan where most often problems are salinity and water logging and where, within the framework of earlier implemented DIWIP financed by the Bank, these issues have been solved.

For achievement of the main objectives of the project, which are more efficient water use and increase of productivity and sustainability of agriculture and agribusiness in the studied three districts, the complex of interrelated actions is proposed. The proposed activities, considered for the implementation within the period of 6 years, include:

- ensuring constantly reliable water flow to the system of canals; four alternative design options have been considered;
- completion of the construction of 70 km Bustan Canal with three large hydraulic structures, 25 km of which passes through the desert;
- reprofiling of Pakhta-Arna and Old Bozyap canals;
- reconstruction of 42 bridges and construction of 12 hydraulic structures;
- construction of new outlet canal of about 1.75 km length on the Right Bank Canal (RBC) from PK:38 to the river, through fields, with 60 m^3/s discharge, for maintenance of the minimum flow in RBC;
- construction of a new section from the Old Bozyap Canal to Nayman Beshtam pump station:
- construction of tail escape canal to the river by reshaping the short supply canal of Nayman Beshtam pump station;
- Pakhta-Arna system: Kelteminar and Bogyap canals will require considerable filling works for cross-section change according to the new, considerably smaller discharge.

The Environmental Assessment of South Karakalpakstan Water Resources Management Improvement Project is subject to ecological examination in the Republic of Uzbekistan (Decree of the Cabinet of Ministers of RUz №491 dd. 31.12.01, appendix 2).

2 LEGISLATION AND REGULATORY FRAMEWORK

National Environmental Legislation

The rights and obligations of the citizens of Uzbekistan in the field of environmental protection and natural resources management are stipulated by Articles 50 and 55 of the Constitution of Uzbekistan. There are also more than 100 laws, about 50 Decrees of the President and Decrees of the Cabinet of Ministers of the Republic of Uzbekistan and other bylaws and standard documents, forming the environmental legislation of Uzbekistan.

- The following legal acts, laws and bylaws govern the environmental compliance of the activities of the proposed project:«On nature protection» (1992);
- «On water and water use» (1993);
- «On ecological expertise» (2000);
- «Land code» (1998);
- "On the concept of national safety" (1997);
- "On protection of agricultural plants from pests, illnesses and weeds" (2000)
- «On State sanitary epidemiological inspectorate in the Republic of Uzbekistan» (1992);
- «On protection and use of objects of cultural heritage» (2001)
- «On especially protected territories» with alterations and amendments (30.08.93)
- «On protection and use of flora» (dd. December, 26th 1997)
- «On protection and use of fauna» (dd. December, 26th 1997)
- «On protection of atmospheric air» (dd. December, 27th 1996)
- «On wastes» dd. 05.04.2002
- «On protection of population and territories from emergency situations of natural and anthropogenic nature» dd. 20.08.1999.
- «On alterations and amendments, as well as recognition of some resolutions of the Government of the Republic of Uzbekistan as invalid» (№ 152 dd. 5.06.2009);
- «On approval of Regulation on state ecological expertise» (№ 491, 31.12.2001);
- «On giving of the status of especially protected natural territories to the zones of formation of fresh ground waters deposits» (№ 23, 16.01.2002);
- «On approval of the monitoring program of environment in the Republic of Uzbekistan for 2006-2010» (№ 48, 16.03.2006);
- «Regulation on water protection zones of water basins and other reservoirs, rivers and main canals and collectors, as well as the sources of drinking and household water supply, medical and cultural-improving purpose in the Republic of Uzbekistan», № 174, 07.04.92.
- « On improvement of hydro meteorological service » (№ 183, 14.04.2004);
- «On approval of Regulation on the order of cadastral division of the territory of RUz and generation of cadastral numbers of land plots, buildings and constructions» (№ 492, 31.12.2001);
- «On approval of Regulation on the state monitoring of environment in the Republic of Uzbekistan» (№111dd. April, 3rd 2002.)
- «On keeping the state land cadastre» (№543 dd. 31.12.1998).
- «On introduction of payment for the above-standard discharge (dumps) of polluting substances to environment and disposal of wastes», 29.06.92

- «On the forecast of key macroeconomic indicators and the State budget of the Republic of Uzbekistan for 2000», 31.12.1999.

Requirements of the Republic of Uzbekistan on environmental assessment

The state ecological examination is regulated by the laws of the Republic of Uzbekistan «On nature protection», «On ecological examination», decrees of the Cabinet of Ministers of the Republic of Uzbekistan № 491 dd. 12/31/2001 «On approval of Regulation On the state ecological examination in the Republic of Uzbekistan», № 152 dd. 6/5/2009 «On amendments and additions, as well as recognition of becoming invalid of some resolutions of the Government of the Republic of Uzbekistan» and other laws and legal acts.

The specified documents establish the types of projects and activities which are subject to the state ecological expertise, and associated environmental impact categories as follows:

- Category 1 – high risk;
- Category 2 – middle risk;
- Category 3 – low risk;
- Category 4 – local impact.

The Appendix to the Decree of the Cabinet of Ministers №152 details the types of activities for each category. This includes as per paragraph 44 of the Decree, «Reconstruction and ameliorative improvement of the old irrigated lands on the areas of more than 1000 hectares», category 2 (middle risk) is applicable to the project activities (i.e. 100 000 hectares of lands will be improved).

The national EA requirements call for the EA to include technical assessment, assessment of institutional set up, and development of the Environmental Management Plan.

The state ecological expertise is conducted by specialized departments of uniform system of state ecological expertise of State Nature Committee of the Republic of Uzbekistan (Goskompriroda) for the purpose of definition of conformity of planned or carried out economic activities to environmental requirements.

State Nature Protection Policy

There is a set of programmatic documents on environmental protection, which have been developed and being implemented with support of international organizations and participation of environmental NGOs:

- Action plan for environmental protection in the Republic of Uzbekistan for 2008-2012
- National Action Plan to combat desertification (1998);
- Intermediate strategy for improvement of living standard (2003)
- Program for provision of population of rural areas and cities with qualitative potable water and economic use of natural gas
- Investment program of the Republic of Uzbekistan for 2009-2012, etc.

International agreements on environmental protection and transboundary impact

Uzbekistan, as an independent state, has become the Party to bilateral and multilateral agreements and participates in regional initiatives in the field of joint water resources management and ecology in the Central Asia. An important stimulus for strengthening the dialogue and cooperation between the countries of Aral Sea basin was signing of number of intergovernmental agreements, such as:

- Agreement between the Government of the Republic of Uzbekistan and the Government of Kyrgyz Republic on cooperation in the field of environment protection and rational nature management (24.12.1996)

- Agreement between the Government of the Republic of Kazakhstan, the Kyrgyz Republic and the Republic of Uzbekistan "On cooperation in the field of environment protection and rational nature management" (Bishkek, 17.03.1998);
- Agreement between Kazakhstan, Kyrgyzstan and Uzbekistan "On use of water and power resources in Syrdarya river basin" (Bishkek; March, 17th 1998), etc.
- Decision of the Heads of the states of Central Asia «On the main directions of the Program on specific actions on improvement of environmental and social-economic conditions in Aral Sea basin for the period of 2003-2010», signed on 10/6/2002 in Dushanbe.

Global and Regional Agreements

In the context of global environment management the Republic of Uzbekistan is the Party of three Rio Conventions: Framework Convention on climate change, Convention on biodiversity, and Convention on desertification protection, as well as a number of other international Conventions, Agreements and Memorandums of mutual understanding in the field of environment protection and sustainable development. Global agreements, in which Uzbekistan is the Party, are the following:

- Convention on prohibition of military or any other hostile use of levers on environment (26.05.1993);
- Basel Convention on the Control of transboundary transportations of hazardous wastes and their disposal (22.12.1995);
- Convention concerning the Protection of the World Cultural and Natural Heritage (22.12.1995);
- Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) (01.07.1997);
- Bonn Convention on the Conservation of Migratory Species of Wild Animals (01.05.1998);
- Ramsar Convention on Wetlands of International Importance, especially areas of distribution of waterbirds (30.08.2001), etc.

On August, 9th, 2007, the President of the Republic of Uzbekistan has signed the Decree № 663 "On joining the Convention on protection and use of transboundary watercourses and international lakes", and "On joining the Convention on the non-navigational uses of international watercourses". The given decision is important for development of principles of integrated water management and environmentally friendly use of transboundary water resources at national and regional levels and in Zarafshan river valley.

As a member of cooperation of CIS countries, Uzbekistan is a member of interstate environmental council on legislation harmonization on environment, EA elaboration and development of economic tools on environment protection, and also a member of interstate environmental Fund for financing of environment protection in interstate and regional programs.

Good example of multilateral and donor partnership is Central Asian Countries Initiative for Land Management (CACILM). The goals of this program are lands deterioration protection and decrease of low-income cases in Central Asian countries by development of comprehensive and integrated approach to sustainable land and water resources management.

NGOs and Public Participation

The interaction of the Government and ecological NGOs is performed within the framework of cooperation and interaction with NGO Ecological Forum of Uzbekistan (Ecoforum), which is an association of ecological and environment-focused non-governmental non-commercial organizations and initiative groups. Its activity is directed on consolidation of efforts of public environmental organizations on resolution of environment protection problems. Tasks of Ecoforum in the sphere of nature protection activity are:

- development of model of joint activity within the framework of target programs;
- preparation and realization of joint projects;

- involving of the public and the population in realization of target programs;
- monitoring.

Ecoforum consisting of non-governmental non-commercial organizations of Uzbekistan has been registered in April, 2007 by the Ministry of Justice of the Republic of Uzbekistan and has united ecological NGOs acting in the country in republican association. Consolidation of efforts NGO for increase of efficiency of participation of the public in environment protection and realization of joint actions in solution of environmental problems became the main objective of Ecoforum NGO of Uzbekistan creation. In its activity aimed at solution of environmental problems and assistance in sustainable development, Ecoforum cooperates with the state, international and regional organizations, SPA (Scientific and Production Association) and mass-media. Presently, the Ecoforum has signed memorandums of cooperation with Goskompriroda RUz and other regional organizations such as Regional Environmental Center of Central Asian countries.

Institutional Structure of Environmental Management System in Uzbekistan

According to the Constitution of the Republic of Uzbekistan the earth, bowels, waters, flora and fauna and other natural resources are national wealth subject to rational use and are protected by the Government.

The following system of environment protection management is operating in Uzbekistan:

- Oliy Majlis (Parliament) of the Republic of Uzbekistan and Jokargy Kenes of the Republic of Karakalpakstan determine the basic directions of nature protection policy, issue legal acts and coordinate actions of the State committee for Nature protection (Goskompriroda). Declare territories as zones of emergency environmental situation, environmental disaster and ecological catastrophe; establish legal regime for these zones and the status of victims.
- President of the Republic of Uzbekistan makes strategic decisions on environmental problems, manages development of international cooperation in the field of environment protection.
- Cabinet of Ministers of the Republic of Uzbekistan and Council of Ministers of the Republic of Karakalpakstan carry out state nature protection policy, adopt state programs of environmental importance, control their accomplishment, organize accounting and assessment of natural resources, develop measures on prevention of ecological crisis situations, natural disasters and catastrophes, etc
- Local public authorities determine the basic directions of nature protection in their territory, approve regional (territorial) ecological programs, perform accounting and assessment of natural resources condition and harmful ecological objects, provide material and technical support for Nature protection measures, etc.
- State committee for Nature protection, is directly subordinate to Jokargy Kenes of the Republic of Karakalpakstan, is the main executive body on environment protection in Karakalpakstan. The competence of Goskompriroda is determined by the Regulation approved by the Decree of Jokargy Kenes of the Republic of Karakalpakstan and Goskompriroda of the Republic of Uzbekistan.

Goskompriroda is specially authorized over the departmental and coordinating body performing the state control and inter-branch management in the sphere of nature protection, use and reproduction of natural resources.

Goskompriroda RKK has its departments at regional levels. In KK republican committee there are 5 inspections: on protection of atmospheric air, water and land resources, on protection of fauna and flora and the state specialized inspection of analytical control. Besides, there is a state ecological expertise and branch of ecological certification and standardization under the committee. The committee has the approved staff of the Board in number of 9 persons. Board structure, besides the ranking officers of the committee, includes director of the institute of Bioecology of KKO of the Academy of Sciences (AS) of RUz, deputy head of Administration of forestry of KK. Ranking officers of Environmental committee of Jokargy Kenes, Council of Ministers of RKK and employees of Aral nature protection Office of Public Prosecutor are constantly invited to the activity of the Board.

For the purposes of present environmental assessment three corresponding governmental bodies are considered:

- MAWR: the Ministry of Agriculture and Water Resources is the main republican organization responsible for development of agricultural sector. In rural and water sector MAWR has two basic organizations of subsector under the aegis of one organization. While agricultural issues are organized through Administrations of agriculture and water resources in each region and districts, the water resources sector is organized at the level of basin Administrations and regional level. The organogram, showing MAWR organizations of agricultural and water economic sector in project zones, is shown on Scheme 1.implementing agency

- Khokimiyats of regions and districts where the proposed project is located: Khokimiyat is state executive office at level of regions, district and cities of the republic. Khokim heads the executive and representative authorities in corresponding territory and provides execution of legislation acts, including, concerning the issues related to the sector of agricultural industry.

- State committee on nature protection (Goskompriroda): State committee on nature protection (Goskompriroda) is the main executive office on environment protection and natural resources. The committee is directly subordinated to Oliy Majlis (bicameral parliament) of the Republic of Uzbekistan and is responsible for coordination of activity on environment protection and natural resources of other national state bodies at central, regional and district levels.

3 WORLD BANK SAFEGUARD POLICIES

'Environmental Assessment' OP 4.01
The project design does not seek to promote a horizontal expansion of irrigated agriculture, but seeks to improve production per hectare. As a result of improved water management in the project area, the project would have an overall positive impact on the lower Amudarya basin and the environment, without undermining the water requirements of the riparians or the Aral Sea. The likely negative impacts (typical to irrigation development/rehabilitation projects) will be limited, such as limited disruption of the ecosystem (e.g. removal of trees to enable developing the Bustan canal). In compliance with OP 4.01 'Environmental Impact Assessment', the project has been assigned an environmental category B, which requires preparation of an Environmental Assessment (EA) and Environmental Management Plan (EMP).

'Natural Habitats' (OP 4.04): One of the co-benefits of improving water management through the project components is to sustain the required seasonal water flow to Baday Tugay (a seasonally flooded forest adjacent to the project area). The canal needed for water supply to the forest has been developed under DIWIP, whereas SKWRIP should ensure the adequacy of its water resource. This policy is triggered to ensure monitoring of the supply of adequate water to the forest.

'Physical Cultural Resources' (OP 4.11): This policy is not triggered as there are no project activities affecting cultural resources. Nevertheless, "chance find" provisions will be incorporated in the works bid documents.

'Involuntary Resettlement' (OP4.12): Project framework provides construction of 35 km section of the Bustan Canal and rehabilitation of another 35 km part of the same Bustan Canal which flows through the settlements. In this view, temporary and permanent allotment of lands for canal construction will be performed.

'Safety of Dams' (OP 4.37): The project area is located downstream of Tuyamuyun Dam. The 2001 Tuyamuyun Dam Safety Inspection Report identified a number of dam safety issues, notably (i) safety of Sultansanjar Dam (part of Tuyamuyun dam), (ii) rehabilitating the hydro-mechanical equipment; (iii) improving dam instrumentation; (iv) updating the O&M manual; and (v) preparing an Emergency Preparedness Plan (EPP). Since then, a dam commission (Panel of Experts) was mobilized, and the dam safety/operation review was updated in 2009. The review recommended a list of measures, most of which were funded and executed by GOU. As part of the ESA, the MAWR has summarized this 2009 update in a brief dam-assessment note. To be decided (by appraisal) would be the pending measures (listed in the 2009 safety update, now listed in AM of October 2012) which, if any, remain to be implemented through SKWRIP. In addition, Tuyamuyun operating rules need to be revisited, in order to reflect the new river and canal flows associated with implementation of SKWRIP.

'Projects on International Waterways' (OP 7.50): The project operates on the Amudarya River which is a transboundary water body, and also the drainage resulting from the project area returns back to the Aral Sea. Hence the project triggers OP 7.50. The project interventions (e.g. switching from pumping from the river to gravity diversion through construction of the Bustan canal and remodeling the secondary canals) will result in bulk-water savings, which will offset the increase in consumptive use due to crop intensification. Also as the water extra releases from Tuyamuyun dam to serve the pumping stations are no longer required, these extra releases could now be focused only on meeting the minimum environmental flows in the lower Amudarya. Hence the current amount and quality of the "environmental flows" returning to Aral Sea, and the irrigation withdrawals by Turkmenistan will not be undermined. On January 31, 2013, MAWR sent a riparian notification letter to the four riparian countries of the Aral Sea Basin that are member of the Interstate Commission for Water Coordination (ICWC), while on February 2, 2013, the Bank sent notification to the fifth riparian country, Afghanistan, on behalf of MAWR.

4 ASSESSMENT OF CURRENT STATE OF ENVIRONMENT IN THE PROJECT AREA

Location and Infrastructure of the Region

The studied *territory* (Project area) is part of the natural-territorial habitat (NTH) of the Lower Amudarya located in the north-west of Uzbekistan, comprising the Khorezm oasis, valley and delta of the Amudarya River.

The NTH has borders with the Usturt plateau in the west, the Aral Sea in the north, and the Kyzyl-Kum desert in the east.

Figure 4: Studied Territory (Project Area)

The Project area lies along the right-bank of the lower reaches of the Amudarya, covers three southern raions of Karakalpakstan which is an autonomous republic by administrative division. The Project territory comprises irrigated lands of Beruni, Ellikkala and Turtkul raions of South Karakalpakstan with raion centers Beruni, Bustan and Turtkul respectively. The zone of the right bank of South Karakalpakstan (RBSK) is an alluvial flat of the Amudarya delta and valley which forms an alluvial belt from 0.3-0.5 to 3-5 km wide. The area of the region is 16,841 km^2.

Physically, South Karakalpakstan Main Drain (SKMD) can be considered as the boundary of the Project territory in the north, Jambaskala Main Collector which runs along the border of the irrigated zone of Turtkul raion with the Kyzyl-Kum desert in the east; and Amudarya River in the south and the west.

Most part of the Amudarya lower reaches is a flat slightly sloping to the north-west plain. Its surface was formed by the Amudarya River which brings huge amounts of sand and clay. Its deposits cover the whole plain (deltaic deposits). Absolute altitude marks in the plain vary *between* +89 and + 105m above the sea level. The territory is a flat plain with a slight grade towards the north-west.

The surface of the plain is crossded by many functioning and abandoned canals and collectors, as well as old dry river-beds. Most of the main and inter-farm collectors lay along old dry river-beds. They are usually 3-5 meters deep, but sometimes deeper. Within the scope of DIWIP (Drainage, Irrigation and Wetlands Improvement Project) existing beds of many of the main collectors have been deepened or reconstructed up to the original depth.

The surface of the Karakum desert adjacent to the Amudarya delta, which is sandy in the west, is markedly divided: sandy barkhans alternate with swale (often alkali soil) features. The height of sand dunes varies between 1.5 and 5 meters. Currently, relict river beds form lots of closed depressions filled with water, the largest of them being the Akchakul Lake.

The Kyzyl-Kum desert divides the deltaic strata of the right bank of the Amudarya River into two parts: the southern part the Turtkul oasis, and the northern part the Chimbai oasis. Desert massifs are represented by stabilized ridge-and-sand dunes with occasional small island hills.

The irrigation systems and irrigated farming in the Project zone exist since ancient times. During the centuries-old human activities, the surface of natural deposits on the irrigated lands has been covered with 'irrigation deposits' sometimes several meters thick. This layer was formed *as a result of* irrigation and leaching. These deposits formed local elevations near ancient irrigation canals which make the relief look somewhat hummock-and-hollow.

Flat topography, soil and water resources make it possible to develop irrigated farming. As of today, the territory with an area of 150 650 ha is considered to be suitable for irrigation, of which 100 000 ha are already being irrigated.

The transportation network with motor- and railroad transportation is pretty well developed in the Project area. The key sector of economy of the Project zone is irrigated. Due to the rich resources of construction materials in the Sultan-Uvais mountains the mining industry has also been developed.

Map 1: Location of the Project area

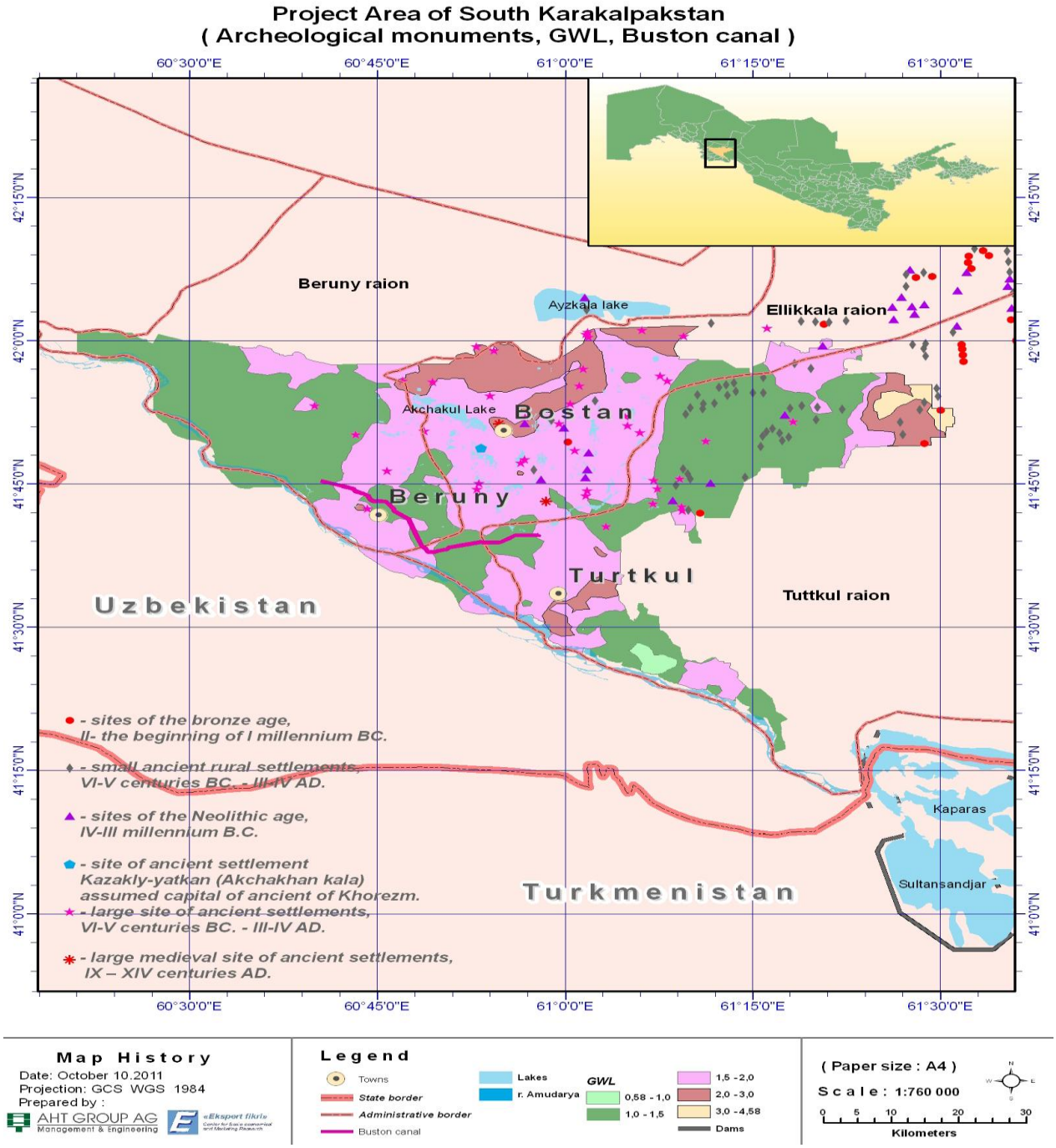
Physical Cultural Resources

The studied territory is rich in archaeological monuments like fortresses and castles constructed more than 20 centuries ago located in the flood plain and delta of the ancient river Akchadarya which had been flowing approximately until the 1st century BC.

The most important ones are:

- archaeological monument Kyzyl-kala, a fortress of the 1st-2nd century BC which is located approximately 100-150 m from the Beruni collector;
- ancient settlement Toprak-kala dated back to 1st-6th centuries AD;
- three fortresses of Burli-kala dated back to 4th century BC - the 1st century AD;
- Ayaz-kala complex dated back to 1st and 7th-8th centuries AD;
- Kurgashin-kala complex, center of ancient oasis of stone and bronze ages.

Outline of location of archaeological monuments (Map XX below) and the route of Bustan canal on the cartographic materials show that the route including the right of way of the Canal does not affect any existing historical objects. However in case of chance finds during implementation of construction works the Contractor shall immediately suspend all the works at the place of discovery and inform the PIU respectively. The PIU, in its turn, should consult with relevant authorities (Ministry of Culture) and obtain official permission for resuming the work after the chance finds are safely handled by relevant authority.



Map 2: Archeological Monuments in the Aral Sea Basin

Existing Impact Sources

To assess potential environmental impacts of the implementation of the South Karakalpakstan Water Resources Management Improvement Project, the existing impact sources and climatic characteristics as well as the current state of soils, geology, hydrology, hydrogeology, fauna and flora have been studied and analyzed.

The main sources of pollution in Ellikkala, Turtkul and Beruni raions of South Karakalpakstan are motor roads, agricultural facilities (stock-raising farms), and the underlying surface of lands filling the air with dust with strong winds.

Processes related to the transportation of dust and sand from sandy deserts with north-east and east winds and particulate pollutants of the salts from the drying out bed of the Aral Sea and the Amudarya delta with north and west winds are among the natural sources affecting the surveyed territory.

The agricultural specialization of the region results from natural conditions allowing development of irrigated farming and distant-pasture cattle breeding. Economic activities of the population have both positive and negative effect on the environment. Poor livestock management practices, involving improper disposal of untreated animal wastes, cause pollution of soil, vegetation and air.

Decades-long intensive application of mineral fertilizers on vast areas of lands, the plant nutrition imbalance, as well as inconsistency between the amount of applied fertilizers and the actual need for the agricultural crops have resulted in aeration of artificial environment in the zone which negatively affects the soil fauna and reduces the soil fertility. Chemicals have been used to manage plant diseases and pests, a certain amount of which get into the ground waters, collector-drainage network, – i.e. mineral fertilizers, together with chemicals, are the source of pollutants.

Agriculture, in particular irrigated farming, is the main source of pollution of surface and ground water because of use of pesticides, mineral fertilizers, and other salts which results in mineralization of water.

Some negative effect is also being produced by settlements with no sewerage system and proper solid waste landfills. Rural hospitals dispose their wastes into unlined cesspits from which they are being taken into saddles or filtration fields thus polluting soils and ground waters.

During the rehabilitation and consequent operation of the irrigation network irrigation water will pass these territories, which will affect inevitably water quality.

Thus, the sources of environmental impact in the studied region are: motor vehicles disrupted underlying surface, agricultural and livestock farms.

Climatic Characteristics

For the assessment of the climatic condition in the surveyed area, data from Turtkul and Urgench meteorological stations of Glavgidromet of the RUz for the period between 1995 and 2011 were analyzed.

The geographic location of the Project zone (inland location at the subtropical latitudes level, far from the oceans, flat relief) creates peculiar conditions for climate formation. Location of the raions in the lower reaches of the Amudarya River, on a plain surrounded with the arid Kyzyl-Kum desert on the one side, and the Khorezm oasis on the other, creates the possibility of active transformation of air masses having free access to the surveyed territory.

A significant amount of solar power accumulated in the summer season results in a strong warm-up of the soil and air. The vast dry Kyzyl-Kum and Karakum deserts surrounding the Khorezm oasis are a strong source of intensive transformation of air masses having free access to the plain from the west, north-west, and sometimes from the north-east.

Transformation processes are most active in the warm six months characterized by clear weather and a huge influx of radiation heat. Dryness of the deserts' underlying surface results in the situation when radiation heat is not being used for the evaporation processes but accumulates almost completely in the surface air which accounts for the high temperatures in this territory. In this period, a mild-low pressure area (thermal depression) is being formed over the strongly warmed up desert area. During the period of this depression development, extreme air temperatures reach + 45-49°C. The soil surface warms up to +70°C and higher.

In the warm season, an intensive transformation of moisture-laden air masses takes place coming from the Atlantic, from the middle latitudes. They pass over the plain with strongly warmed up surface. There is almost no precipitation in hot long summers which results in soil drought. Average annual precipitation is 140 mm, which mostly occurs in autumn, winter and spring months.

The highest air temperature in the summer is +43°C. The monthly average temperature is 35-37°C. The annual average air temperature does not exceed 13°C.

By the end of warm season, the inflow of radiation heat significantly reduces. Cooled off, and sometimes covered with snow, desert surface cannot produce strong transformation effect on the incoming cold air masses which result in a drop of the air temperature in the region to -8.8°C. Monthly average air temperature in January is -5.9°C. In winter, the soil temperature drops down to -13°C.

The Project zone is characterized by a peculiar wind pattern. During the whole year northern, north-northeastern and northeastern winds prevail here, which is the result of the southwest periphery of the anticyclone. Their recurrence is 12.8, 18.1 and 11.1% respectively. These winds contribute to the transfer of dust from the Kyzyl-Kum desert and of salts from the exposed bottom of the Aral Sea.

The annual average wind speed is higher than the norm: 2.1 m/s. Winds with the speed of 2-3 m/s (37.1%) and 4-5 m/s (10.4%) are quite common in the region. Winds with high speed occur mostly in the summer season.

It should be noted that the climate of the Project zone is being affected by closeness to the irrigated lands of the Khorezm oasis. The dense irrigation network, excess wetting of the territory by surface and ground waters, and high ground water level contribute to high humidity of the air and soil. Excess evaporation from the soil surface under conditions of continuous inflow of soil moisture results in a significant lowering of the soil and air temperature. That is why air masses coming from the oasis make weather conditions in the Project zone somewhat milder in the summer.

In summary, the climate particularity of the region is characterized by extreme conditions. The dry underlying surface, high summer air temperatures, low precipitation, high dryness of ambient air and the intensive wind pattern result in high evaporation and soil salinity, in pollution of the atmosphere with dust and transfer of sand particles from the deserts. Low winter temperatures, low snow depth, deep soil frost penetration, early and late frosts are the climatic conditions of the cold season of the project territory.

Geology and Soils

The zone of the right bank of South Karakalpakstan (SKRB) is a flat alluvial plain in the Amudarya delta and the right bank of the Amudarya valley forming a belt from 0.3-0.to 3-5 km wide made of alluvial strata. The plain has been formed by sandy, sandy-argillaceous, loamy and clayey deposits of alluvial and lacustrine-alluvial origin occurring from 20 to 90 m deep. Combination of beds and depressions with alluvial and lacustrine-alluvial deposits in between such as silt and fine sand, with layers and lenses of loamy and clay soils is typical for the plain. Denudation processes were developing in the plain during the Akchadarya cycle of the Upper Quaternary.

The surface of the plain is full of various forms of aeolian relief with rises of loamy island hills. In the northern part there are many soils formed by clay deposits (‘takyrs’) alternating with alkali soils and pit-and-mount semi-stabilized sands. Significant massifs of yellowish-gray aeolian sands on the surface of the plain were formed *as a result of* deflation of alluvial deposits.

The geology of the territory is comprised of the Upper Quaternary deposits with different thickness. In the north, beds are 2-26 m thick, whereas in the central and southern parts of the region 30-45 m. The Upper Quaternary deposits are layered stratum of loamy soils, clay sands, sands and clays from 0.5-15 m thick. Below are fine clay sands buried under the aeolian sands. The substratum in the central and southern parts is comprised of the Upper Neogene deposits. They are alternating layers of sands, clays, sandstones and siltstones, the exposed bed thickness of which vary *from*55 to 70 m. In the northern part of the massif, Neogene deposits are being replaced with the Upper Cretaceous deposits. They are comprised of clays and sandstones, the exposed bed thickness of which exceeds 80 m.

Table 1: Annual wind rose Turtkul meteorological station (Uzhydromet 1993-2010)

Weather report	Average	Minimum	Max	Av.min	Av.max
Wind speed	1.80		25.00		
Air temperature	13.98	-26.20	43.40	-7.23	35.43
January average air temperature	-1.35				
July average air temperature	27.78				

Land surface temperature		17.45	-12.00	66.00		
Precipitation (mm) and fog (hours)	Precipitation	114.70				
	Fog	99.17				

Wind frequencies by compass points						
	N	**NNE**	**NE**	**ENE**	**E**	**ESE**
	13.52	17.01	12.13	7.34	8.30	3.79
	SE	**SSE**	**S**	**SSW**	**SW**	**WSW**
	2.56	2.01	2.18	1.86	2.20	2.53
	W	**WNW**	**NW**	**NNW**	**Calm**	
	6.42	6.65	4.12	7.38	33.14	

Number of cases by gradation						
	0-1	**2-3**	**4-5**	**6-7**	**8-9**	**10-11**
	51.85	33.70	7.86	3.66	1.79	0.80
	12-15	**>15**	**U***			
	0.27	0.07	6.36			

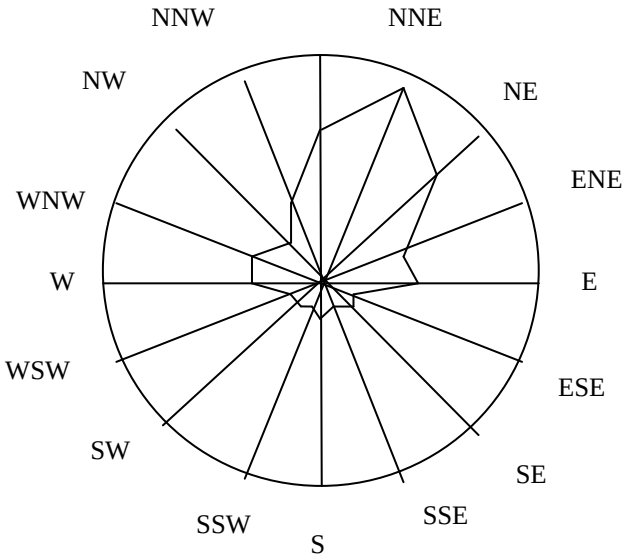


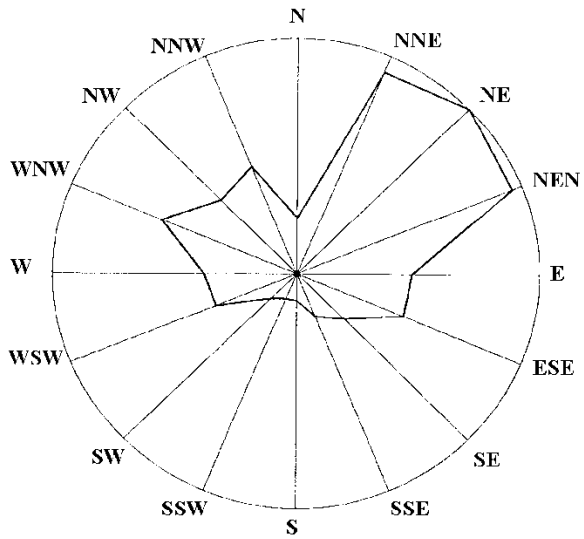
Table 2: Annual wind rose Urgench meteorological station (Uzhydromet 1993-2010)

Weather report	**Average**	**Min**	**Max**	**Av.min**	**Av.max**
Wind speed	3.31		34.00		
Air temperature	13.60	-25.50	43.50	-8.10	35.65
January average air temperature	-2.81				
July average air temperature	28.15				

Land surface temperature		15.83	-27.00	67.00		
Precipitation (mm) and fog (hours)	Precipitation	117.22				
	Fog	60.70				

Wind frequencies by compass points						
	N	**NNE**	**NE**	**ENE**	**E**	**ESE**
	3.02	11.65	12.53	12.00	5.95	5.93
	SE	**SSE**	**S**	**SSW**	**SW**	**WSW**
	3.44	2.48	1.44	1.43	1.87	4.50
	W	**WNW**	**NW**	**NNW**	**Calm**	
	4.80	7.58	5.59	6.22	2.69	

Number of cases by gradation						
	0-1	**2-3**	**4-5**	**6-7**	**8-9**	**10-11**
	14.64	46.55	25.79	9.96	2.54	0.62
	12-15	**>15**	**U***			
	0.11	0.00	7.11			



The lithological structure of the massif is represented by sands, clay sand, loamy soils and clays.

- Sands lie close to the surface or alternate with pit-run fines. These are fine, clay sands. Sands are of yellowish color because of the supply of aeolian sands. The sand hydraulic conductivity is 2.5 m/day.
- Clay sands are sometimes light-gray, yellowish-gray, from light to hard rock types. Their clay content varies from 10.3 to 7.0% by weight, whereas the pulverescent fractions make 64-60%. The hydraulic conductivity is 0.5 m/day.

- In lithologic structure of the massif loams have the biggest capacity. Thickness of interlayers is from 1.5 to 5 and more meters. Light, medium and heavy fractions occur. The pulverescent fractions make 60-70%, clay fractions 20-38%. The hydraulic conductivity is 0.25 m/day.
- Clays lay in the form of lenses and interlayers with thickness of 1 to 10 m. Clay fractions make 35-67%, pulverescent 25-60.5%. The hydraulic conductivity is 0.05 m/day.

All types of soils are saline with water-soluble salts; the salinity is of sulphate-chloride and chloride-sulphate type.

To identify the geo-ecological situation in the upper part of the lithosphere which determines the peculiarities of the human habitat, a complex geological-and-environmental expedition was conducted by *'Kiziltepageologiya'* State Geological Enterprise at the State Committee for Geology and Mineral Resources on the whole territory of the country, including Project zone. Based on the obtained data, a report was compiled and geological and environmental maps of the regions charted. During the expedition, lithochemical samples of soils were collected by 10x10 km grid. These samples were analyzed by quantitative highly sensitive methods for the content of a number of toxic metals and chemical compounds. At the same time, the macro- and microcomponent composition of waters in the rivers and reservoirs was studied. Thus, the map presented reflects the geo-ecological situation in the upper part of the lithosphere of the Project zone during the last 10-12 years. For explanatory purposes, the table of MACs or the background concentrations of chemical elements and compounds accepted in the Republic are taken into consideration when charting the map.

The natural geo-ecological situation in the zone is being defined by the uncontaminated aeolian Kyzylkum sands. In 2010 complex geological-environmental expedition of State Geological Company "Kiziltepageologiya" under the State Committee on geology and mineral resources was implemented over the whole country, including Project zone. Currently, the increased salinization of soils is occurring. Dominating in the overall balance of salinized lands are lands with medium and high salinity. The share of lands with high salinity (more than 8 g/kg) is about 15%. The main type of salinity is chloride-sulphate. The reason for this increased salinization is the rising level of ground waters on irrigated territories and dry climate with predominance of evaporation over the supply of moisture from the atmosphere. In recent decades, a new strong source of salinization has appeared: the dried-up part of the Aral Sea where sand deposits that used to form the bed of the sea contain up to 3560 kg of salts per ha. These are intensively blown by winds, the area they cover probably extending over the western parts of the Kyzylkum.

Table 3: MACs or the background concentrations of chemical elements and compounds accepted in the Republic taken into consideration when charting the map

Chemical element or Compound	Hazard class	MPC mg/kg	
		Soil	Water
Beryllium Be	1	10	0,0002
Cadmium Cd	1	5,2	0,001
Arsenic As	1	2	0,05
Mercury Pb	1	2,1	0,0005
Selenium Se _	1	0,5	0,01
Lead Pb '	1	30	0,03
Zinc Zn	1	23	5
Phosphorus P	1	730-1000*	0,00001
Bismuth Bi	2	0,1	0,5
Cobalt Co	2	5	0,1
Copper Cu	2	3(10)	1

Molybdenum	Mo	2	4	0,25
Nickel	Ni	2	4	0,1
Stibium	Sb	2	4,5	0,05
Chrome	Cr	2	6	0,05
Barium	Ba	3	600	0,1
Vanadium	GROUP	3	150	0,1
Tungsten	W	3	2,5	0,05
Manganese	Mn	3	1500	0,1
Strontium	Sr	3	300	7
Uranium	U	radioactive	2,5*	9,6**
Radium	Ra	radioactive *	3,0 ***	0,94**
Cyanides	CN		-	0,01
Phenols	Ph	*Jt.*	-	0,001
Pesticides	P		0,1	0,2-0,4
Oil products НП			0,5	0,3
Fluorides	F		10-200*	1,2
Nitrates	1ЧОз		130	45

* Background concentrations.
** Bq/l (Becquerel/litre, 1Bq = 1decay/second)
*** Background concentration n10"* gram equivalent. (gram equivalent molecular mass in grams)
MAC – maximum concentration of chemical element or compound not having any harmful effect on the health of the population.

The soils in the Sub-Aral zone are polluted on 43% of the area by chemical fertilizers, pesticides and phenols. In the Republic of Karakalpakstan, increased contamination of soils (up to 15 MAC) was established on the left bank of the Amudarya in Khodjeyly, Shumanai and Kanlykol raions. The right bank is less polluted.

Anthropogenic contamination of soils with heavy metals is not so high which can be explained by the absence of major industrial enterprises of thermal power, chemical industry, metallurgy, and others.

The most negative factor leading to the aggravated environmental situation in the Sub-Aral regions is the poor quality composition of surface and subsurface waters. The water in the Amudarya River and the main canals is already polluted at the latitude of Urgench town, with mineralization of 1-1.2 g/l. In the downstream their salinity is increasing up to 1.8 g/l and more *as a result of* drainage of mineralized ground water and discharge of collector-drainage waters. Mineralization of collector-drainage waters changes from 1.5 g/l in the upstream facilities up to 7-10 g/l in the tail-end. The salt composition changes from sulphate-chloride to chloride-sulphate. The highest mineralization of water is in the landlocked embayments (7-9 g/l) and in the Aral Sea (25-40 g/l).

The main pollutant of surface waters is phenols supplied with wastewater of urban sewerage networks, rural settlements, industrial enterprises, and others, using chemical technologies and hydrocarbon material as fuel. Beside phenols, high concentrations of manganese, lead, vanadium, cadmium, selenium, as well as oil carbohydrates and organ chlorine pesticides in lake waters and in the Aral Sea were established.

Hydrology

The territory of the Project zone is referred to Central Kyzylkum group of basins of fracture waters and artesian basin bordering in the west with the group of Usturt artesian basins, in the east by the Karatau basin of fracture waters (outside the Republic territory) and the Sub-Tashkent artesian basin, in the south by the group of Nurata-Turkestan basins of fracture waters, and the Amudarya artesian basin, the Central-

Kyzylkum group of artesian basins. In the north, the basin goes under the Aral Sea. The basin stretches from the west to the east along the northern Uzbekistan border, with a width of 600-700 km.

The main water-bearing complex is the complex of Quaternary alluvial deposits (alQ). It stretches within the modern Sub-Aral and ancient Sub-Sarykamysh and Alchadarya deltas of the Amudarya. The age of these deposits is from modern up to Middle Quaternary. Water-bearing materials are represented by a stratum of sandshale alluvian-deltaic deposits. Rocks frequently alternate both across and vertically. In the lower part of the cut gray fine and close-grained sands with occasional interlayers of clays and clay sands prevail. The upper part of the cut is represented, approximately at a depth of up to 10 m, by loamy soils, clay sands with occasional thin interlayers and lenses of sands. Only dry beds of the Amudarya, old river channels of Daryalyk, Daudan, as well as areas adjacent to the current bed of the Amudarya are formed by gray fine and close-grained sands with subordinate interlayers of clay sands and loamy soils. Depressions between beds are formed with clays. Thickness of alluvial deposits varies greatly – from 20 up to 140 m, on average being 40-60 m. Aqueous rocks lie everywhere on sand deposits of the Upper Pliocene; its waters are hydraulically linked to the waters of the alluvial complex. In places where Pliocene deposits are absent, the Amudarya alluvium lies over the more ancient formations.

Filtration characteristics of the rocks are characterized by the following values: filtration coefficients for sands 0.8-30.2 *m/day,* for clay sands – from 0.052 up to 1.1 *m/day,* and for loamy soils even less: 0.018-0.035 *m/day.* The well production varies from 0.1 to 1.5 *l/sec*, less frequently 2-3 *l/s* in case of depressions up to 1.5 *mo*ther differences in filtration characteristics of the rocks in the structure section resulted in formation of several interbedded water layers hydraulically linked to *each other* due to the lack of a confining bed.

Ground waters are mostly being recharged with the surface waters of the Amudarya. According to the data obtained from literature, about 1.5 mln m^3 of water from the Amudarya in the course of 1 *km* is being filtrated annually. Most intensively they are being recharged during floods. The highest canal seepage occurs after cleaning the canals from silt, as well as in sections made of sand. In addition, ground waters are being recharged during irrigation, in the period of vegetation. In the autumn and winter periods, ground waters are being recharged by precipitation. During showers, rain waters flow down to depression and form fresh water lenses. Partially, ground waters are being recharged due to steam condensation *as a* result of rapid change of day and night temperatures.

There are fresh water lenses along the canals 50-100 m wide and near the river formed as a result of fresh surface water seepage. They are being formed in places of intersection of surface streams and alluvial deposits represented by sands with thickness of up to 40 *m,* and in some areas overlapped with loamy sands and loamy soils with thickness of no more than 2-3 m. Fresh lenses are being formed only when the level of water in a canal is higher than the ground water level. Fresh water press down on salty waters and push them down and to the sides from a canal and a river. The hydrodynamic influence in the structure section almost always reaches the confining bed. These lenses are of irregular form both vertically and horizontally. The width of the belt changes on both sides of the stream *between* 10 and 800 *m,* the length – *between* 1500 and 3000 *m.* The thickness of the desalinated layer varies from 10 to 20 and from 40 to 50 *m.* The seepage of water from canals depends directly on the filtration characteristics of the rocks.

Favorable conditions for the formation of fresh lenses in the area of old river channels and the biggest explored lenses in the Project zone are the Turtkul and Shabbaz lenses.

Ground water consumption due to the plain relief, flat slopes on the major territory of the Project zone especially between Amudarya River and Pakhtaarna Canal (Beruni raion), hindered drainage and harsh climate are mainly used for evaporation and transpiration by plants. Maximum evaporation occurs between April and September when the temperatures and the ground waters levels are their highest values.

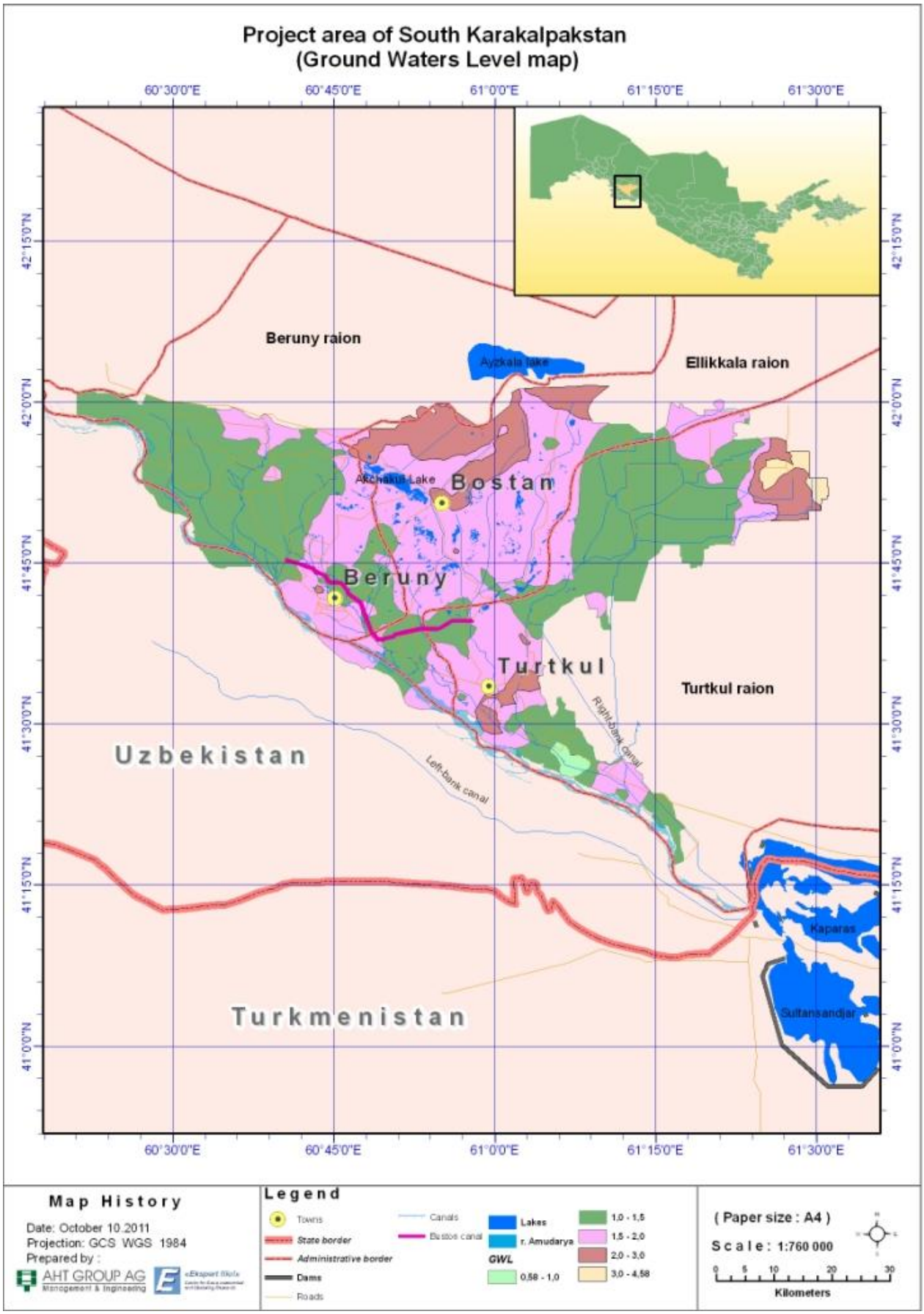
Some of ground water flow, due to groundwater runoff, to non-irrigated lands and the common drainage.

The subsurface geology and relief defined conditions of the ground water depth. The water-bearing layer has a slight grade to the north. Due to slight slopes, their underground outflow is being hindered. The depth of the ground water table is from 1.2 to 8.2 m from the land surface, on irrigated lands 1.2-2.0 m. The average ground water depth of 1.88 m almost did not change in the period of 2003-2005 (1.88-1.92 m).

In depressions, in the zone of the Amudarya influence, the main and irrigation canals and on irrigated areas, the ground water depth level is within 0 to 3 *m.* In winter when the supply of water to canals stops, the ground water level gradually lowers from 2 to 5 *m,* and the relief is flattened. Further from the Amudarya, canals and irrigated areas, the ground water depth level increases from 5 up to 10 m.

The ground water level pattern is determined by the surface discharge and irrigation pattern. This can be explained by a fast transfer of hydrostatic pressure of the river or canals on the ground waters. The width of the zone of the river hydrostatic pressure is 1.5-2.0 km, along the main canals through the sands 1.2-1.7 km. The maximum range of the level fluctuations is on the irrigated areas and on the areas adjacent to the Amudarya and canals, in the period of summer floods and winter ice jams. The exception is the areas affected by waste waters where the water level increases during winter leaching. The highest ground water levels occur during soil leaching (in March-April) and in the vegetation period (in July-August). Usually, the ground water level does not exceed 1 meter thanks to the improvement of drainage performed within the scope of DIWIP (Source: *KK-HGME survey of seasonal and long-term mode of ground and collector waters, water balance and salt composition of soils for control of meliorative improvement of lands of the Republic of Karakalpakstan for 2010).*

Map 3: Groundwater Levels in the Project Area



Hindered groundwater runoff, shallow ground water depth, its evaporation and transpiration in arid climate conditions have resulted in development of processes of continental salinization and creation of salty chloride-natrium waters. The Amudarya has a desalinization effect in a narrow band along the Amudarya to the depth of 15-20 *m.* Mineralization of ground waters varies from 0.5 to 100 *g/l* and more. In some places close to canals, fresh water lenses are forming which are of significant importance for water supply to settlements Shabbaz, Turtkul, Beruni and some others.

Irrigation of lands resulted in re-distribution of water mineralization. In the zone of river and canals influence, mineralization of ground waters does not quite differ from mineralization of surface waters; in general it does not exceed 3-4 *g/l.* By the type, there are hydrocarbonate calcic and hydrocarbonate-sulphate calcic waters during floods, and sulphate-chloride and chloride-sulphate natrium-calcic waters in drought period. Further from surface streams, mineralization becomes 5-10 *g/l*, and on non-irrigated areas 70 *g/l* and higher. Along dry beds, mineralization varies from 1 to 15 *g/l.* By the types of water, there are chloride-sulphate and sulphate-chloride, natrium-calcic and magnesium waters.

The highest mineralization of water occurs in the upper part of the water-bearing complex at a depth of 2-4 *m.* At lower depths, the desalinating effect of the river and canals increases. The lowest mineralization (0.4-0.6 *g/l)* occurs at a depth of 10 *m.* On irrigated lands, on the opposite, mineralization increases on low depths since irrigation during vegetation period and leaching have desalinization effect only at the upper levels of the water-bearing complex.

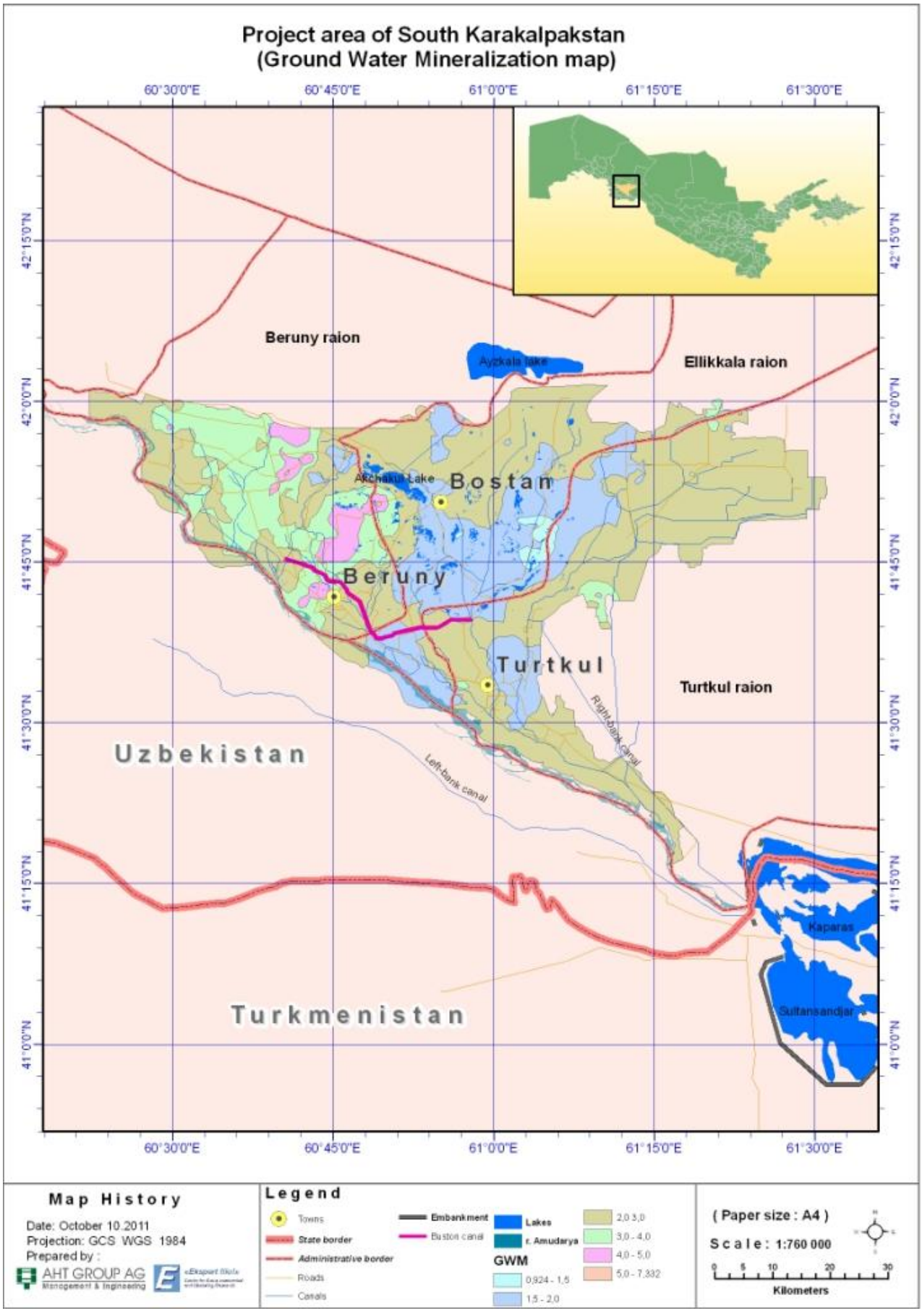
In the period of the survey in the Project zone, ground water mineralization was at the level of 1.3-2.3 g/dm^3. The areas with ground water depths of 0-1 m from the land surface in the region were only 0.4%, with water levels of 1.0-1.5 m, 1.5-2.0 m, 2.0-3.0 m, 3-5 m and more than 5 m – 15.9, 58.7, 23.5, 1.2 and 0.3%, respectively. (Source: *The Karakalpak hydro geological-ameliorative expedition on studying of seasonal and long-term mode of ground and collector waters, water balance and salt composition of soils for control of meliorative improvement of lands of the Republic of Karakalpakstan for 2010).*

The hydrochemical regime of ground waters is being formed by supply of soluble substances in the Amudarya surface waters, as well as in soils.

Two thirds of the run-off is represented by carbonate and calcium sulfate, the rest by sodium chloride and magnesium, sulphate magnesium and natrium. Many salts are being brought to the ground waters from soils. Evaporation contributes to the transfer of hydrocarbonate water into sulphate and then into chloride water.

Ground water chemical composition regime varies throughout the seasons. With increasing level of ground waters in the period of their feeding on irrigated areas and near rivers, mineralization drops. With reduced mineralization, the number of sulphate, chlorine, natrium and potassium ions drops.

Map 4: Groundwater Mineralization in the Project Area



The unit of ground water mineralization: g/l.

Thus, the hydrogeological situation in the Project zone is characterized by several conditions which determine:

- Shallow ground water occurrence;
- Dependence of the ground water depth on the Amudarya and irrigation system surface run-off regime;
- Effect of the hydrostatic pressure produced by the river or canals on the ground water level and quality;
- Hindered subterranian outflow of ground waters due to the gentle gradient of the lands and the waterlogging process;
- Development of continental salinization processes, creation of salty waters as a result of hindered subterranian run-off, shallow ground water occurrence, and their intensive evaporation;
- High sand filtration ability.

Surface Waters and Existing Irrigation and Drainage Network

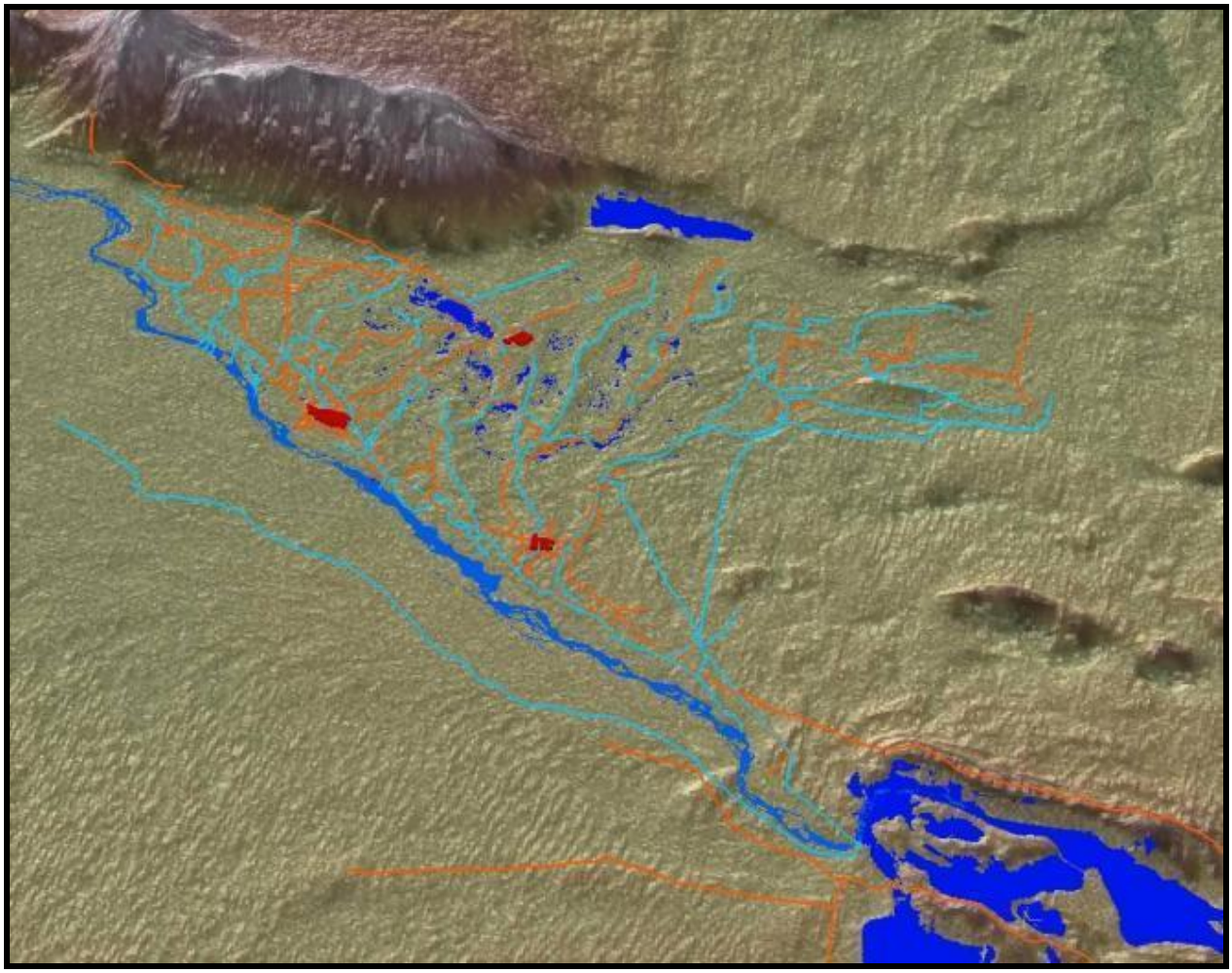
Due to the arid climate and little precipitation a permanent surface discharge is not being formed in the Project zone. The major transit river in the region is the Amudarya. The drainage network in the surveyed region has been created within a long period of time, and is represented by major inter-farm canals and collectors and a dense on-farm irrigation and collector-drainage network. The whole irrigation network was made in the earth bed.

The only source of water supply to the irrigation system of the Project zone is the Amudarya River. The Amudarya is partially a regulated river. In the upstream there is the Nurek dam on the Vaksh River, which is currently run mainly for all-the-year-round production of hydroelectric power. The Rogun dam in the upper reaches of Nurek, if built, will affect the consumption even more. The Tuyamuyun dam in the upper delta of the Amudarya provides inter-seasonal storage of water, and the Takhiatash dam located to the north provides gravity distribution of water for irrigation of lands bordering the Sub-Aral area.

Water intake and outflow are being agreed between the four riparian states and Afghanistan. In the Soviet period, water intake was agreed upon and was limited by all major water-ways. Besides, the built dams were run to meet the needs in irrigation water, – even in the case with the Nurek dam, which was used to generate hydroelectric power although it was not its main function.

Water is being delivered to the fields from the river via the main Right Bank Canal (Pakhtaarna, Shabbaz, Nayman Beshtam). From the Right Bank Canal, water is being further supplied via major inter-farm canals Amirobod, Keltiminar, Kyrkyz, Ellikkala, Bogyap, Bozyap, Khaitbai arna, Kazakyap, Beshtam, Kattagar, Nayman, and further via on-farm canals. On average, about 106.4 m^3/s, or 532 mln m^3/year of water is being supplied to the irrigation system of the region. (Source: *The Karakalpak hydro geological-ameliorative expedition on studying of seasonal and long-term mode of ground and collector waters, water balance and salt composition of soils for control of meliorative improvement of lands of the Republic of Karakalpakstan for 2010).*

Drainage Network in the Project Area



Large collectors - Eastern, Kyzylkum and Ellikkala divert collector drainage waters from the Project zone to SKMD which diverts those waters to Janadarya where they flow into the Aral Sea.

During the last 20 years the average annual consumption of water from the Amudarya at the Tuyamuyun power site has been 920 m^3/s, the peak consumption being in the period from May to August (1,243-2,058 m^3/s). Consumption of the river water varies and is hard to forecast. The standard deviation of annual run-off at the Tuyamuyun power site is approximately 41%.

As per the results of the Glavgidromet observations, the average water mineralization at the Tuyamuyun power site did not exceed 1 g/dm^3 throughout the year, however, in some months mineralization increased up to 1.1-1.4 g/dm^3 (1.1-1.4 MAC). Monthly water mineralization depends on the consumption of the river water: the highest occurs in the winter months and the lowest in the period of increased consumption in July.

On-farm irrigation systems are represented by earth canals with the throughput capacity of 0.2-0.8 m^3/s. The canals are silted and do not meet the estimated need in water consumption for irrigation of crops. The irrigation system has not been adequately equipped with regulators and water meters which results in significant losses of irrigation water, inadequate irrigation of crops, decrease of yields and lands productivity

Return water disposal from the irrigated fields is being done via the Eastern, Kyzylkum and Ellikkala collectors. In the past, the whole drainage runoff (from all the collectors) was pumped by the pump station into the Ayazkala Lake. From the lake, the water was discharged via the Ayazkala collector further into the Akchadarya passage. After the SKMD had been built, drainage waters are self-flowing to the old bed of Janadarya.

The drainage system of irrigated areas is represented by open drains. All the drainage water comes into the drainage system either as surface impoundment or as almost horizontal seepage flow. The distance

between field drains is usually 400 m. Primary open drains are not so deep, – usually about two-three meters.

The maximum volume of collector drainage waters (CDW) occurs in the period of leaching (November-December). Mineralization of collector waters in 2010 somewhat dropped, on the whole, in the Republic; the mean mineralization index is 3.376 g/l, as compared with 2009 (3.479). The data by the raions in the Project zone are shown in Table Mineralization of collector waters by dissolved solids is in gram/liter.

Table 4: Indices of mineralization of collector waters in the Project zone

№	Raions	Y E A R S							Difference 2009-2010 (+,-)
		2004	2005	2006	2007	2008	2009	2010	
1	Turtkul	2.582	2.564	2.803	2.751	3.006	**3.883**	**3.210**	**0.67**
2	Ellikkala	3.027	2.884	2.853	3.115	3.235	**3.489**	**3.291**	**0.20**
3	Beruni	4.432	4.406	4.784	5.161	4.357	**3.854**	**4.360**	**-0.51**

The volume of collector-drainage waters in 2010 in the RK was 2,833.0 mln m³ which is 33.9% of the water intake (8,350.4 mln m³). A significant share of heavily salinized lands is *usually* saline originally, and in most cases is located on the heavy soils. To improve their ameliorative conditions, much higher irrigation and leaching norms are needed. It means that for different types of soils there are different norms of leaching. For example, in the project area less saline soils require 2 500 m^3/ha whereas highly saline soils 4 000 m^3/ha. But it does not mean requirement of more water than the established norm.

As shown in Table 4, in 2010 mineralization of return waters decreased in two raions – Turtkul and Ellikkala, while in Beruni raion there was an increase in salt content per 0.51g/l. Probably, the concentration of substances is being affected by the amount of supplied water, adherence to soil leaching technologies, proper performance of land leveling works.

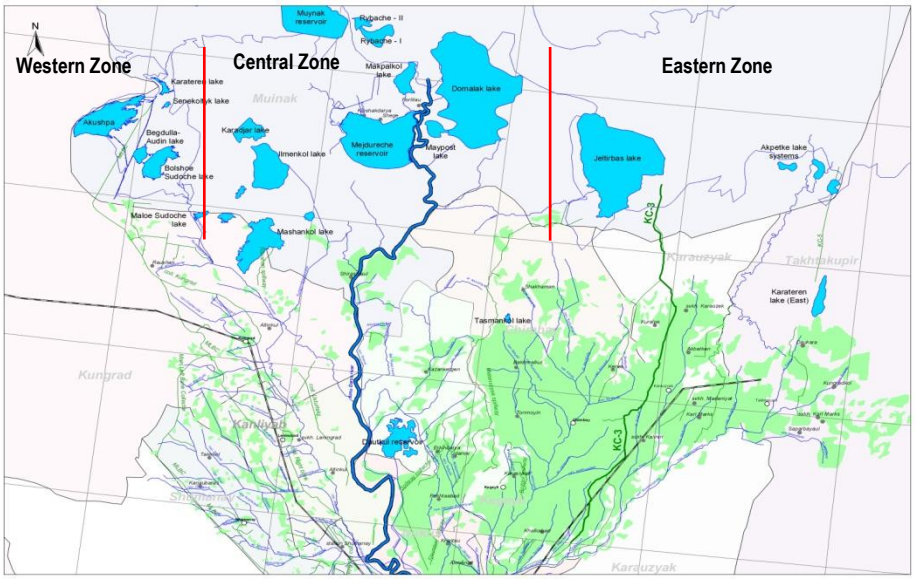
Prior to the beginning of construction of South Karakalpakstan Main Drain (SKMD) all superfluous waters which are taken from irrigated massifs of South Karakalpakstan, were dumped by Beruni pump station to Amudarya, Kyzylkum pump station – to Ayazkala lake and gravity arrived to Akchadarya.

After completion of construction of SKMD all drainage discharge forming within the project area, is diverted now by South Karakalpakstan and Akchadarya main drains.

Wetlands (in the Amudarya Delta)

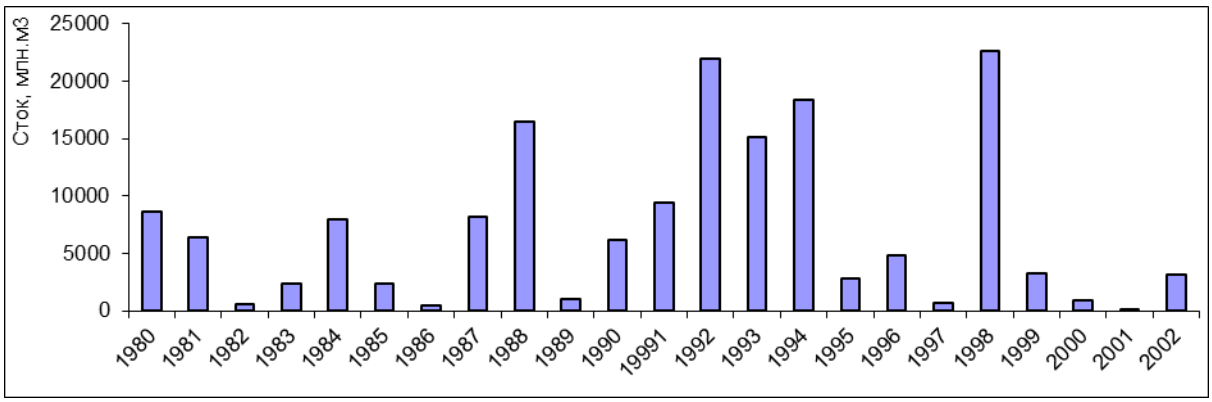
This section gives an assessment of the potential impact of project interventions on aquatic ecosystems in the delta of the Amudarya River, located between 42°30, and 44° Northern latitude. In this area in natural depressions of the delta, a unique system of lakes and flood plains, with a total area of about 160 hectares has been formed.

Figure 5: Location of modern delta of Amudarya (Northern Karakalpakstan)



Lake systems, wetlands and deltas are divided into three zones: Western - on the left bank, central, and east - on the right bank of the Amudarya River. Flows of Amudarya, coming into the delta, are highly variable and dynamic (**Table 5**).

Figure 6: Annual water volume of Amudarya river in Kizildjar section line (1980-2002)



In dry years, the water hardly flows into the delta, but the high water levels in wet years can stretch up to 2 - 3 months, with discharges up to 2,000 m^3/s. Fluctuations in flow depending on the water content of a year are less significant than the variations of river water entering the delta. The total surface water entering the Amudarya delta is presented in Table. 1.

Table 5: The total surface water entering the Amudarya delta, mln m^3/year

	River discharge (Kizildjar Section)	Collector drainage water discharge	Total discharge
Low water	1036	1222	2258
Mean water	2356	1759	4115
High water	9353	2027	11380

Water requirements for the reservoirs and lake systems in the delta and the Aral Sea region are summarized in **Table 6**.

Table 6: Design requirements of reservoirs and lake systems of Aral Sea region

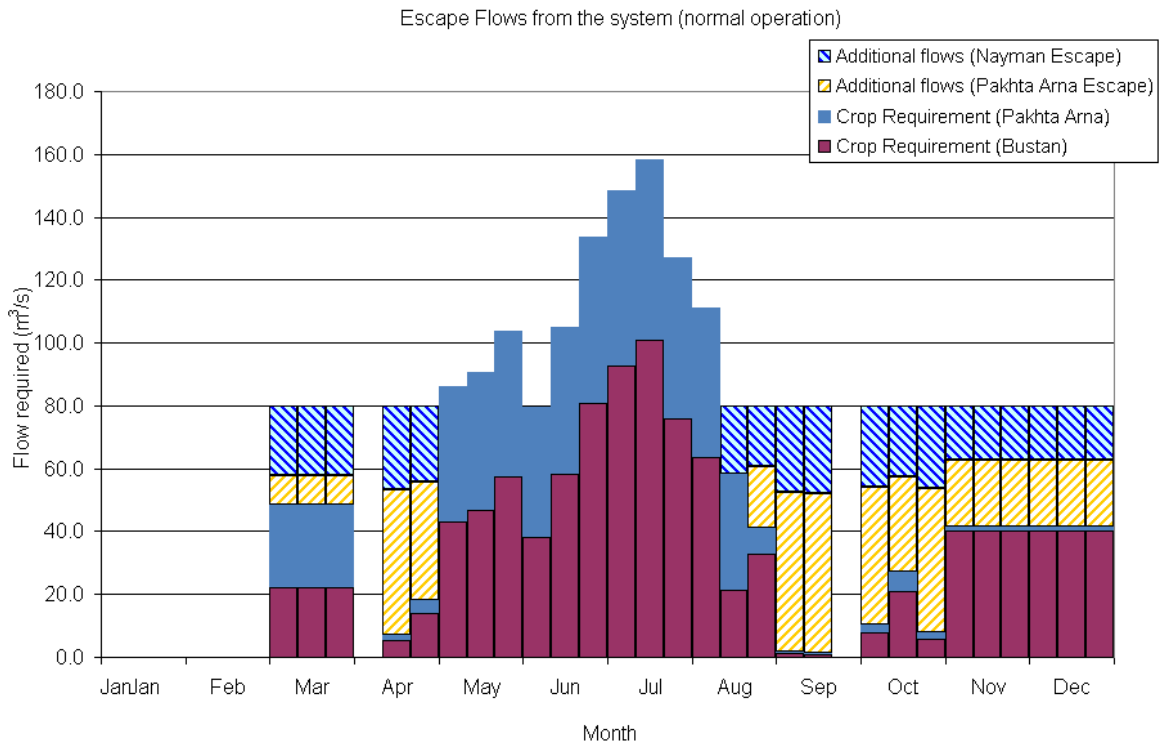
Zone	Subzone (Lake)	Capacity (mln m^3)	Required minimum flow (mln m^3)	Evaporation and filtration losses (mln m^3)	Total (mln m^3)
Western		**764.6**	**267.1**	**932.7**	**1339.8**
	Sudoche	396.0	132.0	728.0	860.0
	Mashankul	259.9	95.3	103.6	198.9
	Ilmenkul	78.5	28.8	72.8	101.6
	Karadjar	30.2	11.0	28.3	39.3
	Pastures		140.0		140.0
Central		**1385.0**	**935.0**	**1357.0**	**2292.0**
	Inter branch	450.0	-	504.0	504.0
	Muynak	161.0	161.0	136.0	297.0
	Ribachi	136.0	136.0	99.0	235.0
	Makpalkol	63.0	63.0	53.0	116.0
	Maypost	27.0	27.0	27.0	54.0
	Domalak	548.0	548.0	538.0	1086.0
Eastern		**598.0**	**290.0**	**803.0**	**1093.0**
	Djiltirbas	290.0	290.0	372.0	662.0
	Akpetki, other lakes and flood plains	308.0	-	431.0	431.0
Total		**2747.6**	**1492.1**	**3092.7**	**4724.8**

Source: Feasibility study Creation of local bodies of water in the delta and coastal area of the Aral Sea, Uzgip, 2004

The main prerequisite for the implementation of measures to reduce CDW discharges from the right bank of the Amudarya is the bilateral agreement to improve the quality of river flow. This Water Management Partnership Agreement was signed on January 16, 1996 by Turkmenistan and Uzbekistan on sharing operation of Tuyamuyun reservoir. According to the agreement, the parties agreed to cooperate over any emerging land acquisition and water use issues in the territory of both sides, and possibly resolving these issues through developing separate protocols.

Sedimentation is a major consideration for the design and operation of the Bustan and more generally all irrigation canals in the project area, because of the high silt content of the water diverted from Tuyamayun reservoir. Despite the functioning of the tunnel excluders located below the intake of the Right Bank canal, a considerable volume of silt is diverted from the reservoir into this canal. The slopes of the RBC and the Bustan canal has been designed to avoid sedimentation assuming than the flow would not drop below a critical value. According to the Consultant the minimum flow should not be less than 80 m^3/s in the unlined shallow RBC and not less than 8 m^3/s in the lined Bustan canal. To meet these conditions, the project provides two escape channels, one at the tail of the RBC and the second one at the tail of the Bustan canal to reject the excess water released from Tuyamayun to the Amudarya River. As shown in **Figure 7** below, these volumes which are in the order of 1 bln m^3/year should not be considered as part of the water abstraction for the project since the water is simply rejected back in to the Amudarya.

Figure 7: Escape flows from the system



To assess the impact of the project to river flow in the Amu Darya delta balance calculations have been made at the existing level for the conditions of average water (50%) and low water (95%) years.
The calculations show that in the average water years water needs of 4725 million m^3/year will be met in full. However, in low water years, aquatic ecosystems and wetlands of the delta, especially the central area will experience an acute shortage of water. The value of environmental flows is 1820 million m^3.
According to GME Karakalpakstan, since 2010 an increase in the volume of collector-drainage water from the South Karakalpakstan can be observed, which goes to the Eastern zone of the Amudarya delta. Because water in Eastern and Western zones partly depends on the volume and quality of collector-drainage water coming from irrigated zone, they are less vulnerable to the lack of water in dry years and in periods of drought.

Table 7: Return flow from South Karakalpakstan

Year	To the river and irrigation network				To the irrigated fields			
	Beruni	Ellikale	Turtkul	SK	Beruni	Ellikale	Turtkul	SK
2003	285.9	-	27.0	321.9	17.0	238.8	141.6	397.4
2004	269.0	-	28.6	297.6	8.8	228.6	166.5	403.9
2006	289.8	-	18.4	308.2	5.0	198.6	154.7	358.3
2007	280.2	-	34.4	314.6	6.4	198.7	122.9	328.0
2009	-	-	10.8	10.8	152.3	153.9	137.7	443.9
2010	-	-	18.5	18.5	256.7	276.1	251.3	784.1

The analysis suggests the following conclusions:

1. Technical measures for the project in average water years do not have and will not have a negative impact on the quantity and quality of river discharge entering the Amudarya delta. It can be concluded that the project "incremental" impact is not negative, since its design is not reliant on altering the river flow regime (be it high or low). However, in dry years, there is a significant shortage of water releases. To mitigate the effects of drought the state is making a number of emergency measures and technical

interventions to restore the delta ecosystem and protect the population, with the support of the public and donors.

2. An increase of collector-drainage water from the South Karakalpakstan to the East zone of the Amu Darya delta being observed since 2010, has a positive impact on the quality of environmental services of lake systems and wetlands. Thus, positive environmental benefits are obvious, both in the total environmental releases, entering the central zone (river flow) + Eastern zone (collector-drainage water), and to improve the quality of river discharge in Tahiatash cross section.

Table 8: Environmental flow in low water years (95%)

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	□
Inflow														
Tuyamuyun	mln m^3	726	1036	1530	1210	1712	2624	3002	2514	1025	762	1274	841	18255
	g/l	0.90	0.94	1.05	1.09	0.96	0.82	0.72	0.67	0.76	0.86	0.88	0.89	0.85
Outflow														
Karakalpakstan	mln m^3	-	407	949	1427	1529	1098	1393	913	374	481	19	2	8591
Kharezm	mln m^3	-	491	521	942	1282	894	1087	603	188	268	1	1	6281
Turkmenistan	mln m^3	-	-	269	256	323	523	544	539	162	169	219	122	3126
Domestic	mln m^3	67	67	67	67	67	67	67	67	67	67	67	67	800
Riverbed losses	mln m^3	31	45	66	52	74	113	129	108	44	33	55	36	785
Total outflow	mln m^3	98	1010	1871	2743	3274	2695	3220	2230	835	1017	361	227	19582
Environmental														
River flow	mln m^3	628	25	-341	-1533	-1563	-71	-218	284	190	-255	913	614	-1327
	g/l	0.90	0.94	1.05	1.09	0.96	0.82	0.72	0.67	0.76	0.86	0.88	0.89	0.85
CDW NorthKK	mln m^3	162	152	315	325	325	284	315	365	294	233	173	203	3147
	g/l													2.80
Total Env. Flow	mln m^3	790	178	-27	-1209	-1238	213	96	650	485	-22	1086	817	1820

Table 9: Environmental flow in average water years (50%)

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	□
Inflow														
Tuyamuyun	mln m^3	900	1514	2472	1897	2974	4812	5007	4519	1490	1552	2019	1120	30276
	g/l	0.88	0.92	1.01	1.05	0.94	0.82	0.69	0.65	0.73	0.83	0.86	0.86	0.82
Outflow														
Karakalpakstan	mln m^3		407	949	1427	1529	1098	1393	913	374	481	19	2	8591
Kharezm	mln m^3		491	521	942	1282	894	1087	603	188	268	1	1	6281
Turkmenistan	mln m^3			269	256	323	523	544	539	162	169	219	122	3126
Domestic	mln m^3	67	67	67	67	67	67	67	67	67	67	67	67	800
Riverbed losses	mln m^3	90	62	40	203	233	249	203	70	72	75	70	87	1454
Total outflow	mln m^3	157	1028	1846	2894	3434	2831	3294	2192	863	1060	376	279	20252
Environmental														
River flow	mln	743	487	626	-998	-460	1981	1713	2327	627	492	1643	841	10022

	m^3													
	g/l	0.88	0.92	1.01	1.05	0.94	0.82	0.69	0.65	0.73	0.83	0.86	0.86	0.82
CDW NorthKK	mln m^3	151	141	292	302	302	264	292	339	273	217	160	189	2922
	g/l													
Total Env. Flow	mln m^3	894	628	918	-696	-158	2245	2005	2666	900	709	1803	1030	12944

Table 10: Environmental flow in low water years (95%) - 2030

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	□
Inflow														
Tuyamuyun	mln m^3	260	680	1296	2150	2910	2307	2708	2208	930	1080	765	360	17654
	g/l	1.03	1.07	1.14	1.23	1.18	1.05	0.86	1.00	1.124	1.28	1.09	1.01	1.05
Outflow														
Karakalpakstan	mln m^3		502	105	448	1432	1666	1106	1407	958	407	423	156	8610
Kharezm	mln m^3		275	190	259	1103	1425	842	1018	608	201	209	38	6170
Turkmenistan	mln m^3		147	379	206	446	863	917	837	143	156	263	55	4412
Domestic	mln m^3	200	200	200	200	200	200	200	200	200	200	200	200	2400
Riverbed losses	mln m^3	11	29	56	92	125	99	116	95	40	46	33	15	759
Total outflow	mln m^3	211	1154	930	1206	3307	4253	3182	3557	1950	1011	1128	464	22351
Environmental														
River flow	mln m^3	49	-474	366	944	-397	-1946	-474	-1349	-1020	69	-363	-104	-4697
	g/l	1.03	1.07	1.14	1.23	1.18	1.05	0.86	1.00	1.14	1.28	1.09	1.01	1.05
Shorbulak	mln m^3	50	50	30	470	500	510	540	300	200	300	120	130	3200
CDW NorthKK	mln m^3	123	115	239	246	246	215	239	277	223	177	131	154	2385
	g/l		2.6	1.8	2.4	2.6	2.3	2.2	2.0	2.0	2.2	2.6	2.9	2.3
Total Env. Flow	mln m^3	222	-308	635	1661	350	-1221	304	-772	-596	546	-112	180	888

Table 11: Environmental flow in mean water years (50%) - 2030

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	□
Inflow														
Tuyamuyun	mln m^3	871	1465	2392	3275	3965	3657	3864	3375	1895	1502	1954	1084	29299
	g/l	0.85	0.89	0.96	0.99	0.88	0.77	0.64	0.60	0.67	0.76	0.80	0.82	0.77
Outflow														
Karakalpakstan	mln m^3		105	448	1432	1666	1106	1407	958	407	423	156	16	8124
Kharezm	mln m^3		190	259	1103	1425	842	1018	608	201	209	38	30	5925
Turkmenistan	mln m^3		147	379	206	446	863	917	837	143	156	263	55	4412
Domestic	mln m^3	200	200	200	200	200	200	200	200	200	200	200	200	2400
Riverbed losses	mln m^3	42	70	115	157	190	176	185	162	91	72	94	52	1406
Total outflow	mln m^3	242	713	1401	3099	3927	3186	3727	2766	1043	1060	751	353	22267
Environmental														
River flow	mln m^3	629	753	991	176	38	471	137	609	852	442	1203	731	7031
	g/l	0.85	0.89	0.96	0.99	0.88	0.77	0.64	0.60	0.67	0.76	0.80	0.82	0.77
Shorbulak	mln m^3				540	540	520	540	540	520				3200
CDW NorthKK	mln	78	73	151	156	156	136	151	175	141	112	83	97	1510

	m^3													
	g/l	2.9	2.6	1.8	2.4	2.6	2.3	2.2	2.0	2.0	2.2	2.6	2.9	2.3
Total Env. Flow	mln m^3	707	826	1143	872	733	1127	828	1325	1514	554	1286	828	11742

Pest Control

The project will not support the purchase of pesticides. The EA tried to infer the likely incremental impact from the project on agricultural residues, only by measuring the current pre-project residues level, to check if this level is within the standards. Uzhydromet (GoU Center for hydrometeorological services) measured soil pollution from agricultural residues during 2009-2010. Residues from pesticides and herbicides are commonly inferred by measuring parameters such as: hexachlorocyclohexane, alpha isomer (alpha HC), hexachlorocyclohexane, gamma isomer (gamma HC) and dichlorodiphenyltrichloromethylmethane (DDT). The DDT and its metabolites in the Amu Darya river were found to be within the limits of 0-0.005 microgram/dm3 (0.05 MAC). In the Tuyamuyun reservoir, isomers of alpha HC, gamma HC and DDT for 2009 were not revealed, and in 2010 the maximum concentration of alpha HC concentration was as low as 0 to 0.002 microgram/dm3. Also the Water Quality Index in Amu Darya river reflected low pollution from agricultural residues. Measurements on a sample of 56 hectares of agricultural lands found DDT in the range of 0.001 to 0.02 MAC, thus way below 1.0 MAC. The residual HC under all crops was negligible. Organophosphorous pesticides (OPP), herbicides and defoliants were not found in the soils of the surveyed raions.

Table 12: Permisable standards for parameters that infer pollution from pesticides and fertilizers

N	Compound	unit	Standard Limit
1	Alpha-BHC	Ug/l	0.02
2	Gamma-BHC	Ug/l	0.02
3	BETA-BHC	Ug/l	0.02
4	Delta-BHC	Ug/l	0.02
5	Heptachlor	Ug/l	0.25
6	aldrine	Ug/l	0.02
7	Heptachlorepoxide	Ug/l	0.05
8	DDE-p',p	Ug/l	0.10
9	Endosulfane-alpha	Ug/l	0.10
10	Dieldrin	Ug/l	0.10
11	Endrin	Ug/l	0.10
12	DDD-p',p	Ug/l	0.10
13	Endosulfane-beta	Ug/l	0.10
14	DDT-o,p	Ug/l	0.10
15	Endrin aldehyde	Ug/l	0.10
16	Methamidophos	Ug/l	0.25
17	Endosulfane sulphate	Ug/l	0.10
18	Malathion	Ug/l	0.25

The low pollution from agricultural residues can be attributed to: (A) the farmers' low income compared to the high cost of insecticides, which poses an incentive to ration the application of insecticides; and (B) the quality control performed on the agricultural produce both in the domestic and international markets.

Nevertheless, the project will stimulate agricultural activities in the project area and hence might lead to increased use of pesticides. If not properly managed, this can cause pesticide residue build-up in the soil as well as in surface and ground water, can disrupt agro-ecosystems and undermine sustainable agricultural production, and can pose human health risks. Also, insufficient infrastructure for storage and disposal of pesticides and related wastes may pose environmental risks. In order to address these potential risks, the OP4.09 is striggered. The project will, as part of its capacity building activities under Component 2, support awareness raising activities and training programs targeted at WUAs and individual farmers. The training will promote application of biological control methods, cover the topics on optimal use of pesticides (preferable WHO class III) on the basis of economic thresholds, determination of adequate amounts, proper storage (away from water bodies and other sensitive receptors) and disposal. The project will benefit from the Intergrated Pest Management Program (IPMP) developed earlier under the Cotton Sub-Sector Improvement Project (closed in 2003), which provided for equipment and technical assistance for the development of insect rearing and dispersal technologies allowing for biological control of pests.

On a selected basis, the project will monitor soil and water quality for the changes of pesticide residue amounts

Flora

Natural conditions of the surveyed territory defined the development of arid plant communities. Atmospheric precipitation in the winter-spring seasons has made plants adapted to its efficient use for the development of biological and soil processes. That is why these soils are covered with thick vegetation in early spring, – sands and takyrs, in particular, – starting with the sand sedge and other plants. For different species of sagebrush and saltworts these conditions are favorable, too. Thus, with favorable wet conditions in early spring, sands are being covered with quite diverse and lush vegetation, the main and most typical representatives being sand sedge (ilak, or rang), saxaul, saltwort, Calligonum and other subshrubs. Besides, quite common here are annual saltwort species: xerophilic and xerohalophilic annual grasses from the goosefoot family. Most of these plants have a prolonged vegetation period: they sprout in early spring, are slowly growing and blossoming during the whole spring and summer; their fruit ripen only in autumn. Very few annuals from the goosefoot family have a short vegetation period ending their life cycle somewhat later than ephemers. Most common are annual saltworts (Salsola turcomanica, Salsola foliosa), Halimocnemis (Halimocnemis Karelinii, Halimocnemis molissima, Halimocnemis sclerosperma, etc.), Suaeda, Petrosimonia, Gamanthos and some other species.

These plant communities are of little importance as fodder crops. On irrigated lands, vegetation has been formed depending on the specialization of the raions.

In spite of the extreme climatic conditions for farming, development of irrigated farming in the territory of South Karakalpakstan allowed the republic to grow different industrial and food crops.

Although the share of Karakalpakstan in the areas under cotton in Uzbekistan is almost the same in the relative share of cultivated areas, the share of Karakalpakstan in wheat, potatoes and vegetables is rather small. On the other hand, the areas under rice and cucurbits make the higher percent of the cultivated lands in Karakalpakstan then in Uzbekistan, on the whole.

In the recent decade, Uzbekistan has been taking measures to grow winter wheat for the reasons of food safety. In South Karakalpakstan, taking into consideration relatively cold winters, rotation of winter wheat and cotton on the same fields is quite problematic. Nevertheless, on one hand, cultivation of winter wheat has affected the increase in the demand for water for industrial purposes, although has probably resulted in a less need in winter leaching.

Households are mostly growing vegetables in their plots: tomatoes, potatoes, carrots, turnip, and radish. Small areas are under young orchards with apple, peach, apricot and quince trees. Artificial stands are located along automobile roads and *between* dwellings, comprising mostly of elms, poplars and plane trees.

The state of vegetation is being affected by many factors (salinity of soils, high groundwater level, droughts, uneven distribution of precipitation throughout the year, transport of salts, etc.). One of them is salinity of soils. In addition to the toxic effect, freely soluble salts increase the osmotic pressure of the soil solution causing the so-called physiological dryness which has the same effect on plants as the soil drought. The excess of water-soluble salts in the soil results in sparseness of vegetation and development of a special group of wild species of plants, – saltworts or halophytes adapted to saline soils. The disruption of the system of collectors or lack of drainage leads to salinization of soils, the factors of accumulation of salts being dry climate and hindered outflow of surface and subsoil waters.

Abundant solar heat and air dryness cause increased evaporation which depletes soil water resources. During droughts, supply of water to plants via the root system is hindered, consumption of moisture for transpiration begins to exceed its supply from the soil, water saturation of tissues drops resulting in disruption of normal conditions of photosynthesis and carbon nutrition.

During droughts, soil water resources deplete which results in lower, or loss of, crop yields because of deep albuminolysis in plants, cytoplasm disintegration, disrupted sugar phosphorylation and consequent energy metabolism. Dehydration causes various disruptions in plants and in colloid-chemical properties of cytoplasm; it changes the degree of its dispersity and the ability to retain adsorptive compounds. Water shortage and related metabolic imbalance result in plants stasis, decreased crop yields, and sometimes even in death of plants.

Aquatic Vegetation

Aquatic vegetation is abundant in lakes, collectors and canals of the raion. It is represented by different species of reed thick bushes of which cover the eastern part of the Ayazkala Lake, the inlet and the western bank of the Akchakul Lake, canals and collectors bed borders. Submersed macrovegetation, – first of all, stonewort, – is thicker at the inlet to the Ayazkala Lake and used to cover approximately 75% of the bed of the Akchakul Lake, and could also be found on the bottom of canals and collectors. Periphyton was the only vegetation in the western part of the Ayazkala Lake. Green filamentous algae and periphyton could also be found on the bottom of canals and collectors.

All these species of aquatic vegetation are capable of surviving with the level of mineralization up to 20 g/dm^3. All this vegetation participates in the process of self-purification of water reservoirs which, *as a result of* its life activity, absorbs different mineral and organic substances from the water mass. Besides, it provides food to fish and ducks.

Water plants in canals and collectors were usually growing on canals or collectors slopes. During regular cleaning of canals, some water plants could be found on the bottom. Submersed vegetation consisted of Potamogeton pectinatus, Myriophyllum Sp., Batrachium circinatum and stonewort (Chara Sp.). Green filamentous algae and periphyton (stuck to the algae) could often be found as well. Reed-beds mostly consist of Phragmites australis and Typha angustifolia which grow on the borders of canals and collectors beds. All these species have a wide distribution and ecological range. They are capable of surviving with the water mineralization level of up to 20 g/l.

Aquatic vegetation, including periphyton and phytoplankton are adapted to fluctuations of mineralization of water. Macrovegetation, first of all reed (Phragmites australis), form dense bushes at the inlet and along the western bank of the Akchakul Lake. Reed can grow even with a wide range of water mineralization, and reed-beds can absorb especially, especially nitrogen and organic substances from the water flowing by. Alongside with stonewort, there are areas with Potamogeton pectinatus, a species common for a wide range of aquatic habitat.

Fauna

The fauna of the region is quite diversified. The most conspicuous of common animals of the desert are great numbers of different kinds of reptiles, small rodents and beetles crawling on the ground.

Due to the sparsity of vegetation and scattered shelters and food resources, many desert animals have developed the ability of fast locomotion. This is characteristic of many running insects, arachnids, lizards, snakes, birds and mammals. Very common in the desert are steppe tortoises. Among the other typical representatives of the class are sand boas easily mining dry sand, as well as very common in deserts, slim, graceful and extremely fast-moving arrow snake Psammophis lineolatus. It mostly hunts lizards which it watches for hiding in bushes.

The most interesting characteristic of the desert rodent fauna is an exceptional diversity of species and abundance of unusual jumping species jerboas.

Aquatic Fauna

The fish fauna found in canals and collectors belongs to the fauna of the Amudarya lower reaches which, in its turn, belongs to the fauna of the Aral Sea basin. The populations of the most of the endemic species have shrunk due to the changing hydrological regime of the Amudarya and the reduction of the Aral Sea water area. Currently, at least six known species and subspecies endemic to the Amudarya (for example, the big and little Amudarya shovelnose) and to the Sub-Aral area are extinct or on the verge of going extinct.

In early 60s', new species were introduced in the Amudarya basin of which most common currently are silver carp (Hipophtalmichtys molitrix), white amur (Aristichtys nobilis) and mudfish (Ophioceplwlus argus), taking into consideration that black amur and spotted silver carp are not so plentiful. According to estimations, approximately 50% of commercial catch is made of the introduced species.

The fauna of fish in canals and collectors is expected to be similar to the fauna of fish in lakes (for example, in the Akchakul Lake) although not so regular since the level of water in canals and collectors are changing.

However, the inlet and outlet facilities on the lake provide for migration of a small amount of fish. Collectors and canals are important for spawning and fish-growing, and as a habitat in case of unfavorable conditions in lakes. Similarly, canals and collectors can serve as passages between different lakes and wetlands.

Most of the fish species in the lower reaches of the Amudarya are tolerant to mineralization levels of up to 10-12 g/l. The most salt-tolerant species is the pike perch which lives at water mineralization level of up to 20 g/l.

In the Akchakul Lake the fauna of fish is quite diverse. Commercial fishing is not practiced there. A wide variety of aquatic plants, in particular submersed macrophyte, provides favorable conditions for the growth of fish and the nutrient medium for cormorants, herons and ducks.

In spite of high water mineralization in lakes and collectors of the Project zone, it is the habitat both for such valuable commercial fish as cat-fish, pike perch, bream, pike, goldfish, asp, carp, white amur, black amur, mudfish, and non-commercial roach. The dominating species in the catch are roach, carp and goldfish.

Reproduction of fish is limited due to complicated conditions: sharp fluctuations in the level and salinity of water in the lake.

Avifauna

Collectors and canals are being used as feeding and resting places by some species of migratory birds, and also as passages between lakes and wetlands. However, they are of no major importance to big waterfowl as nesting sites. Among the birds seen on the collectors were mostly little cormorant (Phalacrocorax pygmaeus) catching fish and colonies of Madagascar Bee-eaters (Merops superciliosus) nestling in holes in steep banks of the collectors, especially when they run through uninhabited desert territories.

Due to the continuing drying-out of the Aral Sea, the role of other water reservoirs providing living space for the waterfowl in the Sub-Aral area is especially important. The Akchakul Lake is the feeding and nesting site for some migratory birds.

The colony of birds in the Akchakul Lake is comprised of the Great-crested Grebe (Podiceps cristatus) and the Pygmy Cormorant (Phalacrocornx pygmeus) included in the International Red Book, the Purple Heron (Ardea purpurea), the Glossy Ibis (Plegadis falcinellus) included in the Red Book of Uzbekistan, the Red-crested Pochard (Netta rufinii), the Gull-billed Tern (Geloclielidon nilotica) and the Clamorous Reed-warbler (Acrocephalus stentorius).

The Aral basin is an important site on the way of birds migrating from the Palaearctic region to the Indian subcontinent and Africa. This region of Central Asia is the site for alternative routes birds can follow; their migrating routes can significantly vary for various species. Birds are migrating from Siberia to the south and south-west crossing the Himalayas or the Arabian Peninsula. The western part of the Ayazkala Lake is located on the way of migration of some species of migratory birds and serves them mostly as a resting site.

The diversity of nesting sites and the availability of water space attract great numbers of birds into these places. Some of the migratory species that could be met here are the Spotted Flycatcher, the Common Redstart, the Black Redstart, the Robin, the Tawny Pipit, the Rosy Pastor, the Rock Sparrow.

The Goshawk, the Eurasian Sparrowhawk, the Short-eared Owl, different thrushes, the Grosbeak are coming here from the northern regions for wintering.

Of non-migratory birds, there are the Kestrel, the Rock Pigeon, the Laughing Dove, the Little Owl, the Long-eared Owl, the Crested Lark, the Turkestan Tit, the Common Myna, the Eurasian Tree Sparrow. Due to the continuing drying-out of the Aral Sea, the role of other water reservoirs providing living space for the waterfowl in the Sub-Aral area is especially important. The Akchakul Lake is the feeding and nesting site for some migratory birds.

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Baday Tugai Reserve

Riparian woodland is a unique flood plain forest of the desert zone which have arisen in Central Asian arid steppes and lowlands. These ecosystems were widespread in previous years in Central Asia, but now are presented by separate fragments in basins of some Central Asian rivers. The area of riparian woodlands decreased catastrophically; and by 1998 made only 10 % of the area of tugai, existing 20-30 years ago. The most extensive remained territory of tugai, about 300 km^2, is in the delta of Amudarya.

For the moment along the main riverbed of Amu Darya, only small woodland remains, including the Baday Tugay reserve (6,500 ha, a seasonally flooded forest adjacent to the project area). Additional water supply to the reserve needs to be provided from Amu Darya during the periods when river's discharge reaches peak runoff. One of the co-benefits of improving water management through the project components is to sustain the required seasonal water flow to Badai Tugay. The canal needed for water supply to the forest has been developed under DIWIP; whereas one of the co-benefits of SKWRIP (since it aims at raising water-use efficiency) is that it would help ensure the adequacy of the forest's water resource.

Supply of water from the Tuyamuyun reservoir via the Right Bank Canal

The 31 km long Right Bank Canal was completed in the early 1980s with a nominal design discharge of 200 m^3/s. This large flow rate allowed for future developments, much of which has still not occurred.

There is a division structure at the end of the canal which diverts water nominally 6 ways.

As Bustan Canal has not carried more than 20 m^3/s, and Yanbash Canal can only practically carry 25 m^3/s, the Right Bank Canal has never been able to carry full design discharge of 200 m^3/s because the downstream are not capable of receiving such a large flow rate of water.

Upon completion of construction of the RBC there were apparently defects which prevented handover (such as the excavated bed level remaining above the design bed level). Handover was only negotiated some 10 years after the RBC was completed.

Table 13: Canals taking water from the Right Bank Canal

Canal	Planned design flow (m^3/s)	Estimated actual flow (m^3/s)	Comments
Yanbash (Djambaskala main canal)	50	12-18	Due to construction or design issues, the canal has never carried is planned discharge
Aidan	?	0	This canal was included for future land reclamation, which never occurred
Bustan	105	0	The currently partially constructed Bustan Canal has never carried neither significant flow nor for any duration
Bozyap-Akbashli	5	5	This is a small canal serving the *Bozyap* WUA in Turtkul raion
Koshilish	100	100	This canal feeds Pakhta-Arna
Flood-discharge outlet	10	-	Currently some lands is irrigated through approximately 1 m^3/s flow from this outlet
Total	270 +	~ 120	

Currently, operators report that there is a significant problem of sedimentation in the RBC, though it is unclear whether this is actually the natural material that has never been excavated or the side slopes that have slipped into the canal leading to the section becoming wider and shallower.

Until the Bustan Canal is commissioned, or an equivalent increase in downstream conveyance capacity is obtained, the RBC will not be able to carry its full design discharge. This could be a contributory factor to the sedimentation in the RBC, which nevertheless (see below) has dimensions reasonably close to that of a stable channel

The RBC has two structures along its length; both are cross regulators, at picket 16 and picket 153. The first structure has a set of radial gates, and its function is unclear given that it is not located close to any offtakes. The structure at PK:153 contains three 5 m by 5 m openings with gates. This structure has two functions:

- drop structure, with a fall of 2 to 3 m
- cross regulator for raising the water level to feed outlets upstream.

However, it is reported that in recent years the gates have been left open and the structure simply functions as a drop structure.

There is approximately 1 160 ha of land irrigated directly from the canal, 230 ha of which is pumped, the rest is fed by gravity.

Main Canals

There is 111.8 km of main irrigation canals, of which 43.6 km is lined. The on-farm systems are nearly all earth canals.

Given that less than 10% of the inter-farm canal system has concrete lining, and only about 2.5% of the on-farm systems, there is a general perception that seepage from the canals is a problem resulting in:

- Reduced water for crops
- Waterlogging near the canals.

In many cases, scheme operators wish to give these old canals waterproof linings, but they cannot easily take them out of service for more than a few weeks in each year.

During preparation of Feasibility Study data of specialists of Holland company RH (Royal Haskoning) on monitoring and evaluation were used. The conducted surveys on six canals in 2008-09 indicates that seepage losses may be less than generally held, which the authors attributed to a 'rather thick layer of silt and shallow ground water level'. The unlined canals typically have almost flat beds of water-transported fine sands and silts. The depth of this material deposited in canal beds varies with canal size and from the sides to the middle across some canals. It reaches 1 or more in some of the largest canals.

Whilst many channels have formed by semi-natural process, general practice in South Karakalpakstan has reportedly been to construct canal banks at a slope of 1 vertical to 1.5 horizontal or similar, in the usual trapezoidal shape. Such constructed sections have been re-formed over time by natural processes so that they consist of steep banks of somewhat cohesive material deposited from the canal water's wash load or comprising the parent material of the ground.

Canal freeboard is very variable, and is apparently negligible in some locations. The canal banks tend to be eroded by people and animals seeking water.

There are occasional canal breaches caused by overtopping. Some breaches are also caused by unauthorized bank excavation so as to obtain extra irrigation water.

Whilst animal burrows may cause occasional leaks this is not, apparently a widespread problem.

Local scour downstream of structures is also common. Away from such locations, the canals have a generally uniform cross-sectional profile.

Inter-farm Canals in the Areas with Traditional Pumped Irrigation

The inter-farm network in the traditional pumped irrigated areas tend to be large canals which supply most of the project area. They are deep earth channels, which may have been old delta channels. Typically they do not command the surrounding fields.

Many of these canals pass through villages, and generally there is no wayleave alongside the canal for maintenance. Particularly for the main Pakhta-Arna channel, over time, buildings and other infrastructure have encroached on the banks. (This has happened much less on the downstream canals.).

Usually vehicular travel along the bank is impossible. Dredgers are not in use on the canal network, and therefore for many of the canals there is no regular maintenance of the section.

Moreover, major periodic maintenance is not undertaken in view of the severe disruption that would occur to the bankside communities, as well as to downstream irrigators were, for example, the channel closed for extended maintenance or remodeling.

The design discharge capacity of Pakhta-Arna is 80 m^3/s. It is 27.6 km long and has a command area of 52 700 ha.

The main distributaries of the Pakhta-Arna Canal are the Keltaminor, Amirabad and Bozyap canals. The latter feeds two big canals: Ellikkala and Kirkkiz. In addition in Beruni district there are the Beshtam, Nayman and Kattagar canals.

There does not appear to be a significant problem of sedimentation or erosion on these sections.

Inter-farm Canals in the Areas with Traditional Gravity Irrigation

For the traditional gravity irrigated areas, the inter farm canals are long, unlined earth channels.

In many cases, fields are commanded by gravity if the inter-farm canal is flowing at its maximum design capacity, whereas if the canal is carrying less than its design capacity the water level is too low to give gravity command.

Under DIWIP, a number of cross regulators were installed on the inter-farm canals to create a backwater which would set up higher water levels to enable command at lower flow rates. In some locations however, such as close to the head of the canal, this was not feasible.

The irrigation subsystem commanded by Nayman Beshtam has some gravity inlets from the river. To avoid pumping costs at the major pump stations, when the river is high enough these inlets are opened and the water flows into the system by gravity, but at a level lower than if pumped.

This gravity flow is at a lower flow rate than if the pumping station is used, but at a longer duration, thus supplying the same amount of water. In this case, as the water level at the head of the system is below the design level, cross regulators cannot be used to set up the backwater effects to bring the water level up to the design flow level. In some locations on-farm pumps are present, owned by either the farmer or the WUA, to pump water when command is not possible from the inter farm canal.

Gravity irrigation in the area of Nayman-Beshtam can be carried out only when the water level in the Amudarya River is relatively high and provide water supply to all consumers. But as this is not the case usually, the pump station Nayman-Beshtam needs to be operated. Therefore calculated in order to get the same volume, more time is required since discharge is less. Water velocity becomes 0.3-0.6 m/s therefore at the end of the system of canals additional pumping is required to raise the water to the field levels. A solution is to construct the main and inter-farm canal network at water supply level at pumping irrigation. Therefore at the farm levels change of water supply system according to the change of inter-farm system of water supply is required. It can be the closed system with pressurized pipelines by analogy to earlier existing flume system.

Large amounts of water are required simply to fill the inter-farm canal channels. The canals tend to have a larger section than required to pass the nominal design flow rate. Reasons for this include:

- The canals have been deepened to allow water to flow when the water level at the head of the system is low, especially in drought years
- The canals have been over-excavated during cleaning to remove reeds,
- The canals have been increased to supply high flows due to decisions taken to shorten the amount of time water is made available;

This would most easily be solved by deepening the canal and increasing the hydraulic gradient. As the water level at the head of the system is not raised, the increase in gradient means that in the middle and tail reaches the water level becomes lower.

In all of the system there is a very shallow gradient. Canals typically run at gradients of 10 to 30 cm/km (0.0001-0.0003, or 1 in 10 000 to 1 in 3 333).

This leads to modest flow velocities, typically in the range 0.3 to 0.6 m/s.

Sedimentation does not appear to be a problem in some of the older canals.

Inter-farm canals in the Engineered Irrigated Areas

In the engineered systems, the secondary canals were originally designed to be concrete lined (*usually* with precast concrete slabs), often in embankments above ground level.

Currently, some of these canals have been replaced by lower level earth canals. The reason for this is reportedly that the original canals were too high for water to flow into them, particularly in drought years.

Probably the most significant inter-farm canal serving the engineered irrigated areas is the Yanbash Canal. .

This is the main supply canal to the engineered systems of the Yanbash Massif (North Turtkul). The Yanbash Canal is a 43.5 km long concrete lined carrier canal. The canal runs through desert areas for the majority of its length.

The irrigated area served by this canal is estimated to be 11 000 ha.

The design capacity is 50 m^3/s but, due to the poor condition of the canal, it is currently only possible to supply around a maximum of 25 m^3/s. Actual flow is estimated as 12 to 18 m^3/s.

In 2005, PAN-ISA proposed that under DIWIP two canal reaches were repaired, where the canal lining has failed. One reach was at around PK:100 and with a total length of 280 m. The second reach was at around PK:110 with a total length of 50 m.

After inspection in 2006, it was concluded that there were many other places on the Yanbash Canal where failure appeared to be imminent and the entire Yanbash Canal would need rehabilitation within the next few years.

However such large scale rehabilitation works were not possible within the DIWIP budget. A recent inspection of the canal (September 2010) showed that the canal now has major failures in 5 or 6 places, and the beginnings of major failures in numerous other places.

In addition, the canal appears to not follow a uniform gradient, leading to areas of rapid flow, where erosion is occurring, and areas of very low gradient, where sedimentation is considerable. This was verified by topographic survey.

The design of the canal includes a liner under the concrete slabs, but does not incorporate any under-drainage. Therefore it is possible that when the canal is empty, the pressure of the groundwater causes the concrete slabs to begin to lift, which then begins the process of erosion when the canal is refilled, leading to eventual failure.

Bustan Canal

This is partially completed canal starting from the RBC.

There is an existing plan to construct Bustan Canal from the tail of the RBC to the outlet of Nayman-Beshtam pump station in Beruni raion. This would enable the decommissioning of the two major pump stations on the river (and many of the smaller pumps), significantly reducing the area's dependency on pumped water supplies from the Amudarya, and on-farm pump stations and/or individual pump units.

A visual inspection of the completed sections of the canal was undertaken during September 2010, and a further topographic survey undertaken. The results of the survey of the Bustan canal:

- the crest level of the right bank is too low
- wind erosion which undermines the clay cap (screen) over the top of the embankment and causes drifts of wind-blown sand (In some places the reduction in embankment height is approximately 1 meter).
- breach in the right bank of the canal where the canal crosses a low lake / wetland area.
- internal side slope failures.
- breach as the canal passes over a collector, which has been repaired by now, although it is not clear whether any anti-filtration measures have been applied to prevent a repeat of the breach

- The culvert at PK:302 (Vostochni Collector) is constructed from a large diameter steel pipe which has apparently a leak, and material from the left embankment has been carried away with the collector water causing a large crater in the left embankment, and sedimentation downstream in the collector. The canal in this part was lined with cast-in-situ concrete, although the concrete stands proud of the bed.
- In some short stretches there have been attempts to line the canal with precast concrete slabs. These slabs have slipped on the sand and do not appear to be stable. The mechanism for this slippage is thought to be linked to wind erosion.
- There are some quite sharp bends which have no erosion protection.
- Existing structures have been constructed in accordance with a low-gradient alignment with drop structures. Should a revised vertical alignment be considered, the levels of these structures should be taken into consideration to provide adequate freeboard.

Completing the canal has been reported as providing economical and environmental benefits ranging from the avoiding the cost and impact of pumping water from the Amudarya to improving agricultural productivity and reducing losses to groundwater, so both making more water available for crops and reducing the occurrence of high groundwater.

However, as the proposed alignment crosses the existing irrigated area, there are also potential social and environmental issues.

Water Intake at the RBC

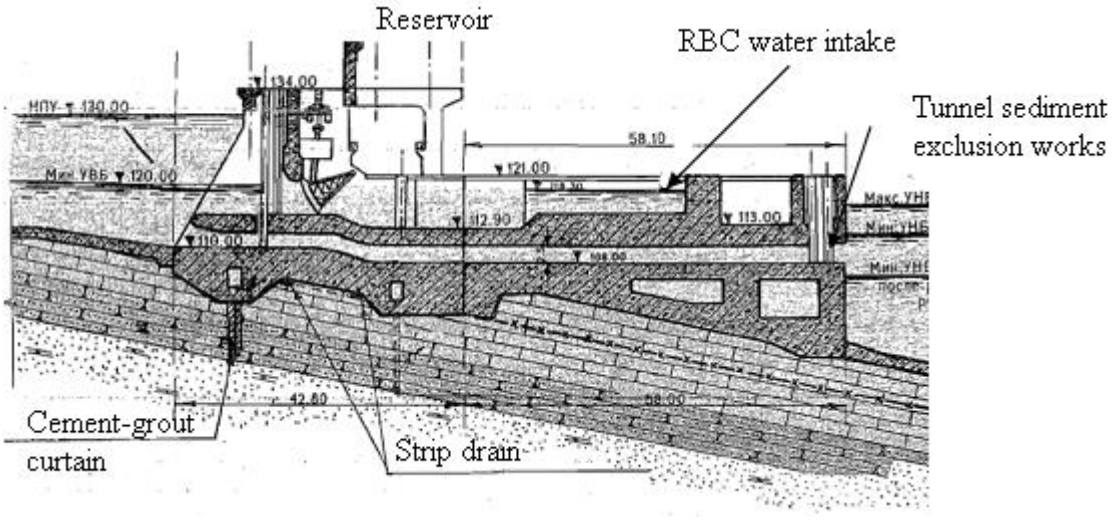
A reservoir offtake, such as the RBC, would usually be expected to have a low sediment load with much of the incoming sediment load either retained in the reservoir or, during floods, passed to the river downstream.

However, the Tuyamuyun reservoir is relatively short between reservoir entry and exit hence there may be limited opportunity for sediment to settle out within the reservoir basin. The offtake structure includes a tunnel sediment excluder.

It is designed to be operated continuously such that water from the upper layers of the flow is diverted into the RBC while the coarser sediment fractions, which are transported in the lower part of the flow, pass through the tunnels below the intake floor and back to the river. Recent aerial images (Google Earth) indicate the tunnels are in operation. However aerial images also suggest that there is a pocket of sediment in front of the intake. This may need to be cleared to improve the flushing operation of the tunnel excluders.

Note that sediment excluders such as this one will do little to exclude finer sediments that are suspended through depth in the flow and thus will only reduce entry of coarse sediments.

Tunnel Sediment Exclusion Facility at the RBC Water Intake



However, on average, current bed levels are only 1.85 m above the intended (but possibly never achieved) design level. Review of current bed levels suggests bed levels near structures are lower than the general slope of the canal would indicate. This suggests deposition has occurred away from those structures.

The evaluation of the sediments drifting capacity in the RBC has shown a fairly low sediment transport capacity for sand fractions present in the canal banks as well as A high silt transport capacity, particularly for the finer silt fraction.

Thus, measured sediment concentrations appear high for an offtake from a reservoir which has a tunnel sediment excluder, assuming the excluder is working efficiently. The excluder will not remove the finer sediment sizes. The presence of silt deposited in the RBC would suggest entry of fine sediment, which will be difficult to remove other than by mechanical extraction.

The transport capacity of the RBC for sand fractions is low (below 300 ppm), hence any sand entering the intake is likely to deposit within the RBC. Review of bed levels would suggest some deposition in the head reaches of the canal.

The current canal dimensions appear reasonably close to predicted stable channel dimensions with the potential for modest erosion leading to some deposition in the lower parts of the irrigation system.

Engineered systems

In the engineered systems, some of the secondary canals are administratively considered as on-farm canals.

The tertiary canals were often canalette flumes, although many of these have fallen into disrepair and are replaced by parallel earth channels. Typically these are 2 km long serving 200 ha.

All areas were originally intended to be commanded by gravity. However, since the development of the lower level earth canals, in some areas these do not command the adjacent fields and farmers resort to using pumps.

In some places, notably in Yanbash WUA at the end of Yanbash Canal, WUA staff have reported problems with sedimentation in canals; this is also visible from significant spoil heaps alongside canals, more than typically seen in other parts of the project area. During investigations for DIWIP, the WUAs in some of these areas indicated that there are also problems with sedimentation in the on-farm canals.

There are no engineered field outlets from the tertiary canal into the field. Earth and filled bags and the like are used to plug the cut through the canal bank into the fields.

Typical field sizes are 8 to 10 ha in these areas.

Traditional gravity irrigation systems

In the traditional gravity irrigated area, on farm canals typically serve 40 to 100 ha, with one or two branches. They are earth channels typically 2 to 3 km long. In some locations, there have been schemes to expand the irrigated area and lengthening these canals to serve up to 300 ha with correspondingly longer channels and more branches.

Despite the general prevalence of gravity provision, in these areas there are some on-farm canals which can only command their fields by pumped irrigation; water is pumped from the inter-farm canal into the on-farm canal. Typically the pumps used have a capacity of 300 to 500 l/s, which is a large flow compared to the area irrigated, often only 20 to 40 ha.

This high flow rate is difficult to control. As a consequence water:

- Is either allowed to flow back into the canal to irrigate fields which would ordinarily be commanded by gravity, or
- Overflows from the fields directly in to the drainage network.

The former is a waste of energy, which is costly; the latter is a waste of both energy and water.

On many other canals, there are typically a few fields adjacent to the canal which require pumped irrigation; these are either served by a pumped secondary canal parallel to the gravity one, or by closing a cross regulator (or creating a dam) on the secondary canal and filling the upper reach by pump. Typical field sizes are approximately five hectares or less.

In both the engineered systems and the traditional gravity irrigated area, one common feature is that the command is negligible. This means that canals flow with low speeds, and shallow gradients, typically 10 to 20 cm/km (0.0001-0.0002).

Traditional pumping irrigation systems

In the traditional pumped irrigated area, on-farm canals serve, on average 80 ha, but the range is from 3 to 200 ha.

As in the traditional gravity areas, the canals are earthen. They tend to be a bit shorter than in the gravity areas. This arises from their location. In these areas there is a narrow band between canal and the collectors; moreover the land slopes relatively strongly away from the canals. Close to the collectors the water table has historically been high, resulting in poor soil condition and discouraging agricultural development.

The on-farm canals tend to suffer from siltation much of which seems to be associated with the pumps being too large and set too low. As a consequence, the pumps effectively dredge material from the canal bed.

Similarly to as described above, typically pumps have a capacity of 300 to 500 l/s, which present considerable water management problems. These tend to be suffered rather than overcome, with water that cannot be managed being returned to the canals or wasted into the drains.

The uneven surface of the lands and the long-line furrow method of irrigation result in water losses due to the excess seepage and surface spillover. At best, plants are using 60% of the water delivered to the fields, although there is reason to believe that the efficiency is still on a lower level in the whole Project zone.

Facilities at main canals

In the engineered areas there are division structures on the secondary canals. Typically these are in a poor state of repair with gates missing and downstream erosion protection damaged. There are few control structures on the replacement earth canals.

Some new structures were constructed and some existing structures were rehabilitated under DIWIP. Very few structures have the physical infrastructure for flow measurement.

All of the structures on the network are for the purposes of flow regulation or division. There are no water storage structures on the network.

With the exception of the RBC, there are no drop structures on the irrigation network. All canal structures are generally designed for the minimum head loss, typically 0.1 to 0.3 m.

During DIWIP it was noted that many structures suffer from scour immediately downstream of the apron.

The worst example of this (Keltaminor Canal) was found to be due to the structure being constructed in a layer of clay, underlain by fine sand. Downstream of the structure the clay layer had been eroded, and the sand layer eroded easily and undermined the surrounding clay layer, creating a layer scour hole. This occurred on two structures prior to DIWIP, at PK:380 and PK:236.

Typically cross regulating structures are used to set up the water level in the canal upstream by use of backwater effects. This is done by "cracking" the gate open slightly, to create a constriction in the canal which causes the water level upstream to increase. However, downstream this leads to a jet of water which may cause erosion downstream if the stilling basin is not designed for this operating case.

Figure 7: Typical problem with erosion in the tail reaches of facilities

Typically stilling basins do not contain baffle blocks, although under DIWIP many structures have included baffles and end sills to intercept such jets.

One further cause of damage to structures downstream is linked to their operation. Many structures have multiple gates, but often not all of these are operable.

Therefore, when gates are cracked open to create a constriction, this may occur on one side of the structure only, leading to asymmetric flow which tends to cause a jet directed to one bank which locally erodes that bank.

A similar result occurs if not all the gates can be opened when it is required to pass the entire design flow: asymmetric flow and jets may occur affecting one bank, and there may be a greater velocity jet than the structure is designed for. The cause of this is a combination of poor maintenance of the structure, and poor operational practice – allowing gates to be opened asymmetrically.

Very few structures are equipped with electro-mechanical lifting equipment. Thus, gates are limited to 2 m x 2 m, and lifted manually with gear boxes. During the design of DIWIP, the question of installing electric gates was discussed with PAN-ISA. At this time it was concluded that electro-mechanical lifting equipment is not appropriate, as:

- Remote rural areas have unreliable electricity supplies and the lifting equipment may not be able to operate;
- There is a high risk of theft of the equipment in such areas.

Structures were graded on the condition of the upstream apron, downstream apron, flexible erosion protection and gates, and then given an overall condition rating.

The survey of the inter-farm canals in the Project zone has shown that out of 193 structures with different discharge capacity, 68 are new, 67 have been reconstructed within the scope of DIWIP, 4 are in a good condition, 15 in a fairly good, 36 in a poor, and 3 in very poor condition.

Out of 39 structures, the head regulators with a discharge capacity of 3 m^3/s and 6 m^3/s on the Bozyap, the ET-1 and the Keltiminar canals (PK:236) (the check with a discharge capacity of 30 m^3/s) are in poor/very poor conditions.

5 DESIGN DECISION ANALYSIS

The Project proposes to change the principle way of water supply to the Project area by reshaping some part of the existing irrigation network and construction of new sections. After the project, water will be supplied to the command area by gravity. It has been envisaged to complete the construction of Bustan Canal up to Km:70 and reprofile the already excavated first 35 km. At the end of the canal, a structure for discharge of the excess water back to the Amudarya River will be constructed. The second main component of the project will be reshaping of Pakhtaarna canal system. Reconstruction of inter-farm and on-farm canals will be implemented at the command area of these main canals.

Thus, project foresees:

- Water intake to the Project Area via the Right Bank Canal
- Reprofiling of Pakhtaarna canal system
- Completion of construction of concrete-lined Bustan Canal of 70 km long to supply water to the Project Area by gravity
- Reprofiling of inter-farm canals

Right Bank Canal

Tuyamuyun Right Bank Canal (RBC) was designed during Soviet period by Uzgiprovodkhoz design institute. Nominal design discharge was 200 m^3/s. 30 km long canal was constructed along Tuyamuyun line on virgin lands. At the end of the canal a distribution structure consisting of head regulator for the existing Pakhtaarna Canal, water outlets for the new Bustan canal, and the Suyargan Canal were constructed. The Pakhtaarna Canal from which lands are commanded via canals Kelteminar, Bogyap, Amirabad and Bozyap, is connected with this structure through a 3 km long canal.

The route of the new Bustan Canal shall start from the above-mentioned distribution structure and continue towards north-west until Km:24, then will turn to the west, pass through the north of Turtkul City and at Km:35 connect with the existing Bozyap Canal. At Km:19 a structure with water outlet for irrigation of Jambaskala area has been designed. At Km:25 and Km:33 a new route will cross Kelteminar and Bogyap canals which will take water from the new canal.

The cross-section of the canal is trapezoidal, with a slope of 0.00005, width of 21 m, water depth of 5 m.

On RBC there are two structures: both are cross regulators, at PK:16 and PK:153. The first one is equipped with a complex of segment gates, however, currently is not operational as there is no water outlet nearby. The one at PK:153 has three openings of 5m x 5m size with gates. This serves for two purposes:

- Drop structure for a head difference of 2 to 3 m,
- Cross regulator to raise the water level for supply of water to outlets on the canal.

However, during the last years, the gates remained permanently open, thus the structure served as a simple drop structure.

Within the scope of the Feasibility Study, topographical survey of the canal was carried out showing collapses of the side slopes at several locations where the risk of breach is high.

Taking into consideration that the canal passes through sand with a roughness coefficient of 0.020, water will flow to PK:42 (left bank) at a discharge of 150 m^3/s. In order to provide a safe freeboard of 1 m, the canal flow should be limited to a maximum discharge of 75m^3/s. This is comparable with the maximum recorded discharge of 100 m^3/s during the last years (WRA).

It should be noted that at a discharge of 200 m^3/s and with an estimate of roughness coefficient of 0.020, overtopping is possible at 14 places (several adjacent pickets) where the embankment height above the water level will not exceed 0.5 m.

Presently, there is a sedimentation problem in RBC. It can be stated that the canal has not been cleaned previously. In some places side slopes have collapsed into the canal which caused enlarging and shallowing of the cross-section.

In this view, in case of need to increase the discharge capacity of the Right Bank Canal over the existing maximum of 100 m^3/s, reshaping of canal with certain volume of excavation and raising the level of embankments will be required.

Proposals on reconstruction of RBC include implementation of several repair works in order to provide sufficient discharge. The required peak discharge at the head of the canal is considered to be 160 m^3/s.

The Environmental Impact Assessment of the Project proposes to place stilling basin of 2.5 km length on the Right Bank Canal with two parallel beds by which the flow will alternately run. It will allow cleaning from sediments without delay in water supply and increase of water turbidity. Selection of site for the basin will not be a problem since the site is randomly populated.

Irrigation System of Pakhtaarna Canal

Pakhtaarna is one of the very old canals in the territory of Karakalpakstan. Canal head is located at 30 km downstream of Tuyamuyun. Canal is 27.6 km long with a design discharge of 80 m^3/s. Canal is an earthen one with a bed width of 20-28 m, having a water depth of 3.3-4.3 m, and embankment width of 2-10 m. All lands of the right bank of Amudarya River from Tuyamuyun to Karatau cape are irrigated from this canal.

At the section of water intake from Amudarya River, banks have been distorted, canal head at daigish have been eroded, sand drifts have been silted, and "kair" at the entrance of the canal have been formed. Kairs are artificial embankments in the river bed, located before the entrance to headrace canal which are created when it is necessary to take water from the river. This results in need of many-head canal and implementation of works in the Amudarya River bed.

In winter-spring period of low water level in the river, gravity water intake to Pakhtaarna Canal is hampered, and hence supply of leaching water is provided by the floating pumping stations taking water from the river.

Five water outlets not equipped with engineered structures were built on the canal. Water supply was regulated by "collars" (tarnau) which is a wooden box-like frame edged in sides having a brushwood bottom. Water is regulated with wooden pins. 28 propeller pumps have been installed on the canal.

The present water intake from the Amudarya River, and water supply to the system of existing canals reveal a number of problems which are to be solved within the scope of this project:

- annual change of the Amudarya River course as a result of creation of headrace canals to supply water to the command areas;
- cleaning of annual sedimentation in canals beds;
- non-regulated water intake to the inter-farm and on-farm irrigation system both during the vegetation season and winter-spring leaching period;
- water conveyance losses of the inter-farm canals and on-farm network.

As a result of the above-stated problems it becomes compulsory to increase the water intake from the River.

It has been reported that PAN-ISA takes on the average 18% more water than stipulated by the water resources management plans. Probably, one of the reasons is that the efficiency of the system declared by PAN-ISA is overestimated; the actual efficiency is lower and actual volume of the required water is more than calculated by its plan.

Project foresees re-profiling of canal by decreasing its capacity. In order to achieve that cross-section will be reduced to a size enough for the new design discharge, thus eliminating the currently existing excessive "dead volumes".

A new end tail about 1.75 km long will be constructed from RBC PK:38 to the river, via the fields with a discharge of 60 m^3/s, to maintain the minimum discharge in the RBC. At the same time Kelteminar and Bogyap canals will continue to supply water to the northern part of the Project area. They will cross the

Bustan Canal where two structures, to be constructed at these points, will allow for more flexible water division. Discharge of the canals will constitute 17m^3/s and 20 m^3/s respectively.

For reduction of cross-sectional areas of the canals according to the new discharge, considerable volume of embankment will be required on the south of the Bustan Canal.

As a result the command area will be reduced (limited between the Amudarya River and Bustan Canal). Decrease in the irrigation area will reduce the required discharge which results in reduction of cross-section of the canal.

Re-profiling of the canal will result in reduced discharge, and lower seepage and evaporation losses. Water supply will not depend on the availability of power for pumping considering that there are interruptions with diesel fuel and power supplies from time to time. The velocity of water will be controlled with higher accuracy.

Reduction in power consumption will result in concomitant economic and environmental benefits.

Construction of Bustan Canal (preferred Option A)

Construction of Bustan Canal was planned in 1970s by Design Institute UzGIP starting from the tail end of the Right Bank Canal to the pumping station Nayman-Beshtam in Beruni raion. Construction of canal would allow liquidation of three main pumping stations (and many other smaller pumps) by the river.

In 80s part of the canal was built. A visual inspection of the completed sections of the canal was undertaken in September 2010 and a further topographic survey was carried out. The following defects were revealed:

- Instability of canal slopes. As a result of wind erosion reduction in embankment levels at the right bank is approximately 1 m, undermining of the clay cap (screen) over the top of the embankment surface and exposure of sandy rocks occurred.
- Breach in the right bank of the canal where the canal crosses a low lake /wetland area.
- Failures of the internal side slopes.
- Breach as the canal passes over a collector introducing water losses into the drain.
- A large crater in the left bank of the canal at PK:302 due to a leak from the culvert at the crossing with Vostochni Collector.
- Damage of canal lining (precast concrete slabs) because of unstable sandy soil.
- Some quite sharp bends which have no erosion protection.
- Existing slopes designed not considering gravity supply of water everywhere.

Geotechnical survey was carried out for the existing part of Bustan Canal. Preliminary analysis of the obtained results gives the following conclusions:

- Almost all samples retrieved show that the material is classified as an even-graded, silty medium coarse sand and therefore the soil may not have good shear strength characteristics.
- The clay content of all samples is less than 10% which means that the soil can be expected to have a high permeability.
- Embankments have been poorly compacted which implies that the embankments are permeable and high filtration can be expected.
- The coefficient of filtration is generally in the range of 4 to 5 m/day.
- Low gradients in the whole existing system of canals results in lower velocities and hence sedimentation in the canals.

All structures of the network serve for regulation and distribution of water supply. Outlets at secondary canals are in unsatisfactory condition. Water storage facilities do not exist in the network.

Emergency discharge structures do not exist in the irrigation network except RBC.

The project envisages:

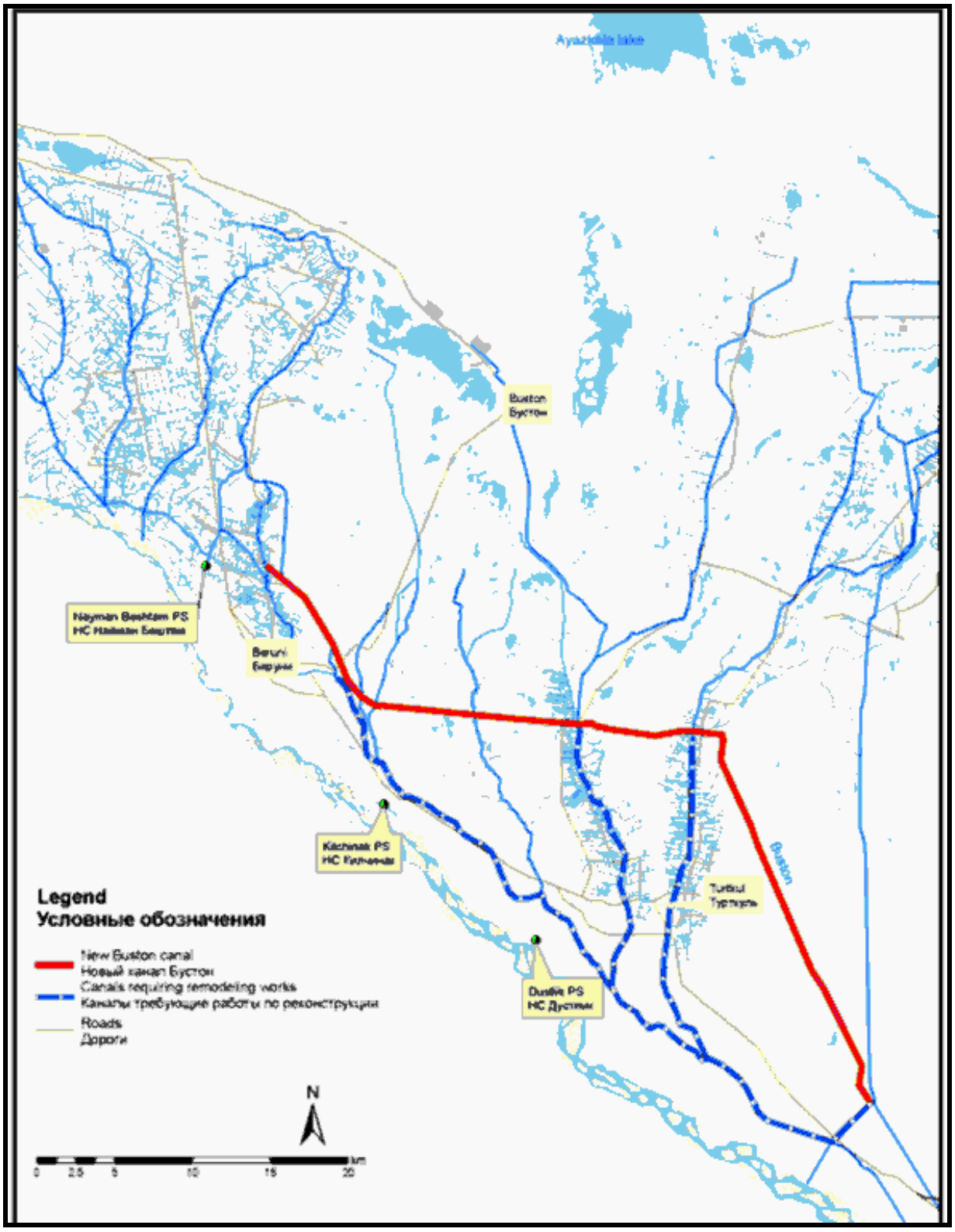
- Construction of 70 km long concrete-lined Bustan Canal;
- Installation of under-drainage under the concrete bed for removal of groundwater;
- Rehabilitation of gates at water outlets at cross regulators;
- Provision of hydroposts which allow monitoring of water supply;
- Laying of spillway facilities for maintenance of the level at fluctuation from 0.1-0.3 m;
- Recovery of clay cover and removal of washouts at Kelteminar canal at PK:380 and PK:236;
- Construction of blocking partitions at end baffles in sediment tanks (for maintenance of water level at the head reach of the canal and backup) in order to prevent washout of canal structure with pressure flow out;
- Drainage will be made under the concrete-lined canal bed in order to relieve the ground waters pressure.
- Step-by-step change of the cross-section with increase of slopes along the whole length of the canal.

Bustan Canal has been partly constructed from RBC to Bogyap Canal. From Bozyap Canal to Nayman-Beshtam pumping station, the second half of the canal will pass from the north of Beruni city.

Total length of the Bustan Canal is planned to be 70 km from the structure at the end of RBC to Nayman-Beshtam pumping station. Design discharge at the head of the canal is 80 m^3/s. It is necessary to raise the bed level of the canal for supply water to the command area by gravity.

Tail ends of the Bogyap and Kelteminar main canals will be connected to Bustan Canal which will allow water supply to the western part of Bustan Canal through the system of Pakhtaarna Canal. Therefore design capacities of Bogyap and Kelteminar canals are 20 m^3/s and 17 m^3/s respectively. This will introduce a reduction in the total volume of water to be supplied. These canals will still have earthen bed, but they will be reshaped. Bridges on the Pakhtaarna, Bogyap and Kelteminar canals will be replaced to serve higher water levels required for command of the adjacent fields. Hydraulic calculations have been made for the re-profiled sections of Bogyap and Kelteminar canals. These calculations show that reshaping of the Kelteminar Canal will not require demolition of the existing railway bridge.

Map 5: Proposed Route of Bustan Canal (Full Construction)



Implementation of the above mentioned works would supply water to 68,300 ha of irrigated area by gravity. The other part of the SKRB zone will still be fed by the existing canals. Thus, gravity irrigation will be almost in the whole project zone (about 100,000 ha).

At the present time the first part of the canal 35 km long (from PK:0 to PK:353) with a discharge of 50 m^3/s has been constructed.

The scope of construction works in this alternative comprises the following components:

Eastern section of the Bustan Canal: Construction of a 35 km long canal, 25 km of which run through the desert. Head flow of the canal will be 80 m^3/s.

Along this route, the existing canal was built in earth with a discharge of 55 m^3/s, however, it needs significant re-profiling in accordance with new hydraulic characteristics for concrete lining. The canal is going to be concrete-lined, with proper drainage underneath. Installation of three major structures is stipulated. Besides, two more hydraulic structures will be constructed at crossings with Kelteminar and Bogyap canals.

Western section of the Bustan Canal: Construction of 34 km canal runs mainly through agricultural lands. This is completely new construction. Western part of Bustan Canal will run mainly through agricultural lands. It will be completely new construction. Discharge at the head works of this section of the canal will be 55 m^3/s. It will include small hydraulic structures; water outlets and two big structures on canals.

17 road bridges, two pedestrian crossings and 9 culverts are envisaged four of which are on the main collectors. Tail escape will be constructed on the river as a result of minor works on re-profiling of short headrace canal of Nayman-Beshtam pumping station.

Canal will be designed with the following parameters:

- Canal will have moderate slopes from 0.0001 to 0.00027
- For cast in-situ lining Manning number 0.02 is considered
- Side slopes are considered as 1:2.5 for provision of stability at several sandy soils along the route.
- For provision of a water level to command all the project zone, canal will mainly be built on embankments
- Bed width is chosen so as to have relatively deep cross-section and minimize the fill volume required for maintenance of the design water level.

Various lining methods were considered to provide a durable, water retaining layer. After considering various options, it is proposed use a sealed geomembrane covered with in situ concrete. The geomembrane will be minimum 0.75 mm LDPE (low-density polyethylene). This will provide a good combination of water tightness and durability.

The canal would need to be regularly inspected and cleared of any vegetation growth, and checked for any signs of compromise in the water retaining properties of the embankments. These would need to be repaired quickly, to avoid risk of the problem escalating to catastrophic failure.

Minor cracking of the concrete lining is expected (and normal), and only major cracks which threatens movement of sections of the lining need urgent attention.

However, care must be taken to maintain the integrity of concrete lining to prevent damage to the underlying geomembrane. If this is done, no maintenance of the geomembrane is anticipated.

Gates on canal structures will need to be regularly lubricated, and seals replaced periodically. There should be a program of operating each gate through its entire range of travel at least annually.

This operation and maintenance requirements are similar to those of the existing canal network.

The advantages of Option A-2 can be stated as follows:

- Reshaping of Pakhtaarna, Bogyap and Kelteminar canals will allow higher flow rates which means reduction of refilling volumes.
- The operation of Pakhtaarna, Bogyap and Kelteminar canals will become more flexible as they can run at a higher flow rate to ensure command and availability, without wasting water.
- There is a lower risk of sedimentation due to standing water in the tail reaches of Bogyap and Kelteminar canals, as a through flow would be maintained.

- At low flow demand periods, there is the opportunity to close the first reaches of Bustan Canal completely to allow for maintenance.

The disadvantages of Option A-2 are as follows:

- This increases the complexity of the operation of the canal network. In particular, there is a risk of "transit flows" in Kelteminar and Bogyap which are intended for Bustan Canal being abstracted without permission by farmers along these canals.
- There is a risk that sediment from Kelteminar and Bogyap canals would enter Bustan Canal.

Increase of Secondary Canals Level for Gravity Irrigation

Reconstruction of secondary canals at higher elevations will improve canal commands. If the entire irrigated area is commanded by gravity even at low flows without the need for water to be set up by a cross regulator on major canals, then there are fewer constraints to when abstractions can occur at a given point.

Likewise, if sufficient hydraulic head is available, a simple flow measurement device can be installed and there will be control of water supply to water users.

The cross-sections decreased to the size necessary to pass the design flow, eliminating the existing excessive "dead volumes".

As a result of these works the environmental situation as a whole will improve. Rational use of water resources at reduced volumes and reduction of losses will be achieved.

Canal discharge will be determined only by requirements of volume necessary for command of the areas, instead of depending on the minimum flow in the canal. Gravity supply will not be dependent on power supply. New canals will be more effective from the point of view of rational water use. Control of velocity of water intake flow can be carried out with higher accuracy.

Serious issues at reshaping of canals are:

- maintenance of irrigation water supply during construction;
- selection of pits for production of loess soil with certain quality required for raising of embankments;
- temporary allotment of lands for realization of construction works since along certain canals, the land immediately adjacent to the canals is occupied by vegetable plots, outhouses or even dwellings;
- reclamation after completion of works.

Possibility of improvement of command at secondary canals increases the effect of the work which has been carried out at irrigation network. Table 14 specifies which canals will benefit from Bustan Canal.

Table 14: Command of Water Outlets from Bustan Canal

Canal	Estimated current design water level	Options providing improved command	Estimated water level at Bustan canal	Estimated bed level
Kelteminar	99,8	A, B, C*	102,75	98,64
Bogyap	99,5	A, B, C*	101,8	97,69
Amirabad	n/a	A, B, C*	100,35	97,45
Khaitbai-Arna	98,35	A, B, C*, D^	100,11	96,71
Bozyap	98,35	A, B, C*, D^	100,11	96,71

Aksakal-arna	n/a	A, B, C*, D^	99,31	96,03
Navoi	98,80	A, B, C*, D^	98,73	95,51
Shimom-yap	n/a	A, B, C*, D^	98,56	95,09
Kazakyap	94,74	A, B, C*, D^	98	95,05
Nayman-Beshtam	96,39	A, B, C*, D^	98	95,05

Notes:

* Possible only by major re-profiling works to Pakhtaarna

^ Possible if pump stations are reconstructed to give a higher lift and consequently higher water level

Source: Consultants, DIWIP

Priority of reconstruction of secondary canals within the project is determined on the basis of proximity to Bustan Canal, possibility of gravity supply with flow reduction after construction of Bustan Canal. Secondary canals proposed for reconstruction within the project are provided in the Table 15 below.

Table 15: Reconstruction of Secondary Canals

Raion	Canals receiving water from Bustan canal (directly or indirectly)	Canals receiving water from Pakhta-Arna canal (directly or indirectly)
Turtkul	Kelteminar (partly), Bitleu	Kelteminar (partly), Bogyap (partly)
Ellikkala	Bogyap (partly), HT-1, HT-2, ET-1, ET-2, ET-3, Kyrkkyz, Kazakatcha Amirabad (partly)	Bogyap (partly),Amirabad (partly)
Beruni	Aksakalatcha, Khaitbai-Arna, Navoi, Bozyap, Shimomyap, Kazakyap, Beshtam, Nayman, Kattagar	

Yanbash system canal

The Yanbash Massif Area (defined as the territories of the Yanbash, Kukcha, Pakhtabad-Navruz and Kumbaskan-Yanbash WUAs) receives water via the Yanbash Canal. This canal takes water directly from the RBC tail structure, and, thus the water supply to this region is currently independent on any proposals for the Bustan Canal, and hence is treated separately.

In general, gravity command is achieved for most of this area. Of the 11,000 ha only 1,300 ha from Kelteminar Canal and 180 ha from Bazarkala Canal are pumped.

In many areas the flume network has long fallen into disrepair and has been replaced by earth canals.

Under DIWIP many new structures have been constructed on the secondary canals in order to re-create an operable system, and many outlets have been rehabilitated.

Water levels are insufficient to use MR-5 concrete canal, however, the alternative canal Vr-MR-5 is used without pumping and the system generally appears to function.

The canal is in poor condition; the security of the supply to this region is low. For the moment discharge capacity of this route is estimated at 10-12 m^3/s. Lack of drainage under the canal and pressure release in the existing lining of the canal results in its deterioration.

The major issue for this area is improving security of supply and improving command for areas irrigated by Kelteminar Canal downstream of intersection with Yanbash Canal. Improved command would be possible

with a full reconstruction of either Yanbash Canal or Kelteminar Canal. Any further work on the on-farm networks is not envisaged; reconstruction of main canals together with on-farm works implemented under DIWIP should provide a workable system well suited better water management.

A complete reconstruction of the canal would require 43.5 km of new canal. Almost most part of the canal from water intake to 43.5 km runs through desert lands where water losses are high and there is no water consumption. Project considers water supply from Kelteminar Canal which in its turn is fed from Pakhtaarna Canal and Bustan Canal. It will improve hydraulics of the canal as for the present canal has problem with sedimentation because of flood decline at the tail end of the canal and damage because of high falls near the head of the canal. This will provide possibility to raise the designed water level at the tail-end of the canal which will facilitate water management at low consumption by the users at the tail-end part.

Construction of drainage in the bottom of the canal is hampered by technical problems.

Provision of alternative water supply route via Kelteminar Canal

Kelteminar Canal may receive water at PK:235 from PK:279 of the Bustan Canal; currently there is an outlet of 20 m^3/s capacity constructed.

If the downstream reach of Kelteminar Canal is reconstructed (from PK:235 to PK:451, 21.6 km) to take water at a higher elevation than is currently possible in this reach of Kelteminar, this flow can then be fed in Yanbash Canal at PK:385 where Kelteminar Canal crosses Yanbash Canal (currently at the same level). The final 5.5 km of Yanbash Canal would then be reconstructed (in concrete) with revised vertical alignment. This would supply water at a higher level to the head of the Yanbash Massif distribution network which would improve command at low flows.

Whilst this would increase the transit length for water to reach the Yanbash area (from Km:43.5 to Km:54.6), there is sufficient head available in the system for this not to be a problem.

As Kelteminar passes through clayey areas, this canal would have a compacted clay lining. The latter section (6 km reconstruction of Yanbash canal) would require geomembrane under concrete lining.

However there are 122 ha of irrigated land at PK:270 of Yanbash Canal as well as other unofficial outlets for shepherds' use. In the light of this, it may be necessary to maintain a small flow down the existing canal even if this option is adopted.

To construct the Kelteminar option is considerably cheaper than reconstructing the Yanbash Canal. This is because for the latter significant earthworks would be required to produce a reasonably constant gradient along the canal and prevent sedimentation in the lower reaches.

The disadvantage of this option is that a small flow may need to be retained down the existing Yanbash Canal channel to serve the few remaining water users along the length.

Considering the existing situation in the lower part of Yanbash Canal, it may be possible to resettle these water users or provide alternative water supply from Kelteminar Canal.

Ellikkala and Yanbash (Kyrkkyz) areas

Both of these areas contain engineering systems. These had tertiary networks constructed of precast flumes, and secondary networks which to some extent contain concrete canals. In both cases certain concrete canals are not commanded by gravity, and thus fallen into disuse.

This has led to a lack of command in some areas. These areas also tend to have a mixture of heavy soils and sandy soils, and before DIWIP these areas were poorly drained.

A large portion of irrigated land which has fallen out of use is located in these area, due to poor drainage or perceived lack of water.

Engineering system of Ellikkala Canal

Many of the irrigation abstractions from inter-farm canals are pumped by pumps obtained by farmers through credit.

The channel of the main Ellikkala Canal appears to be much lower than the design profile, as the concrete canal ET-3 at the tail of Ellikkala Canal does not receive water and an alternative lower earth channel is used.

This area is located at the tail of the system, and there is a strong perception that there is a lack of water. This area is bounded by the SKMC channel and consequently receives excellent drainage, with groundwater levels now some 3-4 m below field level.

Construction of a part of Bustan Canal will approach Ellikkala raion to the head of the system. In case of water supply from a higher level, this system will provide gravity command.

Along with low level of ground waters it can increase appeal of agriculture in these areas. Gravity command will require reconstruction of Ellikkala Canal for providing higher water level.

It is proposed to reconstruct inter-farm canals in this area under SKWRMIP, including new outlets with water metering structures.

The tertiary network is a mixture of flumes and earth canals. If gravity command is restored, it is likely that the tertiary network will need to be completely reconstructed, as it has fallen into disuse. From experience, it is unlikely that any of the flume network is suitable for reuse, and it is likely that it will be most effective to reconstruct the network from earth canals.

Earthworks Related to Re-Profiling of Canals

According to the Final Feasibility Report calculations, change of longitudinal profiles and cross-sections of canals require considerable volume of earthworks. Considering particularity of construction it is necessary to make compacted clay lining as a waterproof layer of 0.5-1.0 m thick depending on the discharge of the canals to be reconstructed. Besides, it is necessary to fill the "additional" area of cross-section with filling rocks. The scope of earthwork is presented in Table 16 below.

Table 16: Scope of Works for Construction / Reconstruction of Bustan Canal and Others

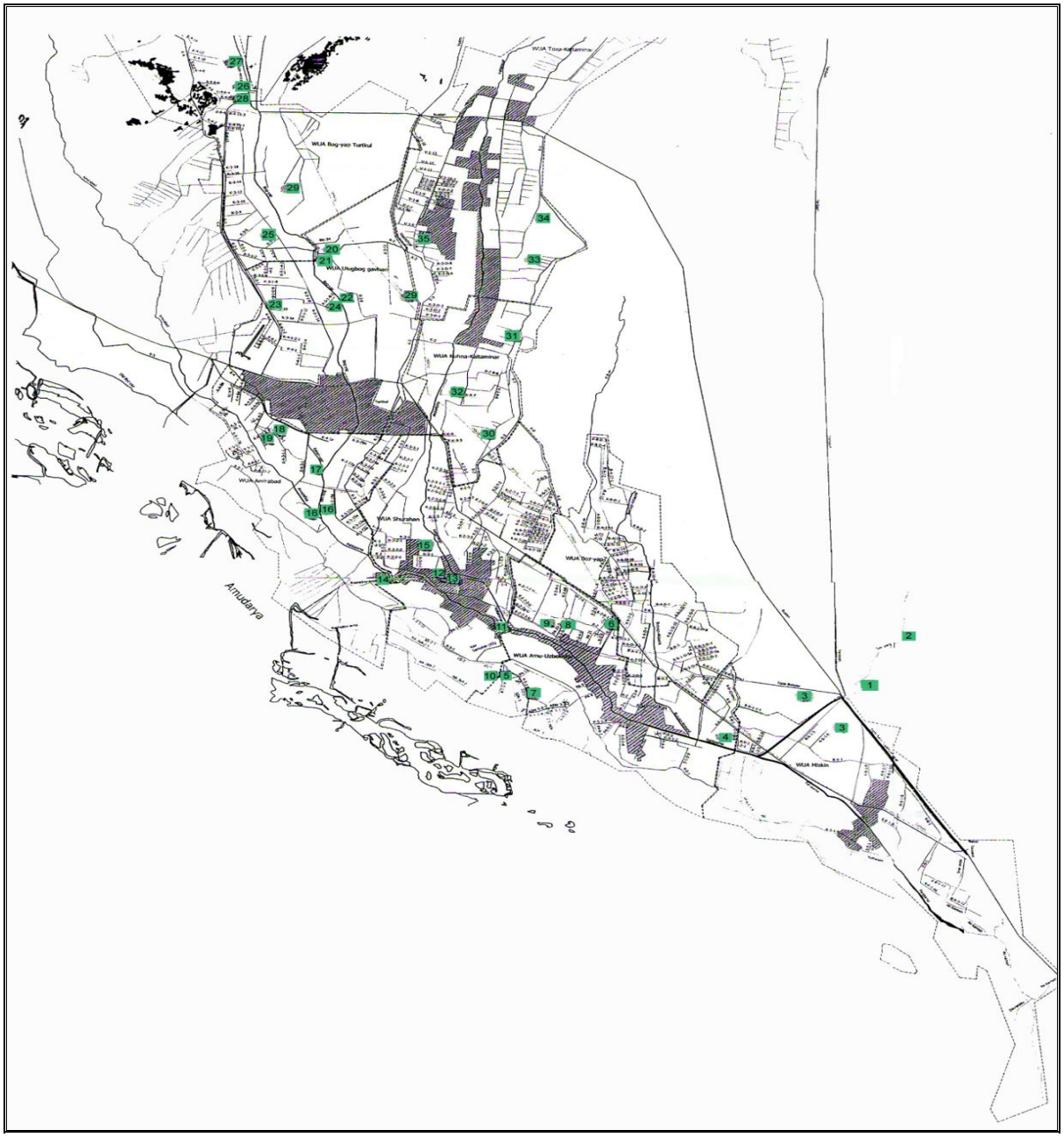
Works	Option			
	A-I	A-2	B	C
Excavation (m^3)	1 780 138	1 780 138	1 980 378	2 435 337
Fill (m^3)	9 682 675	10 394 345	10 176 089	3 808 315
Concrete (m^3)	320 317	311 989	423 279	357 634
Number of:				
Hydraulic control structures capacity >30 m^3/s	9	9	6	9
Hydraulic control structures capacity <30 m^3/s	13	13	16	16
Bridges	29	29	50	50
Culverts and aqueducts	37	37	15	15

Some part of the volume of soil necessary for fill will be provided from the spoil heaps from the cleaning of I&D network which are located along the canals and collectors which is mostly loam and hence can be used as a fill material. The volume of these soils is roughly in the order of 1 mln m^3.

Most of the sources from which fill material can be taken are located close to sites of the proposed works, along the canals and collectors. Their use will have positive impact on environment since on the one hand, there is dust from these loose spoil heaps, on another hand they gradually slide into the canal bed causing siltation and polluting the water. The spoil heaps are practically not used by the inhabitants since they do not have any economic value as a construction material or as an additive to soils. After removal (utilization) of these soils, sources of dust and soil slipping into I&D network over a considerable territory will be eliminated, which is favorable for water protection zone of the canals and adjacent territories.

For lining of canals it is necessary to use clay of a certain quality with density of not less than 1.6 t/m^3, not salted. The exact location and further operation of the borrow areas (clay rocks) are studied by the Client.

Map 6: Location of Borrow Pits for Earthworks in the Project Area



Water Balance with respect to the Tuyamuyun reservoir before and after the project

The present situation before SKWRIP:

Tuyamuyun reservoir was built in 1979 and is located in the lower reach of Amu Darya River on the border of the Republic of Turkmenistan and the Republic of Uzbekistan. Public and agricultural users of Khorezm, North Karakalpakstan and Turkmenistan strongly depend on the water of the Lower Amu Darya, as they consume water from Tuyamuyun reservoir. Tuyamuyun hydropower plant has a capacity of 150 MW and supplies Turkmenistan and Uzbekistan with water. Nevertheless, the reservoir's use is primary for irrigation, and secondarily for hydropower production. A Water Management Partnership Agreement was signed on January 16, 1996 by Turkmenistan and Uzbekistan on sharing operation of Tuyamuyun reservoir. According to the agreement, the parties agreed to cooperate over any emerging land acquisition and water use issues in the territory of both sides, and possibly resolving these issues through developing separate protocols. Another applicable agreement is the Partnership for O&M and Repair of economic entities located in border areas of Uzbekistan and Turkmenistan of March 10, 2008.

Due to the flat topography, the live storage in Tuyamuyun reservoir is around 5.5 BCM. Typically, this volume is adequate for intra-seasonal storage, but not for inter-year storage. Over the last 25 years, the annual inflow available at Tuyamuyun ranged from 27 to 60 BCM/year, with the mean annual being around 35 BCM/year, and a minimum 27 BCM/year recorded in 2001. In the past, prior to the irrigation developments in Tajikistan, Uzbekistan, and Turkemendtan, the Lower Aral Sea (LAS) needed to recieve a terminal flow at lower Amu Darya river of a sustainable minimum 25 BCM/year. As this is now becoming very difficult due to the upstream irrigation expansions in the last 3 decades, LAS has inevitably shrinked (current BSL level is 35m compared to its initial 53m BSL). The volume of water entering the reservoir during very dry years (such as 2001) is not sufficient for the water needs of water users downstream Tuyamuyun in the vegetation season, nor for meeting the required environmental flows. Currently, the annual average terminal environmental flow in lower Amu Darya, which can meet the water needs of the other smaller wetlands adjacent to Aral Sea, is estimated at around 5 to 6 BCM/year (including both the fresh water from lower Amu Darya, cum the saline water from the related drainage systems). The Republic of Uzbekistan is a party to a number of International Conventions and international agreements with the Aral Sea riparian countries, such as the Convention on protection and use of transboundary watercourses and international lakes, and Decision of the Heads of the states of Central Asia «On the main directions of the Program on specific actions on improvement of environmental and social-economic conditions in Aral Sea basin for the period of 2003-2010». In accordance with those, the Aral Sea riparian countries have committed to supplying around 5 BCM/year of water into the Aral Sea, and to providing a minimum flow of 2.5 BCM/year downstream of Takhtiash barrage to ensure the ecological survival of the Amu Darya delta.

The situation after SKWRIP:

By improving water management, SKWRIP would build on DIWIP achievements to re-route the saline drainage flows away from the Amu Darya to improve water quality in the downstream. DIWIP helped Uzbekistan comply with the aforementioned agreement signed with Turkmenistan in 1996 as to the joint and rational use of Amu Darya water. The agreement (Article 9) requires that both countries halt discharging drainage water into Amu Darya. The major change introduced by DIWIP has been the suspension of Beruni and Kyzylkum pumping stations that released mineralized drainage water into the Amu Darya and Lake Ayazkala. All drainage water from the project area is now drained via the former channel of the Janadarya to the Aral Sea. The newly constructed main drain and the rehabilitated on-farm and inter-farm drainage system now flow by gravity, the areas of high water table are considerably reduced, and some of the institutional issues were addressed. Thus DIWIP helped to comply with the 1996 agreement by re-directing the saline-drainage outflow to Aral Sea, with a better water quality.

Demand for irrigation water after SKWRIP is expected to increase as a result of restoring formerly irrigated areas, increasing crop yield, and an increase in cropping intensity.. Pre-project abstractions from the Amu Darya into the project area are estimated at 1,825 million cubic meters per year (MCM/year), with evapotranspiration estimated at 578 MCM/year, giving a ratio between evapotranspiration and abstraction of

32 percent. Thus the incremental crop evapotranspiration as a result of increased productivity on the entire area is estimated at 275 MCM/year.

Post-project evapotranspiration/abstraction ratio is estimated at 47 percent, due to: (A) increasing the off-farm irrigation conveyance efficiency (i.e. diversion-to-farms/abstraction ratio) in particular as a result of canal lining and installation of geomembrane in the Bustan canal and water management improvements, including SCADA, and less significantly due to (B) increasing the on-farm water-use efficiency (i.e. ET/diversion-to-farms ratio) through the on-farm demonstrations and farmer schools, which are limited to the piloting scale under Component 2. A total evapotranspiration of 853 MCM/year will therefore result in an abstraction of 1,815 MCM/year. This corresponds to a net gain of 10 MCM/year, which corresponds to 0.02 percent of average inflow into Tuyamuyun reservoir, or a 0.1 percent reduction over current abstractions in the lower Amu Darya (see table below). Abstractions into the RBC will be monitored on a regular basis by the project, and will be made available for consultation.

	Pre-project	**Post-project**	**Δ**	**Comment**
Evapotranspiration (MCM/year)	578	853	275	Increases due to restoring formerly irrigated areas, increasing crop yield/ha, and increasing cropping intensity.
Abstraction (MCM/year)	1,825	1,815	-10	Net reduction due to improving irrigation efficiency within project area. Will be monitored (verified) via the M&E activity (Component 3).
Efficiency (percent)	32	47	15	Increased through project interventions.
Total environmental flows in lower Amu Darya (fresh plus drainage water); in an average-flow year.	17,422 MCM/yr	17,147 MCM/year	275	Negligiable reduction. Project will actually increase the fresh-water environmental flows from 16,175 MCM/year pre-project to 16,185 MCM/year post-project (due to reducing abstraction from the river by around 10 MCM/yr). But the drainage water returning from project area will decrease from 1,247 MCM/yr to 962 MCM/yr due to increasing irrigation efficiency within the project area. Hence the (negligible) reduction in the summation of fresh plus drainage water. This calculation is for annual-average river flows. In a very low-flow year (e.g. 2001), both the pre-project and post-project environmental flows could fall below the minimum requirements (5-6 BCM/year).

Table 16: **Pre- and post-project comparison of key indicators**

Based on the above analysis, SKWRIP will support the capacity to abide by the commitment to secure at least 5-6 BCM/year to the Aral Sea (during normal-inflow years, as the average inflow into Tuyamuyun reservoir is 35 BCM/year). It should be noted that decommissioning of Amu Darya pumping stations that are no longer needed once the gravity off-take into the SKWRIP area has been developed, may lead to additional reductions in release requirements from Tuyamuyun reservoir, as these pumping stations need large, extra releases from Tuyamuyun reservoir to maintain adequate water levels in the river. This could potentially lead to savings of 1.6 BCM/year, down from 4.2 BCM/year to 2.6 BCM/year. However, as these extra releases may be deemed environmental flows, it is advisable to continue to release them downstream

the project abstraction point, to avoid altering the flow regime of the river and maintain its ecological function (see the wetlands section).

In conclusion, the project interventions would not pose any negative impact on the Aral Sea basin. As implied from the water balance, the project could not lead to incremental improvement of the environmental flows downstream Amu Darya because this would have required raising further the irrigation efficiency, at prohibitively high costs. Based on the very small reduction in the yearly environmental flow, no negative stream impacts are expected.

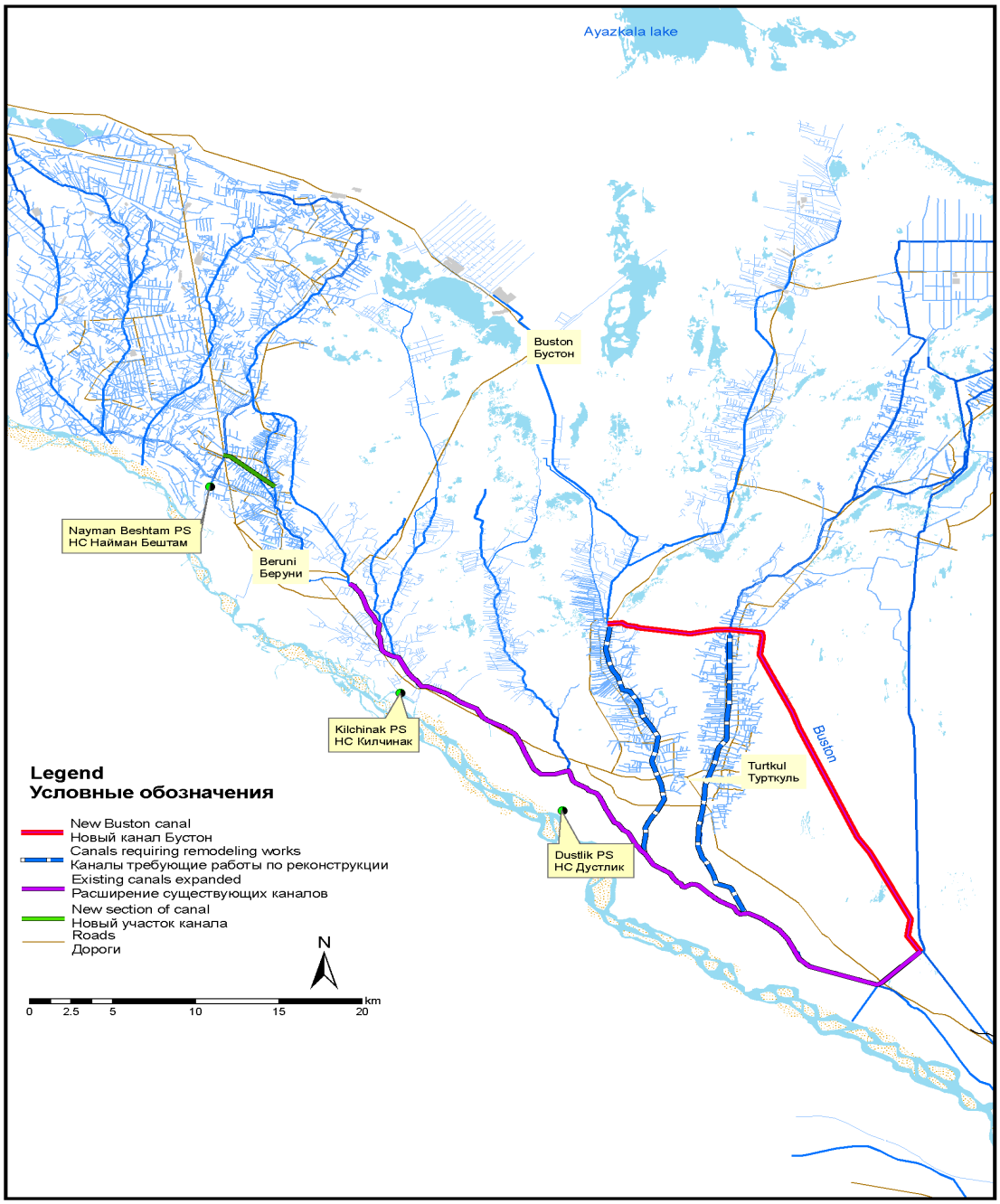
6 ANALYSIS OF OTHER ALTERNATIVE OPTIONS

Project has considered three more options possible for the solution of problems to have sustainable water supply in the Project zone.

Partial Bustan Canal (Option B)

Option B considers partial construction of Bustan Canal.

Map 7: Partial Construction of Bustan Canal (Option B)



According to the design:

- water will be supplied to North Ellikkala district via the existing section of the Bustan Canal;
- water will be supplied to Beruni district by Pakhtaarna and Old Bozyap canals;
- Pakhta-Arna and Old Bozyap canals will be reprofiled to provide a greater conveyance capacity;

- A 21 km section of new canal will need to be constructed to avoid the need to reconstruct Old Bozyap Canal passing through Beruni Town to ensure that water can be supplied to Nayman Beshtam Pump Station at a high enough level to reduce the need for secondary pumping from interfarm canals.

The route from the RBC follows that for Option A. The new canal will be designed on the same basis as for Option A.

The scope of construction works for this solution would involve the following elements:

- Along this route, an existing earth canal has been constructed with a discharge of 55 m^3/s, but this requires re-profiling to suit the new hydraulics of a concrete channel. The proposed channel would be concrete-lined with adequate under-drainage
- construction of three major structures.
- re-profiling of the Pakhta-Arna and Old Bozyap canals over a length of 48 km with a head flow of 97 m^3/s. This proposed channel bed would be concrete-lined with adequate under-drainage.
- reconstruction of 42 bridges and construction of 12 structures.
- construction of a new tail escape of about 1.75 km long for the RBC from PK:38 to the river through the fields with a flow of 60 m^3/s in order to maintain a minimum flow in the RBC.
- construction of a new reach from the Old Bozyap Canal to Nayman Beshtam Pump Station. Construction of a new 21 km reach of concrete-lined canal with appropriate under-drainage having a head flow of 58 m^3/s together with 9 bridges and 6 structures. This canal will be a new construction and predominantly run through agricultural lands.
- a tail escape will be constructed to the river by undertaking minor re-profiling works of the shorter Nayman-Beshtam Pump Station inlet channel.

In case of acceptance of this option it is necessary to execute considerable volume of earthwork for Kelteminar and Bogyap canals. Significant volume of clay soil to change the section to suit the new considerably lower discharge is required. (These two canals are part of the Pakhta-Arna subsystem; under this option the total length of canal requiring downsizing is shorter than Option A).

Besides, there may also need to be soil sourced for construction of water retaining embankments, particularly if the canal section is to be optimized for hydraulic performance and command rather than simply for cut-fill balance.

Analysis of this option shows that almost all negative impacts of Option C below are repeated.

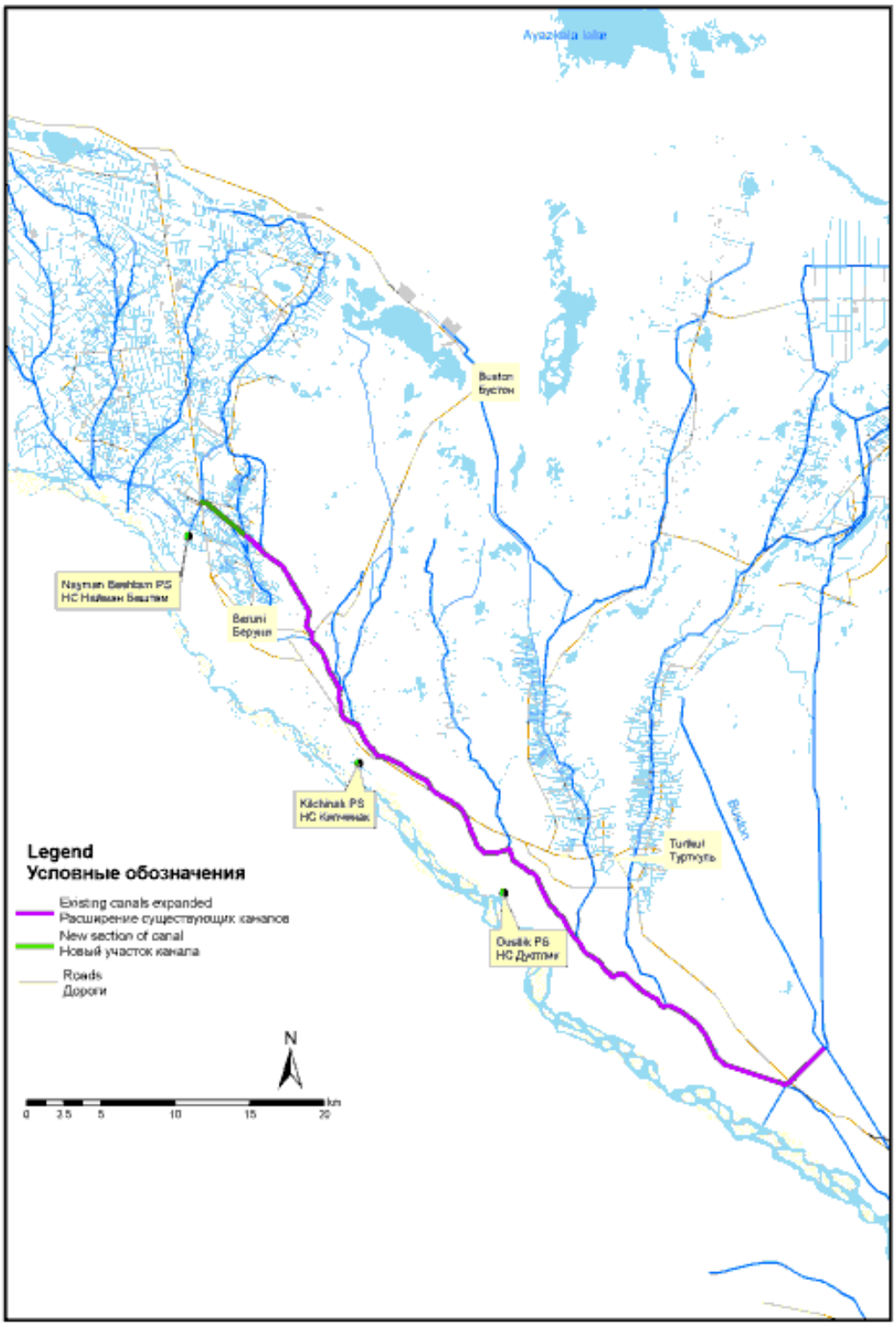
There is a greater risk of water not reaching the tail of the canal as thee will be a larger number of offtakes along the water conveyance route to Beruni district, which will require stronger operational procedures.

For this reason, it will be necessary to establish maintenance roads alongside the Pakhta-Arna-Old Bozyap route, which will require a greater land take.

Extension of the Existing Canals (Option C)

In accordance with this option, water will be supplied by gravity to North Ellikkala and Beruni districts via an expanded Pakhta-Arna canal with a head flow of 157 m^3/s.

Map 8: Extension of Existing Canals (Option C)



In this case, a 21-km long section of new canal will need to be constructed to avoid the need to reconstruct Old Bozyap Canal passing through Beruni Town to ensure that water can be supplied to Nayman-Beshtam Pump Station.

The scope of construction works for this option comprises the following elements:

- Re-profiling of Pakhta-Arna and Old Bozyap canals over a length of 42 km with a head flow of 157 m^3/s. This proposed channel would be concrete-lined, and incorporate adequate drainage. 74 bridges would need to be reconstructed, and 7 major structures required. A new tail escape 1.75 km long will be

constructed for the RBC from PK:38 up to the river through farmland with a flow rate of 60 m^3/s, to maintain a minimum flow in the RBC;

- Construction of a new 21 km reach of canal from Old Bozyap Canal to Nayman-Beshtam Pump Station which will predominantly run through farmland.with a head flow of 58 m^3/s. A tail escape will be built on the river *as a result of* minor works on re-profiling of the short supply canal of the Nayman-Beshtam pumping station. The canal will be concrete-lined with appropriate under-drainage, and have 9 bridges and 6 structures. Along the canals it is necessary to be built service roads for efficient operation and maintenance.

This option has both positive and negative sides. Advantages of the option are:

- It passes through the existing canal route to which water users "are assigned" intersections with other infrastuctures (roads, power lines, pipelines) are already equipped;
- water intake of the canal will not be directly from the live bed of the river which will avoid coastal erosion along the whole length;
- water discharge to the river will be provided by construction of tail escape which is beneficial from the ecological point of view ;
- additional water intake from the river course will be avoided since there is no need for pump stations.

Disadvantages of this option are:

- considerable area of temporary resettlement as the canals passes through a densely populated region with developed agriculture. Thus the area of the effected lands can be more than 17,500 hectares.
- relatively big length of gravity canal (70 km) where the majority of water users are far away creates the risk that in Beruni district water will not reach tail ends of the canal because of large number of water intakes along the route;
- the district is too remote from the head of the system (most of the users are tail-enders); water supply to Ellikkala district will pass through Turtkul district which will require stronger operational procedures;
- in case reprofiling the canal, large volumes of clay rocks of set quality will be required which is not enough in the project zone;
- impossibility of creation of water security zone of the canal along the whole length since it is a densely populated place with irrigated for a very long time.
- availability of existing facilities and settlements, gardens and fields along these canals, especially Pakhtaarna will limit their expansion.
- Reconstruction of Pakhtaarna Canal for water supply to Ellikkala district requires to retain a maximum flow of 40 m^3/s, and to construct bypass channels over much of the length will have negative impact on water quality. Considering the fact that up to 40 % of the population in the command area use canal water for domestic need and drinking purposes, selection of this option is not advisable.
- Water supply to North Ellikkala will require implementation of considerable volumes of earthworks and additional resettlement.

Reconstruction of Pumping Stations (Option D)

This option, is effectively a replacement of the current system with modern pumps. Currently only two of the three major pump stations are in use – Kilchinak and Nayman-Beshtam. The maximum pumping rates of these are 30 and 22.5 m^3/s respectively. Much of the operation of the system would remain unchanged.

It is intended that new pump stations would pump to a higher level which, combined with raising the canals downstream of the pump stations with enable gravity command.

Given the current condition of the pump stations, complete replacement is considered the only realistic investment option. In case of acceptance of this option the following implementations are needed:

- Construction of (new) Kilchinak Pump Station capable of supplying approximately 30 m^3/s at 5 m lift.
- Construction of (new) Nayman-Beshtam Pumping Station capable of supplying approximately 30 m^3/s at 5 m lift (note some increase to allow for removal of smaller pumping stations downstream). The pump station would be designed to operate at lower river water levels than at present and hence overcome a significant operational constraint.
- River-training works (berms) to encourage water into the approach channel for these pumping stations, with design to reduce sediment load.
- Deepening of the existing approach channels to both pump stations.
- Mooring and servicing facilities for a dredger.
- Provision of a dredger for the use for the bed of Amudarya River.

This option has more negative impact on the environment than all the previous options.

Under this option there will be significant harm to the river every year since works will be conducted in the live bed of the river. During operation of the dredgers turbidity of water increases which negatively affects flora and fauna. Bed works will provoke coastal erosion (for the present this process causes loss to ground, soil and vegetative resources of the Project zone). Thus, when all the options are analyzed, the most useful and less harmful for the environment is Option A-2 which has a number of advantages from the point of view of impact on environment.

Changes of existing irrigation network and scope of works for each option can be given as follows.

Table 17: Summary Characteristics of Options

Proposal	Option A-1	Option A-2	Option B	Option C	Option D
Short name	70-km long Bustan canal (Q=105m^3/s)	70-km long Bustan canal (Q=80m^3/s)	35-km long Bustan canal	Expand existing main canals	Rehabilitate pump stations
Water supply to Ellikkala raion	New Bustan canal	New Bustan canal	New Bustan canal	Via Pakhta-Arna and Bogyap canals	Via Pakhta-Arna and Bogyap canals
Water supply to Beruni raion	New Bustan canal	New Bustan canal	Via Pakhta-Arna and Old Bozyap canals	Via Pakhta-Arna and Old Bozyap canals	From the Nayman Beshtam and Kilchinak PS
Works on canals:					
Pakhta-Arna	Decrease in capacity to the interfarm canal	Decrease in capacity	Maintain current capacity	Increase in capacity for transit	Maintain current capacity
Old-Bozyap	Decrease in capacity to the interfarm canal	Decrease in capacity to the interfarm canal	Increase in capacity for transit	Increase in section to transit canal	Maintain current capacity
Bogyap	Decrease in capacity	Decrease in capacity but allow for transit	Decrease in capacity	Maintain current capacity	Maintain current capacity
Kelteminar	Decrease in capacity	Decrease in capacity but allow for transit	Decrease in capacity	Maintain current capacity	Maintain current capacity

Table 18: Types and Scope of Works for Three Options

Works	Option			
	A-I	A-2	B	C
Excavation (m^3)	1 780 138	1 780 138	1 980 378	2 435 337
Fill (m^3)	9 682 675	10 394 345	10 176 089	3 808 315
Concrete (m^3)	320 317	311 989	423 279	357 634
Number of:				
Hydraulic control structures capacity >30 m^3/s	9	9	6	9
Hydraulic control structures capacity <30 m^3/s	13	13	16	16
Bridges	29	29	50	50
Culverts and aqueducts	37	37	15	15

All of the four options offer solution of improvement of water resources management creates conditions for sustainable supply of water for South Karakalpakstan by change of principle of water supply and reconstruction of irrigation network of the Project zone.

Preferable option is Option A since its realization solves the most important environmental problems with the lowest risk for environment.

- to stop the processes of a coastal erosion caused by annual dredging works necessary for water supply;
- to reduce water consumption by application of a set of measures (reconstruction of irrigation network, change of principle of water intake, laser leveling of arable lands, SCADA, control over water distribution and so forth);
- to decrease seepage and evaporation losses from irrigation network in the Project zone;
- to improve water quality supplied to the region;
- to decrease groundwater levels as a result of rational water supply/use;
- to reduce the territory of water objects formed in falls of relief from pinching of GW;
- to decrease mineralization level groundwater;
- to improve the fertility of soil and decrease the salinized area.

The full Bustan Canal (Option A-2) is the most flexible since it allows using water from the Pakhtaarna system for supply to the west of the Project zone by new Bustan Canal if needed. Besides, re-profiling of Bogyap and Kelteminar canals will require less soil, and consequently, the area of effected lands in old irrigated areas will decrease. Existence of two independent substitution systems gives the chance to perform freely O&M of reaches of the canal.

Canal-lining allows water supply in the Project zone during the construction period without additional earthworks.

The new independent main canal is much easier to operate, as there are no water outlets at tertiary level directly from the canal. It facilitates rotation between secondary canals.

Completion of construction of full Bustan Canal (Option A-2) is the most acceptable because the canal route is not linked with the existing canals and need of additional volumes of the earthwork related to water supply in the Project zone during the construction period is not valid.

The only issue not solved yet is provision of a zone with clay soil of a certain quality necessary for filling works of canals. Considering that the loess is used in agriculture and is the most valuable pedogenic soil, their removal will affect the agricultural lands.

Removal and transportation of soil requires very careful management and subsequent reclamation dependent on restoration of effected lands.

After solution of the problem of reliable water supply system, it is necessary to solve the same problem of distribution network. One of the main obstacles against improvement of water resources management is the condition of the distribution network.

It is also deemed to be necessary to consider other options for lining of Bustan Canal. Practice of construction and operation of irrigation network in Karakalpakstan shows that at high levels of groundwater there is a risk that cast in-situ lining quickly becomes unfit for use especially during the season of pinching-out. Canal lining with rigidly bound concrete slabs with holes in the ground slabs of the canal will avoid deterioration of its structure.

Water Resources Management at the Basin Scale

The Hydrological and Meteorological services (Gidromet) of the Governments of Uzbekistan and Tajikistan provide estimates of the expected flows in the Amudarya for each irrigation season. At quarterly meetings of the Interstate Commission for Water Coordination (ICWC), limits on the quantity of water to be allocated to the major areas of each country for the upcoming irrigation season are agreed, based on the estimated flows. These quantities are typically defined for each ten day period. The international river basin water control organizations (BVO) are responsible for the implementation and monitoring of these allocations.

For the Lower Amudarya (downstream of Tuyamuyun), the BVO calls a meeting of water specialists (of Republic of Karakalpakstan and Khorezm province) at the state level every 10-15 days to agree, in the context of the limits agreed by the ICWC, the releases from Tuyamuyun and the flow through Takhiatash barrage, and the flows allocated to each major off take. The volumes of water expected to be available are typically made by experience, and it is unclear the level to which scientific data is available. As noted elsewhere, it appears that operators such as Tuyamuyun reservoir authority have little access to reliable predictions of anticipated flows in the Amudarya. Typically they are only fully aware of flows as they enter Uzbekistan's territory. This makes medium term month-by-month planning of water resources difficult. The bi-weekly meetings therefore are likely to only have reliable data on crop requirements, rather than a dynamic assessment of the anticipated river flows. For the Lower Amudarya, the BAIS (LABAIS) represents Karakalpakstan and Khorezm; in practice the first deputy of the LABAIS, who is responsible for the AISs in Khorezm, also attends.

Water Resources Management in the Distribution Network

The inter-farm network is operated and maintained by PAN-ISA. They have offices in Beruni and Turtkul, with the main office in Ellikkala. Common observations on the distribution of water in South Karakalpakstan are that:

- Whilst there is an overall plan of how water is to be distributed, given available supplies, in practice there is no day-to-day transparency of what flows are being passed and what is imminent.
- The lack of meaningful water measurement compounds the haziness over what is occurring
- Irrigators, other than a few at the head of the canal systems and those with influence, are not able to properly plan for water deliveries; hence they operate inefficiently and this is, in part, reflected in the poor crop yields
- System operators do not have access to the tools (including information) to be able to respond to actual water demands in a coherent, systematic way which optimizes overall water delivery

- Too often irrigation system managers are required to respond to the reactive demands of community leaders who highlight specific areas of water shortage (relative to actual demand) rather than being allowed to allocate water methodologically, taking into account all the various factors which impinge on optimum delivery.

Overall, as described elsewhere in this report, water delivery is sub-optimal, with both apparent deficiencies in the form of high losses and hidden problems as exemplified by the modest crop yields in the project area. The lack of reliable operation of the pump stations means that PAN-ISA is not able to plan the distribution of water throughout the system; when pump stations are planned to be operated for short periods of time, this process of filling canals to the point of overflowing leads to inefficiencies in water use.

In practice, a seasonal plan is developed using spreadsheets based on the area of each type of crop for each WUA, using generic loss factors for the whole network, and water requirements based on average soil parameters. However, the local tuman department for agriculture and water resources, with the interest of the Khokimyat, may apply pressure to PAN-ISA to provide water when they consider it necessary (usually based on calendar dates and not field conditions) rather than when the WUA considers it necessary.

PAN-ISA produce seasonal reports on water use, including the volume supplied to each WUA, but given the lack of opportunity for flow measurement within the system these figures are primarily based on estimates and assumptions rather than recorded data. There is therefore no opportunity for mid-season interim assessments of water usage. Instead, decisions are taken by professional judgment, often (but by no means always) backed by years of experience, of the status of water distribution. Furthermore, control decisions are often affected by requests to release, as an emergency, water to certain parts of the network where, for whatever reason, a shortfall in field applications has become critical. There are significant risks to this approach, not least because this experience is easily lost due to the high staff turnover in water management institutions.

In addition to the absence of a perceived need amongst operators, the general absence of flow measurement structures has arisen partly because conventional flow measurement devices involve some degree of hydraulic head loss. In the flat terrain of the SKRB area such losses are seen negatively as the consequence is that fewer fields can be irrigated by gravity and pumping heads increase. The prevailing opinion is that head loss in the system should always be kept to the minimum possible in order to avoid water lifting and to allow farmers to irrigate by gravity.

Communications occur by mobile phone, and instructions are predominantly given through the main dispatch office at Ellikkala. Authorization must be given by senior staff for adjustments to major structures. In general it appears that the system is operated by experience and rule of thumb, with no practical written rules.

In theory PAN-ISA collects water requirements from WUAs, collates them, and passes them on to the LABAIS. The LABAIS then takes these to the ICWC, and quotas are agreed for each country. The LABAIS then informs PAN-ISA what percentage of their requested water they receive, and this reduction is passed on to the WUAs. On the basis of requests from WUAs, PAN-ISA requests water from either the pump stations or Tuyamuyun reservoir.

In order to save water, it is often perceived that losses will be reduced (such as infiltration losses) if the duration of the canal operation is decreased. Thus the canals are filled to their maximum capacity (sometimes this is exceeded and breaches occur) for a short period (window) of time, and farmers rapidly abstract their requirements.

Reasons for this “pulsed”-flow approach are:

- Operational difficulties of Nayman-Beshtam Pump Station mean that the river flow sufficient for the pump station to operate may only be sustainable for a short period of time; hence the Nayman-Beshtam sub-system can only receive water for a very limited period.
- It is perceived that infiltration losses will be reduced if the canals are operated for a shorter period.

The attraction of this approach can be understood. However, there are several associated risks or problems:

- Farmers may not be ready to irrigate within the short window of water availability; this can often lead to the canal needing to be reopened later for the farmers who missed the first window, leading to a large loss of water
- When water is applied to fields rapidly, it is more difficult to measure and more difficult to prevent overflows or spills into the drains at a field level
- More water is required to fill the canals to their design level. Given that the cross section of many canals is effectively oversized, a significant volume of water is required (and often wasted) just to fill the canals.
- There is a risk of damage to structures at such large flows
- There is a risk of canal bank breaches, or structure overflows which lead to water flowing directly into the drainage network.

These problems and risks dramatically reduce the efficiency of such an approach, especially when farmers miss the initial window of opportunity to irrigate. The theoretical efficiency of rotation is unattainable because it does not allow for farmers to be late.

Dam Safety Assessment

Due to SKWRIMP, the reservoir operating rules may not need to be revisited, as SKWRIMP design would not require altering the common pre-project flow regime of the lower Amudarya.

The 2001 Tuyamuyun Dam Safety Inspection Report identified a number of dam safety issues, notably (i) safety of Sultansanjar Dam (part of Tuyamuyun dam), (ii) rehabilitating the hydro-mechanical equipment; (iii) improving dam instrumentation; (iv) updating the O&M manual; and (v) preparing an Emergency Preparedness Plan (EPP). Since then, a dam commission (Panel of Experts) was mobilized, and the dam safety/operation review was updated in 2009. The review recommended a list of measures, most of which were funded and executed by GOU. To fulfill OP4.37, as part of developing this ESA/ESMP, the MAWR has summarized the 2009 update in a dam-assessment note (see below), which was reviewed by the Bank's dam-safety advisor. Thereupon, the Bank and MAWR teams agreed that, the GOU's dam authority (Gosvodkhoznadzor), assisted by PIU consultants, would complete, before project negotiationsl, a "Potential Failure Mode Analysis"(PFMA). The outcome of the workshop will be synthesized in a report that will be submitted to the Bank and to GOU before project negotiations. The report will include inputs for preparing the 3 plans described in the following table. Hence, by negotiations, a full Instrumentation Plan (IP), a preliminary O&M Plan, and a framework EPP, will be completed. In addition, Gosvodkhoznadzor, assisted by PIU consultants, would undertake a diagnostic inspection, including dynamic modeling (particularly to fully examine the dam's ability to withstand seismic activity). The outcome will be summarized in a report that will be submitted to the Bank and to GOU before project negotiations. Also it is recommended that a second inspection be undertaken in the last year of project implementation.

Instrumentation Plan (IP)	This is a detailed plan for the installation of instruments to monitor and record dam behavior and the related hydrometeorological, structural, and seismic factors. It should cover the existing and the proposed additional instruments. The Plan should be finalized before Project appraisal.
Operation and Maintenance Plan	A preliminary plan should be provided to the Bank for use at appraisal. The plan is refined and completed during project implementation with the additions which will become necessary (e.g. new radial gates, additional instruments, etc.)

Emergency Preparedness Plan (EPP)	The broad framework plan and an estimate of funds needed to prepare the plan in detail are provided to the Bank prior to appraisal. The Plan will be finalized during project implementation as necessary.

Measures to be undertaken during project implementation (budget 5 US$ million):

As part of the project components, GOU financing will be mobilized to finance instrumentation, civil works, consultancy services, as needed (subject to the outcome of the PFMA workshop and the diagnostic inspection) to improve dam performance or safety. The estimates are as follows:

1. Consultancy services around US$1 million: TA support to the Panel of Experts (e.g. to help detail the EPP, finalize the O&M plan), develop a DSS for improved reservoir operation (possibly to be coupled with the introduced SCADA), undertake the 2nd diagnostic inspection in the last year of project implementation.
2. Bathymetric surveys, around US$1 million.
3. Seismographs in the order of US$250,000.
4. Other works to be identified by the local organizations in the order of US$2-3 million.
5. Reinforcing works (for the Sultansanjar Dam, if any): Local authorities had proposed to continue the impermeable bentonite wall of 60 cm thick and 30-40 m depth (which was already done until KM:2+300) to KM:9+000. This is around 224,000 m3 of works which could now cost more than US$20 million. Cost depends on whether local bentonite will be used or not, and on the equipment. By raising the wall, an additional 1 Billion m^3/year of water can be stored in the reservoir. The decision should be taken after the aforementioned dam-safety assessments are completed.

Figure 8: Tuyamuyun hydroelectric complex, constructions' schematic outline

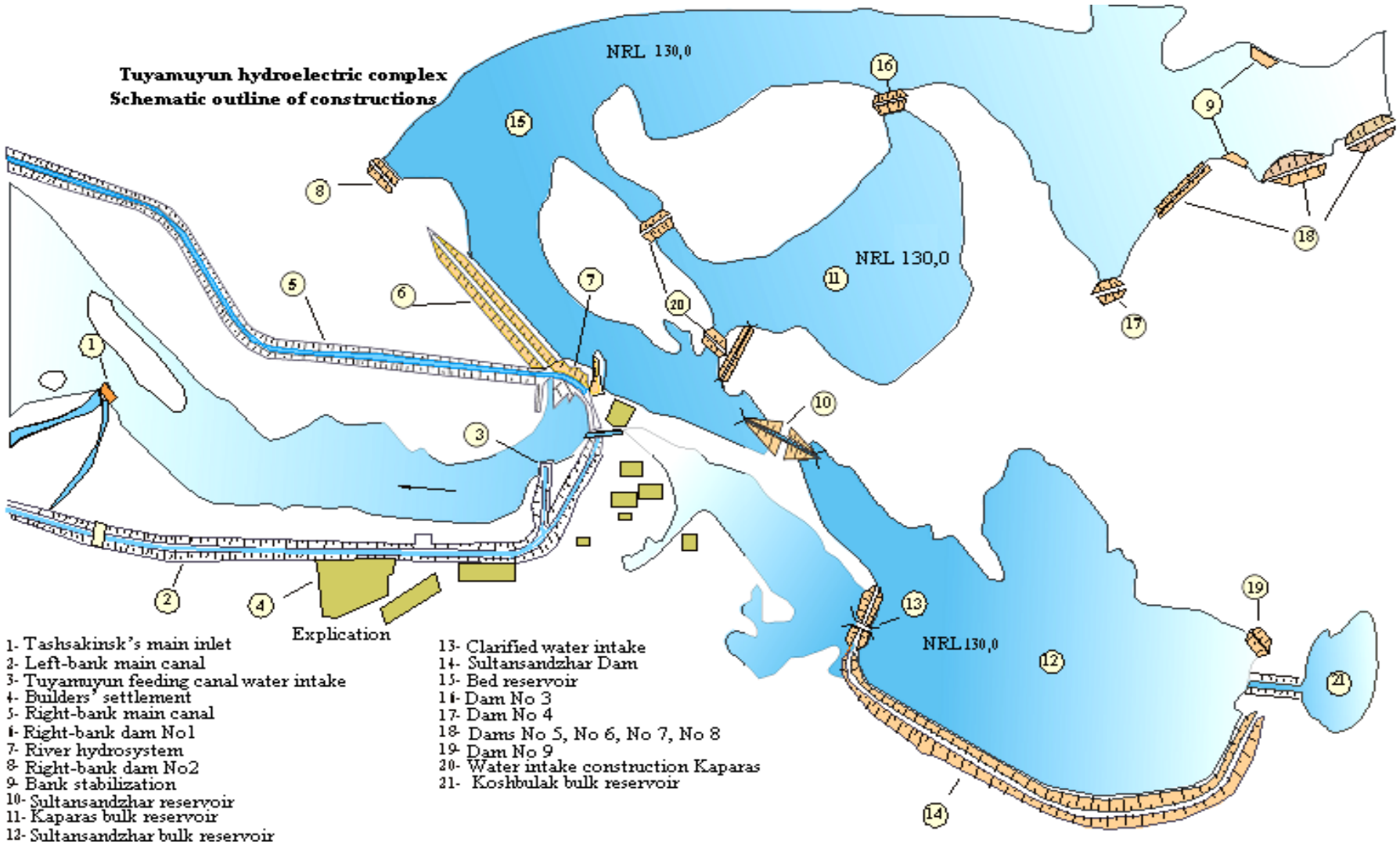
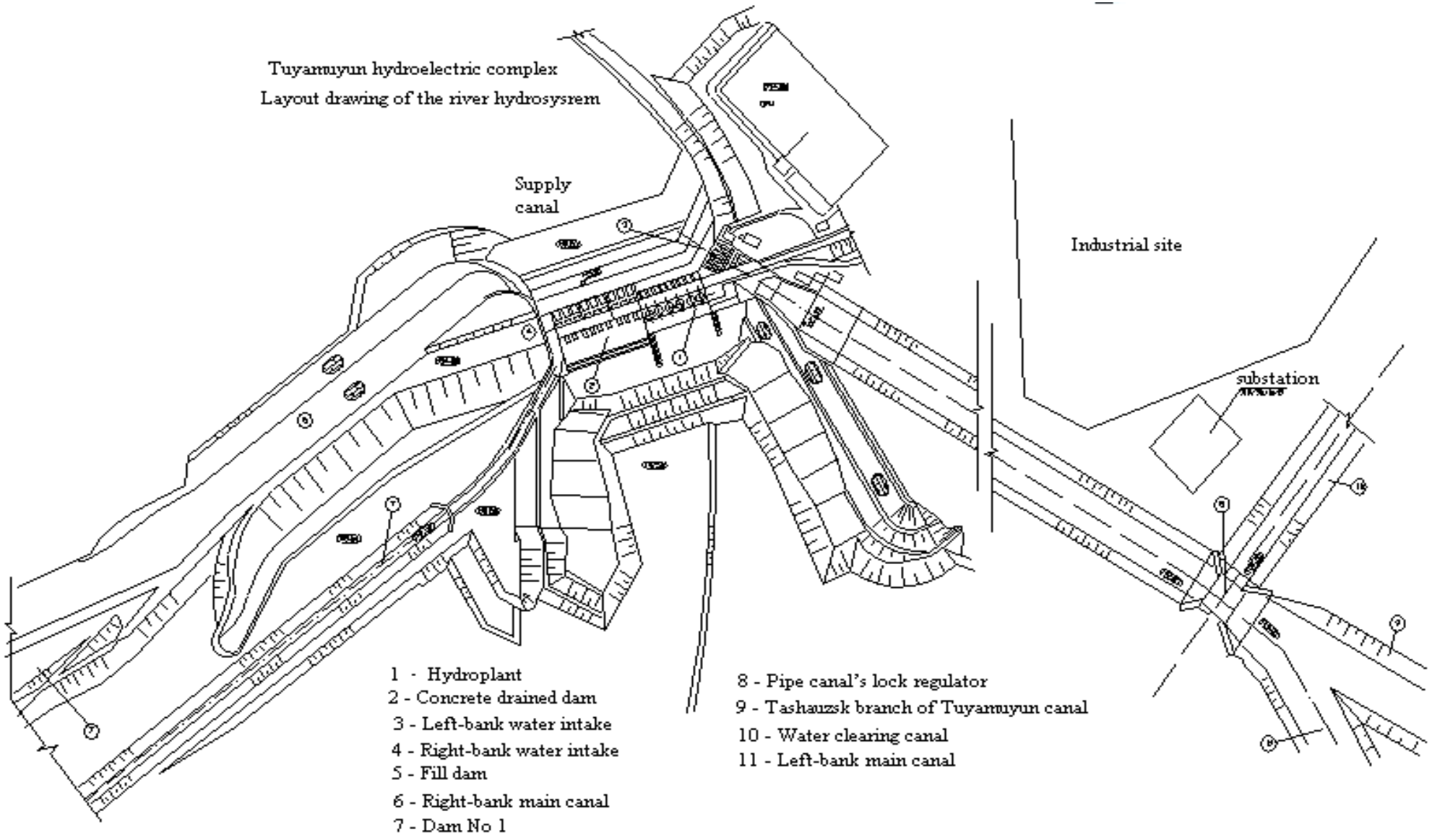


Figure 9: Tuyamuyun hydroelectric complex, the general layout of the river hydrosystem



7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An Environmental Management Plan (EMP) considers measures on mitigation of environmental impacts expected to occur during the project implementation; monitoring programs; the program of institutional development/strengthening for EMP implementation, and estimated cost for the implementation of mitigation and monitoring measures.

This EMP identifies measures to mitigate potential adverse environmental issues relating to construction and functioning of the Irrigation and Drainage systems, which may include:

- Pollution of surface water by sediments from canal cleaning and by construction wastes
- Change of irrigation flow and temporary disruption of irrigation water supply
- Impact on biodiversity: cutting of vegetation during site clearing
- Pollution of soil and surface water by spills of fuel, oil and lubricants;
- Impact on health of workers and local population, engaged in construction and operation of mechanisms;
- Pollution of soil by wastes generated from cleaning of collectors and irrigation canals;
- Ecological infringement in canals and collectors, both inside and outside (in downstream) the project area (destruction of nutrition areas and cultivation of fish, birds and other animals);
- Generation of construction wastes due to dismantling of three pumping stations and several river pumps, which might pollute soil and water during the implementation of dismantling activities;
- Risk of generation of hazardous wastes due to dismantling of pumping stations transformers;
- Potentail legacy soil contamination by fuel and lubricant spills/leakages at the sites of pumpting stations to be dismantled;
- Increased traffic, dusting, effluxes, noise and vibration from operation and repair of vehicles and mechanisms.

The EMP identifies mitigation measures to be implemented by the project, which would be aimed at:

- Introduction of new effective materials and constructions, technologies of works execution in construction;
- Foreseeing creation of safe and healthy conditions facilitating the work and excluding breakdowns and accidents, provision of safety rules of labor protection with the correct choice and technically sound sizes of work places and their arrangement;
- Establishing proper sequence of rehabilitation works at collector irrigation systems so that any inconveniences to local users are minimized Site fencing, providing access to work places and residential areas during construction;
- Proper handling of wastes to be generated due to dismantling of pumping stations, including disposal at sites ageed with local executive and environmental bodies, and where possible, re-use/re-cycling (e.g. metal scrap);
- Prevention of pollution of river water by wastes generated due to the dismantling;
- Proper management of asbestos wastes, if any, in accordance with the Pollution Preventtion and Abatement Handbook ;
- Clean up of the sites of pumping stations after those are fully dismantled. This may include soil clean up from fuel or lubricants spills/leakages, and propoer disposal of contaminated soil;
- Proper dismantling and disposal of transformers, including prior draining of dielectric fluid (PCB fluid), washing down of metal parts by solvent, placing all the parts and contaminated wastes in steel containers and final disposal at designated areas;
- Before the start of dismantling activities, contractor to prepare and agree with the PIU Environmental Specialist specific management plans, related to environmentally safe execution of

dismantling activities. This will cover the following aspects: method statement, waste transportation and disposal, water protection, dust suppression, noise mitigation, soil clean up and disposal of contaminated wastes;

- Environmental provisions incorporated into contracts;
- Implementing traffic safety measures;
- Development and implementation of plan on derivation of drainage water during reconstruction;
- Timely clearing of the site from construction wastes, and disposal of excavations only in the places established by monitoring bodies;
- Creation of water conservation zones on sites of new canals, based on SNIP 2.04.02-97 (Construction Norms and Rules);
- Post-construction site cleanup

The program of institutional development/strengthening for realization of EMP includes support to institutional strengthening of public and private institutions/organizations involved in strengthening of water resources management (I&D system and O&M, water use) and agricultural production in Project area demonstration plots, institutional strengthening and training for WUA; consultations on support of technical, institutional consultations and trainings. According to this program financing of training and study travels, distributions of demonstration plots, field and O&M equipment, laboratory and support of advisory services on training is provided.

Main Impacts and Mitigation Measures for Project Implementation

Land and Water Resources

During construction or reconstruction of irrigation and drainage systems water and land resources can be polluted by waste from sites during the clearing and construction of canals and collectors, and dismantling of pumping stations. For prevention of pollution of surface and ground waters, soils, protective measures from possible sources of pollution should be taken. It requires:

- Derivation of surface and drainage flow from construction sites;
- Prompt removal of construction wastes from the project sites, and disposal of excavated soil only in the places established by monitoring bodies, both executive and environmental;
- Creation of water conservation zones on sites of new canals and dismantled pumping stations (for latter during the actual dismantling), based on SNIP 2.04.02-97 (Construction Norms and Rules);
- After completion of works on repair and upgrade irrigation and drainage system should be cleaned.

Measures on protection of all types of water resources, lands, from any possible sources of pollution should be undertaken during dismantling, rehabilitation and construction works. Involuntary floods of oil and fuel from reservoirs in sites, along with the improper handling with lubricants during the machinery maintenance are possible sources of pollution of surface and ground waters at project sites. Corresponding measures should be taken for prevention of flood and leakage in surface and ground waters in places of refueling and during transportation.

Construction works may also lead to temporary closing of irrigation system. As construction will mainly be conducted during the dry season it can affect significantly the crop and livestock farming, as well as the work of farmers. It can be mitigated by using temporary alternative water sources or canals, or using the flexible irrigating pipeline. In each of the cases details of mitigation measures should be developed at the stage of detailed design and included into respective construction contract documentation. WUA will also be involved in project planning and construction and will ensure that local farmers are informed on construction schedule aimed at reducing consequences of temporary closing in the future.

Land works may cause the increase in water turbidity at several locations. Its light exposure, and as consequence - level of photosynthesis and efficiency of seaweed thus will decrease. Ground particles, accumulating on phytoplankton surface, reduce their buoyancy and carry off to bottom.

The main environmental impact on land resources during rehabilitation and construction works are pollution of soils by alluvium, building wastes and lubricants, along with flooding of the adjacent areas at possible breach of dams. Corresponding places should be arranged for collection and disposal of building wastes and sediment bowls for decrease in negative environmental impact.

Soils can be subject to pollution by the same sources, as water resources, namely: the improper handling with solid and liquid wastes and the inadequate maintenance of mechanisms, in particular at replacement of oil or refueling.

Excavated soil from clearing of collectors and irrigation canals should be placed in slopes of trapezoidal shape. For the prevention environmental impact because of wind erosion, the slopes should be strengthened by planting of drought-resistant plants. Minimal width of 5 m should be provided and maintained from both sides of the collector in order to use inspection and approach roads.

While use of chemicals is reduced and biological means of pest control are more applied, agriculture intensification may cause raised use of pesticides, including mineral fertilizers and pesticides what in turn, may lead to soil and water pollution. While the current use of chemicals is low, the project foresees monitoring and limitation of chemical use in the future by promoting the following: (i) optimum, conscious use of mineral fertilizers in combination with organic ones (ii) the concept of integrated pest control, based on economic and ecological or favorable methods of pest control (iii) persistently suppress use of permanent pesticides (iv) application of agricultural methods concept recognized at international level, in particular the systems of minimum and zero lands treatment which could be applied in irrigated agriculture of Uzbekistan.

As discussed earlier in the 'Water Balance' and 'Wetlands' sections of the report, the project interventions would not pose any substantially negative impact on the Aral Sea basin, including the system of lakes and wetlands .

Transport, Atmospheric Air, Noise and Dust

Temporary environmental impacts from rehabilitation and construction works at irrigation and drainage systems and dismantling of pumping stations are related to the use of mechanisms and operations on removal of old facilities, repair and renovation, including the increased traffic, dusting, effluxes, noise and vibration from mechanisms.

Heavy trucks traffic for transportation of construction materials will be temporarily increased during project implementation. Other temporary ecological concerns related to the use of excavators, cranes, compressors and other machinery for construction and will include: (i) noise and dust from the site, and (ii) safety for workers and local residents.

During the excavations works, atmospheric air will be impacted by inorganic dust from the surface of the earth and products of combustion of diesel fuel in construction machinery and motor transport.

Work of construction machinery and motor transport is associated with noise and vibration. During the course of works traffic density will increase. The noise level at an outer lane is usually 80-81 dB, at collector road–72 dB as traffic volume is less there These are in accordance with national sanitary norms.

Measures should be taken to strengthen accurate observance of safety rules at crossroads of the main roads, along the main roads, along the streets of makhalla and near the site. Temporary and permanent traffic lights should be established by contractor's at the most sensitive crossroads under the supervision of PIU. Control of traffic police will be intensified in makhallas during the rehabilitation/construction period and the adequate prevention will be provided to strengthen precautionary measures among schoolchildren.

Measures on decrease of dust during the works and transportation should be undertaken by watering of sites and roads. Sites should be located as far as possible from the places of residence to minimize noise and vibrations levels. All sites and passages should be cleaned after completion of works.

Ground Vegetation and Water Flora and Fauna

Rehabilitation works on open drains and collectors usually consider that vegetation will be removed and put along the site. It will also affect both water and ground flora and fauna.

Habitats of various animals, mainly, rodents, lizards, amphibious, fish living in collectors, and the birds nesting in thickets of external water vegetation and growing along the collectors and roads trees and bushes will be temporarily disrupted during the implementation of civil works, and then restored after the banks are recovered.

Since the project is not expected to have any adverse impact on the Ayazkala and Akhchala Lakes and the Aral Sea basin (see 'Water Balance' and 'Wetlands' sections of the report), which are important nesting and resting sites for migratory birds, the impact on the rare and endemic spieces of migratory birds is found to be negligible.

Temporary and Permanent Land Use – RAP summary

Project framework provides construction of 35 km section of the Bustan Canal and rehabilitation of another 35 km part of the same Bustan Canal which flows through the settlements. In this view, temporary and permanent allotment of lands for canal construction will be performed. Project realization provides payment of compensations to eligible land users for loss of the agricultural income and property. All farmers and households are notified on the Project and about possible allotment of lands. Also, for this segment of the Project the comprehensive Resettlement Action plan (RAP) has been prepared. Assessment of the project-affected households (PAH) was carried out by the independent appraisal company.

Assessment of PAH assets was carried out in December 2011 and January 2012. Thus, assessment identified 83 households, namely 63 houses, 12 incomplete construction projects, 2 foundations, one uninhabited house, a garage, a hen house, a petrol station, a service station and a mosjid (mosque). The total value of the affected assets according to the market value calculation is about 5 712 186 714Uzbek sums or 3 159 098 US dollars at the rate of the Central bank (CB) of the Republic of Uzbekistan on 24.01.2012.

The total area of the project-affected territory (construction of Bustan Canal) is 427 ha, namely:

- 335 ha is irrigated agricultural land and gardens;
- 17 ha is the area of PAH;
- 75 ha are unused land and roads.

Agricultural land plots that would be expropriated as a result of the construction works consist of different types of crops and orchards. Thus, the cotton and wheat are prevalent among crops and mulberry trees are prevalent among gardens, although apple and peach are rather spread within the territory as well.

As mulberry trees are rather precious species of trees and have "natural drainage" qualities, then payment of compensation for its damage should be applied. According to the estimates of specialists, the number of mulberries makes up 7000 species within the project area and its market value constituted about 280 000 000 Uzbek sums or 154 853 US dollars at the rate of the Central bank (CB) of the Republic of Uzbekistan on 24.01.2012.

Besides that, a technical area, which constitutes nearly 700 ha, 100 m to the left and to the right of expropriated area of the Bustan Canal, will be created. This area will be used for allocation structural engineering, approach roads to the site and other builders' needs. Acquisition of land for organization of the technical area will be temporary and after completion of construction works this land will be returned back to land tenants, leaseholders, land owners and land users.

Besides temporary and permanent expropriation of land along the Bustan canal, it will require acquisition of 4000 ha of land along the secondary canals of the system as well that was determined during the project elaboration. Mathematically it was determined the calculated value of real property along these canals equals to 5 193 731 600 Uzbek Sums or 2 872 369 US Dollars.

Recovery of agricultural losses to the main categories of the project affected people will be implemented in compliance with the land legislation of the Republic of Uzbekistan. In case of expropriation of the land plot with houses, enterprises, and other buildings, constructions, plantations belonging to legal entities, assets of the equal value is provided to them and losses caused by the land allotment for the state and public needs are fully compensated to them.

Besides that, khokimiyats of appropriate region (city) must notify owners of residential, production and other types of buildings, constructions and plantations of the made decisions in written form under their signature not later than six months prior to demolition and attach to notification copies of the appropriate decisions of the Council of Ministers of the Republic of Karakalpakstan and regional and Tashkent city khokims on the land allotment, demolition of residential, production or other types of buildings, constructions and plantations located on the land plot. Acquisition of land would be possible only after payment of compensation to PAP. These measures would allow reducing losses of PAP due to they will have an opportunity to prepare for forthcoming acquisition of land (harvest and sell their crops, dig up young plants, cut trees and so forth) and it would definitely prevent some conflicts and grievances.

Implementation of the RAP will be monitored through internal monitoring by the PIU as well as an external monitoring by the independent expert group, consisting of three members.

Impact Mitigation Measures

Costs the implementation of mitigation measures of Project will be included in tender documents which will be prepared by MAWR PIU. The implementation of the specified implementation measures will become an integral part of construction contracts and will be mandatory for Contractors.

For decrease of atmospheric air pollution in the area of dismantling, repair and rehabilitation works and excavations and during the land transportation, measures are provided on:

- dust suppression during the construction period;
- avoidance of excessive number of motor vehicles at site, for gas and dust pollution reduction.

For protection of grounds, underground and surface waters it is planned to:

- Provide construction sites with trenches for surface flow and drainage waters diversion, their surface after completion of works is subject to reclamation;

Ttake the appropriate measures on prevention of leakages of fuels and lubricants, all land reservoirs of combustive-lubricating materials will be equipped above the terrestrial surface and integrity of their walls will be under the constant control. Collection and recycling of depleted oil products should be according to ecological requirements;

- Provide development and accomplishment of waste management plan;
- During the implementation of dismantling activities, prevent any generated wastes from entering into water course. If temporary waste storage is needed, it should be distanced from the water course. Any leakages of fuels, lubricants or PCB fluids into the water course shall be prevented;
- Development and implementation of the plan of collector-drainage waters diversion during reconstruction; timely cleaning of construction objects from building waste and disposal of excavated sediments only in the places, designated by monitoring bodies;
- For water resources economy the water formed on a site (if it is pure) should be used as resources for production activity;
- Grounds after excavation and other works at site should be laid so that not to interfere the water streams and to be a pollution source.

In order to mitigate soil impact from repair and rehabilitation works it is assumed to**:**

- carry out lands reclamation after completion of works and removal of temporary passages, canals, trenches, constructions and building waste;
- activities for prevention of water and wind erosion, application of rational methods and observance of watering mode;
- prevent leakages at filling and transportation of combustive-lubricating materials, to provide collection of combustive-lubricating materials and recycling of their remainders;

- arrange for disposal of construction and other wastes (cut trees, paper, glass, plastic etc.) on water-proof (cemented) platform in separate reservoirs before recycling and their transportation to specialized enterprises for recycling.
- to carry out mechanical and biological recultivation of forest pits and spots of soil development left after cleaning of drainage system
- to organize execution of construction works inside of canals in order to prevent adverse impacts on adjacent territories;
- clean up soil from any fuel or lubricant contamination at the sites of dismantled pumping statopm, and proper disposal of contaminated soil.

Solid and Liquid Wastes Management

The following waste will be generated during repair and rehabilitation works in canals:

- Waste-sediments after mechanic cleaning of collectors beds, mostly consisting of silt and sand and water vegetation, mineral salts and organic substances as well;
- Land wastes in section of canals after expansion and deepening of canals;
- Waste consisting of crushed concrete and duct that occurs after canal coating repairs.

Waste-sediments should be completely used for building-up and leveling inspector track or store in expropriated area and leveling by bulldozer.

Removed soil (waste) should be used for filling dump pits or remove it by trucks for its application in agriculture to restore soil in places of land subsidence, erosion, etc.

Waste from concrete crushing should be removed with subsequent recycling, use in the building sector or filling of quarries matching with the local nature protection committee. It is not expected adverse impacts on the environment in case of application of the offered ways of waste recycling.

Use and disposal of these wastes will be envisaged in project design. At sites there will be various types of solid waste, including wood, oil filters, plastic and cardboard wrapper for equipment. Mitigation measures will include provision of separate containers for collection of mentioned wastes for their further recycling in specialized enterprises. After completion of rehabilitation and construction works all sites will be cleaned and planted.

For flora and fauna protection it is envisaged to use only the stipulated roads and temporary sites, and, thus, avoid uncontrolled roads pavement. The civil works should be scheduled in such a way as to avoid the nesting period for birds living in thickets of water vegetation along the collectors.

For restoration of the lost vegetative cover works on restoration of wind belt and bank protection vegetation will be conducted.

Preventive measures connected with personnel health protection, maintaining design objects, provide strict observance of safety rules and normative documents on I&D infrastructure operation. The personnel involved in O&M will be specially trained.

Work methods at rehabilitation and under construction objects may cause dangerous situations for workers and the population of nearby settlements. Sites fencing and bridges over canals will be provided. Traffic control, emergency signals and illumination will be based on local rules. If necessary, safe loop roads and passages for pedestrians and cattle will be established.

Mitigation of impacts related to agricultural activity

Mitigation of pesticides impact. Reliable guarantee of public health care is strict observance of hygienic standards by farmers - the content of separate reagents in air of working zone, atmospheric air, foodstuff of vegetative and animal origin and water of open reservoirs and water courses. Such standards are developed for all used pesticides.

For observance of maximum-allowable concentration in air of working zone the directed dispersion of pesticides on processed plants will be provided so that the reagent is not get to the zone of workers presence. Workers should be towards the direction of wind blowing so that dispersion was carried away aside from them. Cabins of tractors should be hermetic with supply of the cleared air. The subsequent works on the processed sites should be carried out in the terms established for each reagent - after certain number of days after processing. It is recommended to observe strictly norms of reagent use, terms and ways of application of separate forms. Oil emulsions, for example, are more dangerous as they provide considerable remains on the processed surface and capable to get inside of fruits, vegetables etc. For the prevention of pollution of the soil and water chemical tests of the soil concerning the content of pesticides will be carried out.

In order to guarantee that the best practice is used for prevention of any harmful impacts from transportation and use of pesticides, it is important to promote use of existing national (and international) guidelines which provide enough practical information.

In case of availability of stable chloroorganic compounds (polychloropinen, polychlorine camphene, heptachlor, hexochloran, etc.) in arable layer of soil (up to 30 cm) it is not recommended to sow carrots, to grow up root - and tuber crops meant for food of people and forage of animals, for them it is necessary to select fields with the uncontaminated soil. Observance of measures on prevention and protection of forage and fodder crops from pollution by pesticides which are subsequently found in products of animal origin (milk, oil, meat etc.) is necessary.

Table 19: Recommendations on environment protection and creation of sustainable agricultural enterprises

Activity	Recommendations
Seeds	- Select the seeds requiring minimum use of chemicals for provision of high productivity - Select the seeds least subject to influence of pest and diseases. Carry out strict sanitary control at import of seeds. - Strict sanitary control at export of seeds. - Consultations on correct use of fertilizers and pesticides. Everywhere, where possible to render services on assistance to sustainable agricultural activity, including complex pest control of plants, soil processing with the minimum number of tillage, planimetric plowing, crops rotation, and green fertilizers
Fertilizers	- Choose the best fertilizers and prevailing soil-ground conditions - Perform application according to recommendations of manufacturers of products and service providers
Pesticides	- Training and consultations on complex pest control of plants (CPCP) and safety rules when using chemicals, for farmers and the personnel occupied in agribusiness.
Butcher cattle	- zero waste (are used as fertilizers)
Tractors	- procurement of tractors with the effective engine, providing high capacity and economy of fuel - Tractors with the highly effective control of exhaust gases - To acquire tractors with the capacity of no more than required for expected works
Agricultural inventory	- inventory suitable for handling of soil with the minimum number of tillage
Land preparation	- Planimetric plowing, minimum plowing, sodded waterways, and etc.
Small equipment	- Should be economic
Irrigation equipment	- maximum effective equipment - equipment promoting carrying out of effective irrigation
Buildings and constructions for cattle, machines and chemicals	- Buildings should be located in places, the most safe for resources being in them. - Economic design of constructions, including heating and ventilation - Buildings are designed taking into account the minimum consumption of materials, and use of materials harmless to environment

CLM, spare parts and other materials for provision of works	- safe storage of CLM and chemicals

Environmental Monitoring Plan

Monitoring of environment condition will be implemented in order to verify that the project activities conform to the established national ecological standards and the procedures and the requirements of this ESMP, and monitor and manage project's environmental footprint. Monitoring will pay attention to construction and rehabilitation works, cleaning of canals and collectors, and dismantling of pumping stations.

Main organizations performing monitoring in the Republic of Uzbekistan are:

- MAWR and its territorial divisions (BAIS, HGME) (monitoring of level of ground waters, mineralization of ground and surface water of collectors, salinity of soils);
- Uzglavgidromet of the Cabinet of Ministers (monitoring of surface water quality of the main rivers, atmospheric air, soils and meteorological monitoring);
- Goskomgeologiya with divisions of UzGidroInGeo (monitoring of level and pollution of ground waters);
- Goskompriroda (environmental monitoring of fauna, flora, and monitoring control of pollution sources).
- WUA, farmers of association.

A monitoring program of quality, standards, terms of superficial waters supply, availability and provision of water-metering equipment, land efficiency, soil fertility, timely collecting of waste and storage in places appointed by a monitoring unit, the level of crop yield, soil salinization and pollution, depths of occurrence of levels and mineralization of ground waters, quality of surface water will be conducted under the agreed plan between MAWR, Goskompriroda and project management group.

Monitoring of level of ground waters is conducted by regional division of Republican committee on irrigation and drainage under the MAWR of the Republic of Uzbekistan which laboratories will perform sampling from wells monthly. Besides measurements of depth of ground waters samples of tests from these wells and collectors for determination of level of soil and surface water mineralization in collectors are selected. Hydro-geological Meliorative Expedition (HGME) carries out regular monitoring of salinity with main ions (chlorides, sulphates, calcium, magnesium, etc.). Results of analyses will be used also for determination of requirement of washing watering and adjustment by drainage system.

Control of level of ground waters is registered by HGME every 10 days. The purpose is preserving of depth of water at level from 180 to 210 cm, or lower at the areas of cotton growing. According to the results of salinity analysis HGME establishes restriction of water use and requirement for washing of soils for WUA or farmers. After carrying out of washing of soils HGME once again checks salinity of soils, and if level of salinity is still high, farmers are recommended to conduct washing of soils once again.

Environmental monitoring is performed by the State specialized inspection of analytical control (SSIAC (GosSIAK)) of Goskompriroda of the Republic of Uzbekistan and its branches. Monitoring is conducted on: fauna, flora, quality of air at pollution sources, surface water and sources of their pollution, soils.

Short-term Environmental Monitoring Plan (EMP)

Specific objectives of EMP are: (i) sampling and data collection on the project area; (ii) collection and processing of the additional data required for creation of system of analysis and transparent, effective information reporting which will allow to determine project influences; (iii) provision of WUA members and communities with information developed by the given system of analysis and reporting; and (iv) provision of project managers with the information on assessment of successes or failures in project activity, and adjustments of project activity, if necessary.

Environmental monitoring during project implementation (1-5 years) will provide monitoring of:

- Quality of soil and surface water at sites above and below the project territory;
- Salinity and pollution of soils.
- Timely water supply and rates of water to the project area;
- Availability and provision of water-metering equipment;

- Monitoring of collector-drainage waters (CDW).
- Canal bed works throughout rehabilitation of the Pakhta-Arna canal system in order to decrease risks of superficial water contamination;
- Quality of soil consolidation in earth fills;
- Provision the site with clay soil of the appropriate quality to construct and fill canals;
- Hydro-dedusting during excavation works;
- Demounting of sites and rehabilitation of land plots after completion of works ;
- Technical and biological revegetation of loessial pits after soil removal.

For assessment of potential impact of the project on environment condition it is necessary to trace the level of bedding, salinity of ground waters, degree of lands contamination, quality of water in canals of the project area. Monitoring plan consists of the following elements:

Monitoring of level and mineralization of ground waters conducted in the project zone regularly, with frequency of sampling to be 2 times a year. After cleaning of collectors and drains the level of ground waters will be researched and necessity for the further actions will be specified. Determined components:

- Basic analysis: PH, suspension, electric conductivity, dissolved oxygen, dry remainder (mineralization)

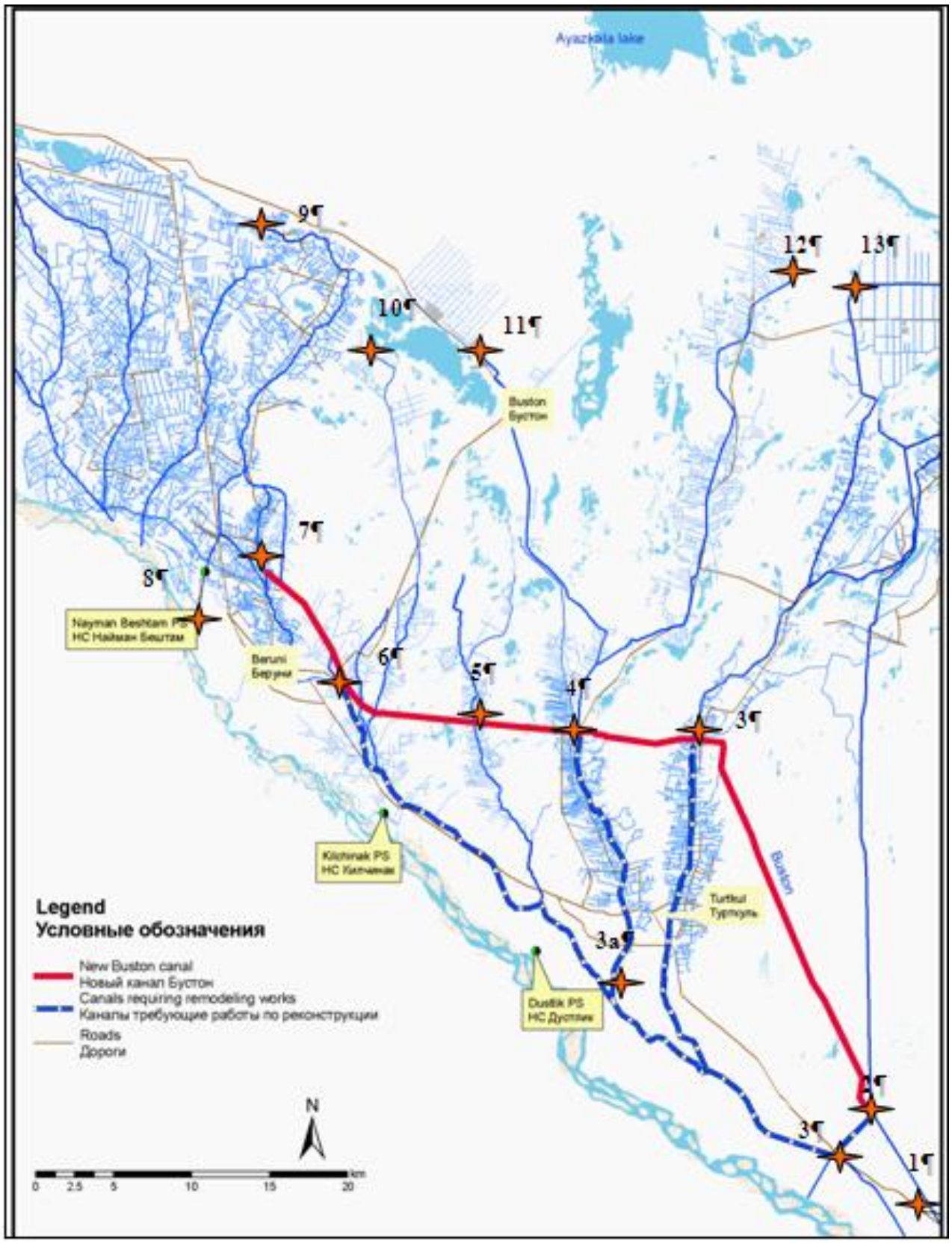
- Expanded analysis (A Kit): ions of salts (sulfates, hydrocarbonates, chlorides, sodium, potassium, calcium, magnesium), mineralization, rigidity;

- B Kit: biogenic elements (nitrates, nitrites, ammonium, phosphates and so on), pesticides (DDT, DDE, DDD, α-HCCH, aacyclo, propanil), oil products, phenol etc.

Places for measurement of ground water levels should be specified, fixed in the field and surveyed during detailed field survey. After end of project works monitoring of collector-drainage waters will be performed by the reduced quantity of components. Locations are approximate for the moment, and their precise identification depends on various factors which will be solved during project implementation.

Monitoring of water quality and discharge in Amudarya river (monthly sampling) will be conducted by Uzglavgidromet at main gates and at the planned temporary gates. Sampling of water is reasonable at the intersection of Bustan Canal and inter-farm canals, at water intake of Tuyamuyun water reservoir, at Pakhta-Arna Canal, at water discharge places from Bustan and Pakhta Arna to Amudarya River, at constructions of inter-farm canals of remote areas of the project zone, and at the sites of puming stations to be dismantled. Location of water sampling places in the project zone is shown below. Information on water quality will be used for assessment of impact of project works on quality of water of the rivers.

Figure 10: Location of outlets for water sampling in project zone



Monitoring of quality of collector-drainage waters in gates of servicing zone of WUA and pilot farms by 1-2 samples collector exit from WUA (farm) territory. Sampling 2 times a year, on April, 1st and on October, 1st.

Determined components:

- Basic analysis: PH, suspensions, electric conductivity, dissolved oxygen, dry remainder (mineralization)
- Expanded analysis (A Kit): ions of salts (sulfates, hydrocarbonates, chlorides, sodium, potassium, calcium, magnesium), mineralization, rigidity;
- B Kit: biogenic elements (nitrates, nitrites, ammonium, phosphates and so on), pesticides (DDT, DDE, DDD, α-HCCH, aacyclo, propanil), oil products, phenol etc.

After completion of project works monitoring of collector-drainage waters will be performed by the reduced quantity of components.

Monitoring of quality of the reclaimed lands is necessary for revealing and establishment of functional dependence between types, volume and quality of conducted ameliorative works and degree of qualitative changes of soil. Such dependence will allow planning improvement of lands quality on the basis of carrying out of ameliorative works and to control costs for ameliorative works.

Conducting lands monitoring will require special equipment for carrying out of field and laboratory inspections. The results of monitoring of reclaimed lands quality should be used for enhancement of existing technique of soils valuation.

Monitoring of lands condition is conducted by average analysis of tests samples selected from the planned points of demonstration plots, including sites of dismantled pumping stations. Depth of sampling is 0-30 cm and 30-60 cm. The analysis is carried out on the following indicators: soils specific electric conductivity at 30, 70 and 150 cm depth, mechanical composition, humus content, salt content (sulfates, hydrocarbonates, chlorides, sodium, potassium, calcium, magnesium), dense remainder, total and mobile forms NPK, microelements and heavy metals, pesticides (DDT, DDE, DDD, α-HCCH, lindane, propanil). Pollution of soils is determined before the beginning of project works at demonstration plots in two periods for the April 1^{st}, and October 1^{st}. On the basis of the received data salt test charts are prepared for April 1^{st}, and October 1^{st}. It allows monitoring migration of salts within a year. The constituted water-salt balance gives the opportunity to make relevant decisions for carrying out of mitigation measures.

Within each project district at demonstration plot installation of piezometers, for salinity analysis (through soil profile) and analysis of single sample of collector at exit from demonstration zone (on pesticides) is planned.

Analysis on determination of pH medium, electro conductivity, dissolved oxygen and temperature can be executed by multimeter, such, as YSI 556 portable Multimeter or similar devices. Samples of tests can be taken at the same time when field surveys are conducted. Divisions of Uzglavgidromet or Goskompriroda should be hired and equipped to execute the basic analysis in field conditions and to perform sampling for carrying out of the expanded analysis.

Laboratory involved in works for accomplishment of researches, should be equipped with corresponding devices, in particular with chromatograph and colorimeter. Chromatographic method is used for the analysis of ions of bromine, nitrites, chlorine, phosphates, fluorine, sulfates, nitrates and other trace quantities of ions; colorimetric method - for analysis of NH_3, NO_3, NO_2 and all forms of phosphorus. As the alternative variant, many of analyses can be executed in one of existing laboratories of Goskompriroda divisions within the project districts of the region. Analysis on pesticides can be made in laboratory in Tashkent.

Table 20: Monitoring of environmental parameters during the project implementation

Objects of monitoring	Responsible organization	Indicators	Location and frequency
Environmental hazards at/nearby operation sites	PIU, contractors	Pollution of soil by oil products (fuel and oil spill), with waste/deposits, air pollution by dust, exhaust gases from working aggregates and motor transport	Operation site Quarterly
Environmental situation in project area	PIU, Goskompriroda,	Breach of water and ground inhabitancy	Operation site and adjacent area, twice a year.
Levels of ground waters	PIU, HGME& WUA, HGS	Groundwater level and their quality	Project area, Quarterly
Soils salinity and pollution	PIU, HGME, MAWR, WUA, Uzglavgidromet, Goskompriroda	Mechanic content, humus content, mobile and gross NPK, dry residue, pH, ions of salts (sulfate, hydrocarbonates, Cl, Na, K, Ca, MG), mineralization, rigidity, nitrate, nitrite, ammonium, phosphate, pesticides, oil products, pesticides.	Project area twice a year
Volume and quality of drainage and surface waters	PIU, HGME, Uzglavgidromet, Goskompriroda	Water consumption, mineralization of waters, pH, suspensions, ions of salts (SO_4, CO_3, Cl, Na, K, Ca, Mg), rigidity, BOD, COD, nitrogen nitrate, nitrogen nitrite, nitrogen ammonia, phosphate, pesticides, oil products, phenol	Project area, twice a year
Water supply to the Project area	BAISLA, MAWR local stuff, contractors, WUA	Terms of water supply	Project area, constantly
Soil fertility	State Agency of Land Resources, PIU	Quality of locality of the soil fertility	Project districts, once a year
Crop capacity	WUA, farmers, PIU	Crop capacity, tonnes/ha	Project districts, once a year
Loess pits	Kontechnazorat, a contractor	Technical and biological revegetation of loessial pits after soil removal	Pits of loessial rocks after soil removal

Capacity building in the PIU/Training

The program of training aimed at PIU, WUA and farmers, will be realized within the institutional program of the project. It is recommended that some modules of training will be specially devoted to environmental issues, procedures and methods of realization of EMP. Cost for this program of training is included in cost of realization of EMP.

Table 21: Recommended training program on protection and management of environment

	Training module	Duration (days)	The trained/ Departments	Location of training /Center
1	Environmental protection and mitigation	3	State nature committee and its regional departments	Beruni, State Nature Committee
2	Environmental measurement and monitoring	3	HGME	Beruni, HGME
3	Laboratory training on work with equipment	5	UzGIP, HGME	Beruni, HGME
4	Environmental legislation	3	Goskompriroda	Beruni, Goskompriroda
5	Economic assessment and analysis of expenses/benefits	3	MAWR, BAIS	Beruni, BAIS
6	Measures for protection and preservation of soils	3	SRI of soil science and agro chemistry	Tashkent
7	Water resources management with joint participation of interested parties	3	MAWR, UzGIP, HGME	Beruni, HGME
8	Guidance and management of WUA	3	MAWR, BAIS	Beruni, HGME
9	Involvement of Interested parties in the Integrated Management of Underground Resources	5	MAWR and its regional departments, Uzhydroingeo	Beruni
10	Sharing of surface and ground waters	5	MAWR, UzGIP	Beruni, BAIS/HGME

Long-term Environmental Management Plan

Long-term EMP is necessary for sustainable preserving of project deliverables. EMP should limit possible negative environmental problems or, whenever possible, to provide their resolution.

Monitoring during operation of irrigation-drainage infrastructure stipulates monitoring of:

- Quality of ground and surface water in the project area and downstream;
- Salinization and pollution of lands;
- Level of ground waters and bogging;

- Flora and fauna;
- Control of timely service and repair of constructions on canals of engineering and drainage systems;
- Control of observance of norms and terms of water supply;
- Control of dumping of sewage of any objects to canals not to allow, that the content of harmful substances in sewage exceeded maximum permissible concentration for waters of fishery;
- To watch, that run and watering of cattle in the places not meant for these purposes is not carried out through canals;
- Control of sanitary condition of canals banks (not to allow dumps of garbage, household and other types of waste, placement of not isolated cesspools);
- To observe technology of regulation of solid drain;
- Control of condition of embankment along the canal with fixing of soil excavated during cleaning;
- Canals' water protection area;
- Provision of water-metering equipment;
- Land use efficiency and quality of the soil fertility;
- Crop yield capacity;
- Species composition and wetlands biogenesis composition;
- Sedimentation especially in the end of canals and places of water pumping out of inter-farm canals.

Long-term monitoring will be carried out by the main state organizations in the established outlets and points as sampling, analysis can be carried out only by specialized laboratories.

Long-term monitoring will be carried out by the main state organizations in the established outlets and points with the subsequent publication of information.

Estimated Costs for Institutional Development, Training, and Monitoring

Expenses on institutional development, training, monitoring and evaluation will make 20 246 000 US$.

Consultant under the contract with PIU for water infrastructure will carry out monitoring of institutional development and training activities, to complete package on institutional development and support of WUA (organization of training for WUA and other establishments participating in water resources management: BAIS, PAN-ISA, KHGME, raion department of MAWR; maintaining demonstration plots as part of the program of agricultural training).

Consultant for monitoring and evaluation on the basis of the contract with PIU for water infrastructure will carry out all necessary actions for M&E and will provide training on M&E of personnel of PIU for water infrastructure, BAIS and KHGME.

Costs of actions for mitigation of environmental impact will be included in the contract and become a part of the contract of Contractors. 600 000 USD are necessary to allocate for implementation of Environmental Management Plan which includes necessary measures for protection and preservation of environment, addressed on overcoming of impacts related to construction.

The ESMP Matrix is presented in Annex 2.

Below is the Summary of the ESMP and its budget:

Expense items	Environmental/ social impact	Mitigation or monitoring measures	Responsible	Cost $US

Mitigate disruption of ecosystem	Soil erosion	Procure drought-resisting plants for canal-bank stabilization to prevent wind erosion	PIU	600,000
	Disruption of flora and fauna	Restore trees and plants that would be cut down to access the construction site	PIU	
		Purchase special seeds, farm machinery, fertilizers for farm households	PIU	
Training on environment and water quality	None	Purchase stationeries, office and other equipment; rentals for training premises	PIU	474,000
Consultants for institutional development and training including for the ESMP	None	Consultant, likely international (60 months)	PIU	1,540,000
Monitoring and evaluation consultant, including for the ESMP-related M&E	None	Consultant, likely international (72 months)	PIU	1,500,000
Pilot plots	None	Four plots per district (hence total twelve) for: on-farm water improvement, water sharing, improving soil fertility, and application of IPM.	PIU	326, 000
Resettlement and compensation costs	None	Provide timely compensation payments (at full replacement cost) for loss of assets attributable directly to the project	PIU	6,186,320
	None	Resettlement assistance		
	None	Provide assistance to improve the displaced- persons livelihoods and standards of living (at least restore to the pre-project levels)	PIU	
Transportation of materials and personnel	Air pollution	Provide vehicles for transportation of materials, personnel, wastes; environmental tests for vehicles' exhaust	Contractor in coordination with MAWR	Embedded in works contract
	Safety and health	Provide traffic lights and warning signs for access roads and construction sites	Contractor in coordination with MAWR	Embedded in works contract
Contingencies	Soil erosion and salinization	Restore canals / control structures in case of bursting	Contractor in coordination with MAWR	Embedded in works contract
	Safety and	Repair access roads	Contractor in	Embedded

	health		coordination with MAWR	in works contract
	Environmental pollution	Measures on incidental oil and fuel spill clearance	Contractor in coordination with MAWR	Embedded in works contract
	Property ownership	Compensation for incidental damage to private entities or other emergency situations	Contractor in coordination with MAWR	Embedded in works contract
Compensatory water supply	Water shortage	Arrange temporary water intake either from canals, or using flexible irrigation pipes, in case of temporary closure of canals due to construction works	Contractor in coordination with MAWR	Embedded in works contract
Storage of construction materials, fuels and lubricants	Soil contamination	Provide containers for storage of solid wastes and used oil	Contractor in coordination with MAWR	Embedded in works contract
Additional ESMP-related studies (mostly related to the core project components).		(1) Engineering of loessial pits for provision of project works with soils of certain quality; (2) Arrange construction works within boundaries of existing allotments to reduce land disruptions; (3) Determine type/structure of canal concrete lining; (4) Develop new on-farm irrigation systems instead of existing ones (concrete flumes, aryks), and introduce flexible polyethylene pipes with hydrants; (5) Recover soil excavated at cleaning the irrigation network, with determining best possible disposal and reclamation locations.	MAWR	TBD
Dismantling of pumping stations and smaller pumps	Generarion of construction wastes	-Segregation of wastes on site; - Re-cycling/re-use of suitable wastes (metal scrap etc.); - segregation and proper disposal of asbestos wastes under the supervision of local environmental authorities; - Propoer disposal of other wastes at sites approved by local executoive and environmental authorities; - Prevention of river water contamination by the wastes generated during dismantling.	PIU/ Contractor[1]	Embedded in works contract
	Excessive dust	- Dust suppression by water spraying;		Embedded

[1] Contractor shall prepare specific plan(s) to describe method statement, waste management procedures, including asbestos wastes and disposal of transformers, dust suppression procedures, and methods of soil clean up

	- Avoid working on windy days		in works contract
Water pollution	- Prevent wastes to enter the water course by proper storage and timely removal from site; - Machinery to be kept away from water courses		Embedded in works contract
Legacy soil contamination	Clean up soil from fuel/lubricant contamination		Embedded in works contract
Soil damage due to excavation works	Retsore the soil coverage after the completion of dismantling activities		Embedded in works contract
Contamination of soil and water due to improper dismantling and disposal of transformers[2]	- Draining PCB fluid in a specialized area with impermeable flooring; - Wahsing down metal parts which were in contact with PCB fluid by solvents; - Collection of contaminating fluid and contaminated wastes in steel containers; - Disposal of steel containers in designated areas		Embedded in works contract
Human health risk due to skin contact and inhalating PCB fluid an vapors	- Wearing PPE is mandatory at all stages of transformers dismantling and disposal; - Workers to change in a specialized area after the work with transformers.		Embedded in works contract

[2] Good international practices shall be followed, e.g. UNEP Guidelines 'PCB Transformers and Capacitors: From Management to Reclassification and Disposal', May 2002

8 LONG-TERM POSITIVE ENVIRONMENTAL IMPACTS OF THE PROJECT IMPLEMENTATION

Implementation of South Karakalpakstan Water Resources Management Improvement Project will have in general a positive impact on environment in the Project area.

Relief and resources

It is expected that there will be changes in the relief however with no negative relief-forming processes. Raising embankment levels of main and inter-farm canals in average by 2.0 meters, laser leveling of the command area will positively change the existing relief.

In the canal construction sites, reclamation of slopes of embankments and reinforcement of soil with vegetation should be done to bring back relief to its original state.

Exclusion of bed works will allow minimizing of coastal erosion at Amudarya River. Reconstruction of embankments will allow avoiding of water erosion in the Project zone.

Mechanical and biological reclamation of loess quarries will recover soil for agricultural use.

Shallow and underground waters

Taking water for irrigation via the Right Bank Canal instead of taking water directly from the Amudarya riverbed will result in improving the surface drainage condition. There is a risk of water pollution during implementation of river bed works.

Quality of the water for the whole Project area will be much better because of change in the principle of water supply. Clear water will be brought to the project area.

The groundwater level condition in the area will be better. Seepage from the whole irrigation system will decrease which will have effect on the existing level of the groundwater level and result in its decrease. The mineralization degree will also become less which will decrease the probability of pollution of the existing lenses of fresh groundwater under the canals.

The area of shallow salt lakes created due to breaks, filtration and water drain in the lowest relief.

Atmosphere air

During realization of construction works (excavation and transport of soil from the non-tampered non-consolidated surface of the canal body, embankment and the service road) the condition of air will get worse but still remain within permissible limits.

Reclamation of the effected soils, overgrowing of the ground surface will exclude additional pollution of air due to soil sputtering.

Shift to gravity system of water supply will avoid using of diesel pumps and hence will lower the emission of hazardous substances into the atmosphere and improve the air condition.

Soil, vegetation and fauna

Beyond the Project area the condition of soil-ground, flora and fauna will keep acceptable in the future. During construction works and re-profiling of the irrigation network the vegetation will likely be suffered from the consequences of earthworks. With realization of the project, due to supply of better quality water, and decrease in the level of mineralization of the ground water on the project area, the condition of growing vegetation will become better; and there will be crop diversification.

At the moment great concern is caused by the large scale deforestation of white saxaul, which is used by the local people for household needs. Decrease in the area of saxaul bush may activate the process of sand movement. Taking into account the prevailing wind direction (north and north-east) sand transfer may be directed towards the irrigated arable land of the South Karakalpakstan.

Fauna (fish fauna and birds) will change significantly. Hydro-biocoenosis formed currently in the live riverbed of the Amudarya River will get the favorable habilitation condition.

By the conclusion of ornithologists, migratory birds will gradually change the migration routes. Alternative versions of their rest places may become the lower reaches of the Amudarya, wetlands and big lakes.

For the permanent staying and nesting of birds, comfortable and stable wetlands to be formed can become the place of their habilitation with time. At the moment this is not the case.

Thus, realization of SKWRMIP will allow:

a. Improve water resources management
b. Reduce the consumption of electric power and diesel fuel
c. Improve the condition of ground water, soils, vegetation
d. Decrease the pollution of air and surface waters
e. Temporarily worsen the habilitation area of flora and fauna
f. Reduce the level and mineralization of ground waters
g. Reduce the risk of pollution of the surface drainage of the Amudarya river
h. Suppress the evolution of erosion processes and accumulation of sediment in the system
i. Improve the condition of soil and crop capacity.

Table 22: Environmental benefits of the project

Environmental component	Before project implementation	During project implementation	After project implementation
Surface waters (Amudarya river and irrigation network)	Excessive water intake; Increased content of suspended particles; Aggregation of sediments in canals; Water losses due to seepage, evaporation and leakage; Vegetation growth in canals Waterlogging Use of pump stations for water supply with high consumption of electric power	Temporary increase of water turbidity in canals Gradual decrease in sedimentation	Rational use of water resources Decreased water turbidity due to clear water supply of Improved water quality Gravity water supply Reduction of water losses due to reconstruction of canals lining and reduction of area of evaporating surface Decrease in energy consumption due to withdrawal of pump stations from water supply system from the Amudarya river and inter-farm canals
Ground waters	High GWL, flooding of lands and waterlogging; poor characteristics of soils and adverse conditions in the root zone for growth of crops (problems most of which have been solved by DIWIP)	Insignificant decrease of GWL due to reconstruction of canals and restoration of embankments;	The project is not oriented on direct solution of this problem, but indirectly favors to decrease in mineralization and GWL that leads to improvement of property of soils and increase of its fertility
Soils	salinity of soils, poor characteristics of soils and low fertility; low productivity of crops;	Desalination process; Improvement of ameliorative condition of lands	Reduced desalination; improved properties of soils; increased fertility and productivity
Healthcare and sanitation	Pollution by microbes and bacteria because of high GWL and insufficient systems of sewerage. Use of water by population from canals for household	Insufficiency of sewerage systems and lack of alternative sources of household and drinking water supply. Temporary increase of wastes along the canals.	Issues of drinking water supply, sewerage and spread of infectious diseases remain. Wastes along the canals are liquidated.
Flora and fauna	Overgrowing of canals and collectors with aquatic and ground vegetation, which is habitat for fish and other animals.	Destruction of aquatic and coastal vegetation, infringement of habitat of fish, birds and small animals.	Recovery of coastal vegetation, formation of habitat for near-water fauna Increased crop productivity due to observation of norms, methods and terms of irrigation.
Atmospheric air	Admissible condition of air with low level of pollution	Temporary increase of content of dust and exhaust gases from construction	Same as before the project

Landscape	Insignificant pollution with household and agricultural wastes. Accumulation of heaps of grounds along the canals from their cleaning	Additional pollution with construction wastes. Use of accumulated soil from reconstruction of canals	Cleaning from solid wastes, improvement of landscape.

9 PROGRAM OF ADDITIONAL RESEARCHES

Since for the time being several aspects of project implementation have not been developed yet and it is impossible to estimate the impact of the Project realization completely, it is necessary to conduct additional investigations during the project implementation as follows:

- to develop a documentation system on the identification of borrow (loess) pits and their reclamation;

  tTo identify the most appropriate construction method for concrete lining of the canals, i.e. laying cast in situ concrete will not ensure the long term operation of the canals without destroying.;

- taking into account that the existing on-farm irrigation network does not meet the terms of water consumption, to develop new systems of on-farm irrigation instead of the existing ones (concrete flumes, aryks etc.) with implementation of flexible polyethylene pipes with hydrants;

- to find alternative ways to make use of the soil from the cleaning of the irrigation canals with identification of locations for storage, determination of the places for storage and methods for reclamation of these areas.

10 PUBLIC CONSULTATIONS

The Environmental Impact Assessment and Environmental Management Plan have been duly disclosed and discussed at the public consultation meeting held on February 6th 2013 in Beruni Khakimiyat. The consultations have been initiated by the MAWR PIU, with assistance of the TA consultants. The participants included representatives of local executive and environmental authorities as well as local communities, WUAs and other related stakeholders. The detailed Minutes of the consultations are presented in Annex of the EIA /EMP. As the comments received during the Public Consultation meeting are mainly implementation related (i.e. detailed design, construction and operation) they will be incorporated at a later stage during realization of the Project.

ANNEX 1: MINUTES OF PUBLIC CONSULTATIONS

Date: February 6th 2013

Venue: Meeting Hall, Khakimiyat of Beruni Tuman

The Public Consultation has been opened by the Deputy Khakim of Beruni Tuman. Mr Bahadir Boz, Team Leader for the Consultancy Services for Preparation of the SKWRMIP Feasibility Study has made a presentation on the technical issues, and environmental / social impacts of the project in Uzbek language. Questions were answered by Mr Boz; Mr Pavlanbay Kulumbetov Deputy Project Director of DIWIP, and Mr Begdulla Davlatyarov Local Team Leader of M&E Consultancy Services for DIWIP.

List of Participants:

No.	Name	Organization
1	Mustafoev Davlatmurat	House owner, Toza-Bogyap WUA, Ellikala
2	Dadabaev Bayramgeldi	House owner, Toza-Bogyap WUA, Ellikala
3	Erjanov Nazar	House owner, Toza-Bogyap WUA, Ellikala
4	Bakhanov Jumagul	House owner, Toza-Bogyap WUA, Ellikala
5	Yusupov Kuranbay	House owner, Toza-Bogyap WUA, Ellikala
6	Yusupov Ihtiyar	House owner, Toza-Bogyap WUA, Ellikala
7	Saparova Khanagul	House owner, Namuna WUA, Turtkul
8	Jumatov Zaripbay	Manager of WUA Shabbaz, Beruni
9	Matchanov Huseyn	Manager of WUA Biybazar, Beruni
10	Yusupov Yangabay	Manager of WUA Bozyap, Ellikkala
11	Aytimov Sadabul	Manager of WUA Oltinsoy, Beruni
12	Shukirbaev Holmurod	Manager of WUA Makhtumkuli, Beruni
13	Turabaev Oybek	Manager of WUA Jumaniyazov, Beruni
14	Radjapov Sadulla	Manager of WUA Azat, Beruni
15	Bobojonov Shurkullo	Manager of WUA Bogyap, Turtkul
16	Nizametdinov	Manager of WUA Azat, Kazakyab Beruni
17	Kadirov Azamat	Land Cadastre Organization, Beruni
18	Hujamuratov Oybek	Deputy Khokim, Beruni
19	Kazakbaev Oibek	PAN ISM Beruni branch Head
20	Abdullaev Romonberdi	Manager of WUA Toza-Bogyap, Ellikkala
21	Urunov Oibek	Land specialist of MMTP Namuna, Turtkul
22	Yusupov Kuvondik	Farmer, WUA Namuna, Turtkul

23	Ismoilov Otabek	Farmer, WUA Namuna, Turtkul
24	Kurbanbaev Sheripbay	House owner, Toza-Bogyap WUA, Ellikala
25	Mirzaklov Kamol	Head of State Ecological Committee Ellikkala branch
26	Ruzimov Olimboy	Manager of WUA Navoi, Beruni
27	Kurbanbaev Zeripbay	House owner, Toza-Bogyap WUA, Ellikala
28	Allabergenov Atahan	House owner, Toza-Bogyap WUA, Ellikala
29	Begimbetov Adambay	House owner, Toza-Bogyap WUA, Ellikala
30	Begimbetov Yakubbay	House owner, Toza-Bogyap WUA, Ellikala
31	Norboev Rashid	House owner, Toza-Bogyap WUA, Ellikala
32	Nurumov Ikram	Specialist, PAN Turtkul
33	Karimov Ibodulla	WUA Gavhar, Ellikala
34	Shuhrat	KGME Beruni head
35	Kodirov Azamat	Land Resources organization, Beruni
36	Masharipov Komiljon	AWR Department, Beruni
37	Saparbaev Muzaffar	KGME Ellikala
38	Ibragimov Hursand	Distrct Land Resources organization, Ellikala
39	Egamberdiev Rashid	WUA Al Khorazmiy, Ellikala
40	Sayitimbetov Olimboy	Deputy head of AWR Department, Ellikala
41	Boltabaev Umar	Land Cadastre, Ellikala
42	Rozimov	PAN Deputy head
43	Reyimbaev Doniyar	Accountant, Gulistan WUA
44	Matchanov Bahodir	Specialist, PAN Turtkul
45	Kulumbetov Polvonboy	Deputy Head of PIU
46	Ataniyazov Komiljan	Specialist, PIU
47	Davlatyarov Begdulla	Monitoring and Evaluation, DIWIP
48	Zaripov Yuldash	Specialist, PAN Ellikala
49	Khudaybergenov Shurkullo	Farmer, Beruni
50	Kurbanbaev Yusupbay	House owner, Toza-Bogyap WUA, Ellikala

Question/Answer Section

Name / Position	Question	Answer	Recommendations / Proposed change to FS or ESA/EMP/RAP
Technical Details			
O Kazakbaev / PAN-ISA Beruni Branch	Will the small floating pumps which supply water directly from Amudarya river be liquidated as well?	The Project aims to liquidate all the pumps in the project area including these small floating pumps. However if these pumps supply water to very small marginal lands, they will be evaluated individually during the design of the secondary canals in order to reach an optimal solution.	During the detailed design of the secondary canals, marginal areas should be analyzed separately to find the best solution keeping the ultimate project objective in mind.
O Seyitimbetov / Deputy Head AWR Department Ellikkala	During the design of the Bustan Canal have factors like soil properties, ground water pressure and other negative effects been taken into consideration? What are the parameters of concrete lining?	During the preparation of the tender drawings for the Bustan Canal, according to the soil properties and groundwater levels along the canal different types of cross sections have been developed. Depending on these conditions, sections of the Canal where what type of measures will be applied have been identified. Among these measures; laying of perforated pipes under the canal aim at taking ground water to the nearest culvert whereas installation of flap gates under the canal aim at taking water into canal and hence relieving the pressure. Canal lining will be 12 cm thick underlain by minimum 1 mm geomembrane.	During the implementation of the Project, groundwater levels along the Bustan Canals shall be monitored and the soil types shall be identified in more detail in order to exactly identify the sections to apply different cross sections and revise the tender drawings if necessary.
S Bobojonov / Bogyap WCA Manager Turtkul	How Bogyap canal will be reconstructed? Will structures be constructed in order to receive water by gravity? What type of measures will be taken to avoid filtration from the Canal?	Within the scope of the Project, the discharge capacity of the Bogyap Canal will be reduced to 20 m^3/s. This will be implemented under the first Contract however only after the completion of the first half of the Bustan Canal. The bed level of the Canal will also be raised which will allow gravity command of the fields. It is believed that seepage losses will be removed by the collector drainage network which had been completely rehabilitated within the scope of DIWIP.	During the implementation of the Project, groundwater levels along the secondary canals to be raised shall be monitored and mitigation measures shall be taken in case seepage losses cause serious problems in the neighboring fields.

Name / Position	Question	Answer	Recommendations / Proposed change to FS or ESA/EMP/RAP
K Mirzakulov / Head of Ecology Department Ellikkala	How many bridges will be constructed on the Bustan Canal? Is it possible to increase the pedestrian bridges if the budget allows?	According to the location and category of the existing roads, types and places of the bridges have been identified taking into account the local standards; and tender drawings have been prepared. Depending on the future needs based on the situation during implementation, exact type, location and number of bridges may change.	During implementation of the Project, possible changes should be considered and final locations of the bridges should be agreed with the stakeholders in order to minimize the possible negative impact on transportation.
R Egamberdiev / Al Khorazmiy WCA Manager Ellikala	There is an existing water outlet at the point where Bustan and Bogyap canals will cross which supplies gravity irrigation for farmers downstream. What will happen to this outlet after the Project?	During the preparation of the tender drawings for the Bustan Canal, detailed surveys have been conducted for such points showing all types of infrastructure and the designs have been prepared taking into account these factors. In line with the ultimate objective of the Project, this outlet will continue to receive water by gravity after the completion of the Bustan Canal.	
Social / Resettlement Issues			
O Hujamuratov / Deputy Khokim Beruni	There are some sections on the proposed route of the Bustan Canal which can be realigned in order to reduce the resettlement costs. Is it possible to make these changes?	During the preparation of the tender drawings such locations have been identified based on the detailed surveys conducted. These changes and proposals from the stakeholders will be taken into account during preparation of the detailed working drawings.	During preparation of the designs, utmost attention should be given to minimize the loss of property and existing design should be revised based on the updated detailed surveys and proposals if necessary during implementation.
B Dadabev / House owner, Toza Bogyap WUA Ellikkala	Proposed route of the Bustan Canal passes through my house and another 3 houses. Is it possible to shift the route just 200 m away where there are empty fields?		
U Baltabaev / Land Cadastre Ellikkala	Where can people get a map showing the proposed route of the Bustan Canal?	People can get information on all Project related activities directly from the PIU offices at any time. Moreover, ESA reports produced under the Project will be disclosed on the relevant web sites.	Stakeholders shall be informed on how they can access these maps, reports etc.; sufficient number of copies of these documents shall be kept in the PIU offices, Khakimiyats and other relevant organizations for easy access and review of the public.
O Rozimov / Navoi WCA Manager Beruni	Construction of Bustan Canal will destroy some small structures and crossings. Will they be reinstated?	All of the infrastructure which will be demolished during construction works to be implemented within the scope of the Project will be reinstated properly if deemed necessary.	

Name / Position	Question	Answer	Recommendations / Proposed change to FS or ESA/EMP/RAP
Y Kurbanbayev / House owner	Who will be eligible for compensation? How long time will be given for moving to a new house?	In accordance with WB OP 4.12 which prevails in cases of discrepancies between WB and Uzbekistan legislation displaced persons may be classified in one of the following three categories: a) persons having formal legal rights to the land plots; b) persons not having formal legal rights to land plots at the time the census begins but having claimed their rights to such land or property; and c) persons having no recognizable legal rights and claims with regard to the land plots they are occupying. Persons who represent categories (a) and (b) will be provided with compensation for the land they lose and assistance within the conditions given in the relevant laws and legislation, whereas others only assistance.	
N Erjanov / House owner	In case we face problems or have complaints about the project related activities, where can we apply?	Affected persons can submit their grievances to the chairman the makhalla committees or PIU. Project steering committees will be established in Nukus and Tashkent which will regularly meet and evaluate such issues. Moreover, there will be indicators which will assess whether such complaints are solved properly on time by the Project.	
Environmental Issues			

Name / Position	Question	Answer	Recommendations / Proposed change to FS or ESA/EMP/RAP
K Mirzakulov / Head of Ecology Department Ellikkala	Amudarya is a sediment-laden river, and hence when the system will be in operation, inter-farm and on-farm canals will be silted. Does the Project propose any measure on this problem?	Based on the gradation of the sediment particles, necessary calculations have been made and possible sections where sedimentation may cause a problem have been identified. Accordingly in order to prevent sedimentation in the system, an operation plan has been prepared showing the discharges to be given to the main canals in every decade including minimum values which will always guarantee minimum flow velocity. Release of this extra discharge is calculated to be in the order of 1 billion m^3 annually which will have positive impact on the environmental flows released downstream.	
O Rozimov / Navoi WCA Manager Beruni	Material will be taken from quarries to be used in embankments. Will these lands be recultivated?	The Contractors will prepare Site Environmental Management Plans in accordance with the Environmental Management Plan of the Project and accordingly take all the measures to minimize the negative impacts. Hence these lands will be recultivated. In case there needs bigger scale remedial works, they will be realized under a separate Contract by using the budget allocated for Environmental Management Plan.	
K Mirzakulov	How will the Project affect Baday Tugay Reserve and Laken Akchakul?	One of the co-benefits of improving water management through the project components is to sustain the required seasonal water flow into Baday Tugay Reserve. The canal needed for water supply has been constructed under DIWIP, whereas the Project will ensure the adequacy of its water supply.	
K Mirzakulov	Will there be training activities for environmental monitoring activities?	Within the scope of the Project, there will be training and capacity building activities for the staff of relevant organizations.	

Name / Position	Question	Answer	Recommendations / Proposed change to FS or ESA/EMP/RAP
K Mirzakulov	Have the environmental factors been taken into account when selecting the alternatives developed in the feasibility study?	During the feasibility study alternatives have mainly been compared technically and financially. However the ESA conducted afterwards has assessed the alternatives developed from the social and environmental points of view and concluded that proposed alternative is the best option socially and environmentally as well.	
K Mirzakulov	Many debris and garbage are thrown in the canals which may be stuck in the canal. Does the Project propose any measure on this problem?	As this issue is related with the level of consciousness of the people, Project has not taken this into consideration. However during the preparation of the working drawings of the escape structures to Amudarya, physical measures like installation of trash screens can be incorporated to avoid entrance of the garbage into the River.	During the implementation of the Project, the importance of active participation of the people and communities in the proper O&M of the canals shall be one of the themes of training.

ANNEX 2. Environmental Mitigation Plan

Phase	Activity	Issue/Impact	Mitigation measures	Responsible institutions
Construction/ reconstruction	-Construction and reconstruction of main, inter-farm and on-farm canals; -Construction and reconstruction of hydraulic facilities; -Cleaning and rehabilitation of collectors	*1. Water resources*		
		1.1. Change of water supply mode	- Consultations with WUAs, farmers and local governments to identify and agree on alternative water supply mode for the period of construction/reconstruction activities prior to start of civil works; - Inclusion of the requirement to identify and agree on alternative water supply mode into the respective construction contract	Contractor, Supervision Consultant, PIU
		1.2.Pollution of surface water by sediments from canal cleaning and construction waste	Temporary disposal of excavated sediments behind canal embankment; - Formation of banks in the trapezoid form with application of dozers; - To the extend possible, re-use of excavated sediments in other construction activities; - Final disposal of remaining/exsessive sediment materials at designated sites agreed with local governments and environmental authorities	Contractor, Supervision Consultant, PIU
		1.3. Pollution of water from construction sites	- Provision of surface and drainage flow diversion from operational sites;- Sorting out of construction wastes, with possible re-use of metal scrub; - Timley collection and removal of construction wastes, either by contractor or by specialized communal services available in the project area; - Disposal of construction wastes in designated areas agreed with local governments and environmental authorities; - Rehabilitation of disrupted sites as needed during the construction period and upon completion of civil works.	Contractor, Supervision Consultant, PIU
		1.4. Change of irrigation flow mode	- Identification and use of diverted mode of irrigation waters for the reconstruction period. The diversion shall be identified prior to start of civil	Contractor, Supervision Consultant, PIU

Phase	Activity	Issue/Impact	Mitigation measures	Responsible institutions
			works and agreed with local communities, including WUAs and individual farmers	
		2.Soil resources		
		2.1. Pollution of soils by construction waste	- Proper collection of construction wastes and their regular removal and disposal at designated sites agreed with local governments and environmental authorities; - Reclamation of disrupted sites upon completion of civil works	Contractor, Supervision Consultant, PIU
		2.2.Fuel and oil leakage	- Fuel reservoirs to be stored at designated storage yards, with concreted and gravel or sand covered floor, fenced and covered; -Construction vehicles to be refueled at designated areas, concreted and gravel or sand covered; -Waste water from car washing should be collected in a concrete three-chamber settling pit, with further removal and disposal of settled oily wastes by specialized communal services; -Timely clean up of accidentail spills and leakages by replacing contaminated gravel or sand	Contractor, Supervision Consultant, PIU
		2.3. Deterioration of soil quality	- Presevtation of topsoil separately from the other excavated materails, with further use for construction sites rehabilitation	Contractor, Supervision Consultant, PIU
		2.4. Dusting or erosion of external dam slopes	– Levelling and grass planting on slopes upon completion of works	Contractor, Supervision Consultant, PIU
		3.Atmospheric air		
		3.1. Exsessive dust due to excavation works and transportation of construction materials	- Regular watering of roads, construction sites and camps (more frequent in dry season); - Covering of trucks transporting construction materials and wastes	Contractor, Supervision Consultant, PIU
		3.2. Pollution by exhaust gases from construction machinery and vihecles	- Supervision of technical condition of machinery and vehicles, use of quality fuel.	Contractors, Supervision Consultant, PIU
		3.3.Noise, vibration from operating	Noise level to be within acceptable limits of 70 dB	Contractor, Supervision

Phase	Activity	Issue/Impact	Mitigation measures	Responsible institutions
		machines	and not to occur out of established working hours	Consultant, PIU
		4. Flora and fauna		
		4.1. Damage to trees and vegetative cover by site clearing and civil works	- Clearance of matured trees has to be avoided. If unavoidable, compensatory planting has to be done, with tree types and compensatory ratio to be agreed with environmental authorities; - Strict prohibition for removal of white saxaul as it can cause movement of sands.	Contractor, Supervision Consultant, PIU
		5.Social aspects		
		5.1. Improper working conditions resulting in failures, accidents, work inefficiency and decreased living standards of employees.	- Provision of PPE to all construction ite employees; - Maintaining proper sanitary and hygienic conditions at camp and construction site facilities; - Placing signage, lighting and fencing where needed to ensure safety of staff.	Contractor, PIU, Supervision Consultant
		5.2. Affecting quality of life as a result of interruption of water supply and decrease of lands productivity	- Consultations with local communities, WUAs, individual farmers, likely to be afftected by interrupted water supply, in order to raise awareness, identify and agree on alternative water supply options for the period of civil works; - Commencement of civil works only after alternative water supply options are identified and agreed with local users and authorities	PIU, MAWR, Contractor, Supervision Consultant
Operation and maintenance of irrigation and drainage network		*1.Water resources*		
		1.1. Operational water losses, water contamination due to accidential floods along the canals.	- Regular and frequent monitoring of irrigation network functioning; - Timely repair of misfunctional equipment; - Monitoring of water flow in the canals so that silting is avoided; - Regular monitoring of quality of collector-drainage waters and of surface waters in natural water bodies affiliated with te project area; - Monitoring and maintaining of all technical	BAIS, local service personnel, WUA, MAWR

Phase	Activity	Issue/Impact	Mitigation measures	Responsible institutions
			parameters in the irrigation network	
		1.2. Quantitative and qualitative changes of water resources.	- Provide protective fencing to water intake sources to avoid any pollution, contamination and exhaustions; - Drainage water discharge to be conducted in accordance with the engineering design; untreated sewage discharge shall be avoided; ; - Monitoring of water quantity to be as envisaged by the construction design (water meters application)	BAIS, Local MAWR body personnel, leasehold farms
		1.3. Potential impact on local biodiversity and composition of wetlands biocenosis.	Monitoring species composition and composition of wetlands biocenosis	Hydromet, local nature conservation authorities
		2. Soil resources		
		Change of soils quality	- Minimization of topsoil erosion by proper leveling of land and field drainage; - Monitoring inlet flow so that furrow erosion is avoided; - Annual inspections by WUAs, individual farmers, MAWR representatives to ensure clear filed drainage before the start of irrigation season, to avoid water logging and salinization; - Awareness raising to WUAs and farmers on application of deep root grassing for the reinforcement of canal embankments.	local service personnel, WUA, farmers, MAWR, State Agency of Land Resources, raion department of MAWR
		3. Potential increase in pesticides use in the project area Pesticide residue built up in soil and water, resulting in surface and ground water pollution and soil contamination, as well as representing health risks	- Awareness raising program among farmers and WUAs, on agricultutral practices compatible with IPM principles; - Training programs targeted at WUAs and individual farmers, on IPM based use of peticides; - Promotion of biological control methods over the application of chemicals	PIU, MAWR, Consultants

Location of pumping stations