IRRIGATION DEPARTMENT
GOVERNMENT OF BALOCHISTAN

PROJECT DESIGN, CONSTRUCTION SUPERVISION AND IMPLEMENTATION SUPPORT FOR BALOCHISTAN WATER RESOURCES DEVELOPMENT SECTOR PROJECT

EIA REPORT OF BALOCHISTAN WATER RESOURCES DEVELOPMENT SECTOR PROJECT

DECEMBER 2019

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AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
AP	Affected Party
BAP	Biodiversity Action Plan
BCM	Billion Cubic Meters
BEPA	Balochistan Environmental Protection Agency
BID	Balochistan Irrigation Department
BIDA	Balochistan Irrigation Drainage Authority
BIWRMD	Balochistan Integrated Water Resources Management Development
BSSIP	Balochistan Small Scale Irrigation Project
CARD	Coastal Association for Research & Development
CCA	Cultivable Command Area
CGM	Community Grazing Monitors
CIA	Cumulative Impact Assessment
CIFO	Community Irrigation Farmers' Organization
CITES	Convention on "International Trade in Endangered Species
DAD	Delay Action Dam
DDT	Dichlorodiphenyltrichloroethane
EA	Environmental Assessment
ECP	Environmental Code of Practices
EFA	Environmental Flow Assessment
EHS	Environmental, Health and Safety
EHSG	Environmental, Health and Safety Guidelines
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESMP	Environmental and Social Management Plan
ESIA	Environmental and Social Impact Assessment
ESSU	Environmental and Social Safeguard Unit
FAO	Food and Agriculture Organization
FIS	Flood Irrigation Schemes
PAP	Project Affected Person
PCC	Public Complaints Centre
PCRWR	Pakistan Council of Research in Water resources
GFP	Grievance Focal Points
GOB	Government of Balochistan
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
FO	Farmers' Organization
GA	Government Agency
GIS	Geographic Information System
HEIS	High efficiency irrigation scheme
HNP	Hingol National Park
IEE	Initial Environmental Examination
IPM	Integrated Pest Management
IUCN	International Union for Conservation of Nature
IBIS	Indus basin irrigation system
IRBM	Integrated River Basin Management
IWRM	Integrated Water Resources Management
LAA	Land Acquisition Act
MARPOL	Convention for the Prevention of Pollution from Ships
MEA	Multilateral Environmental Agreement
M&E	Monitoring and Evaluation
MEC	Monitoring and Evaluation Consultant
MCM	Million Cubic Meters
MDG	Millennium Development Goals
MIGA	Multilateral Investment Guarantee Agency
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NGO	Non-governmental Organizations
NSL	Natural Surface Level
OFWM	On-farm Water Management
OHS	Occupational Health and Safety
OP	Operational Policy
RSC	Residual Sodium Carbonate
SIA	Social Impact Assessment
SIAMP	Social Impact Assessment Management Plan

PEPA	Pakistan Environmental Protection Agency	*STI*	Sexually Transmitted Infection
PEPC	Pakistan Environmental Protection Council	*SWAT*	Strengths, Weaknesses, Opportunities and Threats
PIS	Perennial Irrigation Scheme	*TB*	Tuberculosis
PIU	Project Implementation Unit	*TDS*	Total Dissolved Solids
PMU	Project Management Unit	*TOR*	Terms of Reference
POP	Persistent Organic Pollutants	*UNFCCC*	Framework Convention on Climate Change
PPE	personal protection equipment	*USBR*	United States Bureau of Reclamation
PRB	Porali River Basin	*VEC*	Valued Environmental Components
PSC	Project Steering Committee	*WAPDA*	Water and Power Development Authority
PSIA	Project Supervision and Implementation Assistance	*WC*	Watercourse
PSIAC	Project Supervision and Implementation Assistance Consultant	*WEAP*	Water Management Evaluation Approach
RCD	Regional Cooperation for Development	*WUA*	Water Users' Association
RSA	Regional Safeguard Advisor		

Conversions

British Units	Metric Units		Metric Units	British Units
1 ft	0.305 m		1 m	3.28 ft
1 mile	1.609 km		1 km	0.621 miles
1 cusec (ft^3/s)	0.283 cumec (m^3/s)		1 cumec (m^3/s)	35.315 cusec (ft^3/s)
1 ac	0.405 Ha		1 ha	2.47 ac

1 INTRODUCTION

The Balochistan Water Resources Development Project (the Project) is a proposed project, by the Government of Balochistan (GoB), for improved water resources planning, management and monitoring by the government, and increased adoption of water-efficient practices and technologies by water users, in targeted communities in the Zhob, and Mula river basins of Balochistan.

The proposed Balochistan Water Resources Development Sector Project(BWRDP) will comprise of three outputs: (i) the construction and/or rehabilitation of irrigation infrastructure and watershed protection, (ii) establishment and/or improvement of command area, and (iii) strengthening of institutional capacity. The project outcome will be increased agriculture productivity in the project area. The project will be aligned with the following impacts: (i) increased farm income, and (ii) improved water resource management (WRM). The project will adopt an integrated water resources management (IWRM) approach for the irrigation development activities. It will support implementation of the IWRM policy, and in turn supports and strengthens several principal elements of ADB's water policy, including: (i) improving the efficiency of water use and delivery, (ii) fostering water conservation and sustainability of infrastructure, and (iii) improving governance through beneficiary participation and capacity building.In addition to irrigation infrastructure, the project will help establish a water resource information system (WRIS) for improved WRM and monitoring, and address watershed degradation by improving vegetative cover and undertaking physical interventions to reduce erosion in critical areas through integrated and participatory approaches.These activities not only have a positive impact on environmental sustainability but also build resilience to climate change. A comprehensive Environmental Assessment (EA) has been carried out for the Project and is presented in this report.

1.1 Background

Agriculture is the mainstay of Balochistan economy. About 60% of the GDP and 67% of 13.2 million Balochistan population live in rural areas and mainly depend on agriculture and related activities for their livelihood. The lack of water, severely constrains agricultural development, and only 1.5 million of Balochistan's 35 million ha are under cultivation. Climatic conditions range from dry to hyper-arid, and annual rainfall varies from 80 mm in the west to 250 mm in the east. Soils are mostly thin and calcareous, low in organic matter and prone to erosion. Balochistan farmers can be split between *Khushkaba* - those who grow rain-fed crops and also run small livestock flocks, and *Sailaba* - those who have access to irrigation water and grow irrigated crops.

The main rain-fed crops are wheat, sorghum, rapeseed, mustard and fodder. The main irrigated crops are wheat, rice, apples, apricots, peaches, grapes, pomegranates, dates and vegetables. Only 37% of Balochistan's cultivated land is under perennial irrigation; most of the farmers in the province rely on erratic partial irrigation. An estimated 47% of the population live below the official poverty line (33% nationally). Annual per capita GDP is US$757 (US$1,297 nationally), literacy rate is 50% (58% nationally) and less than 15% of people have access to safe water supply. In Pakistan, agriculture accounts for 20.88% of GDP and 43.5% of employment in the fiscal year of 2014-15. Agriculture GDP consists of 32.8% major crops, 11.1% minor crops, 53.2% livestock, 2.9% fisheries and forestry. Through its production, agriculture contributes 60% to the country's export earnings and 45% of the nation's labor force. Pakistan is among the top 20 global producers in over 48 different agricultural commodities including rice, sugarcane, wheat and cotton.

Irrigation is critical for agriculture in Balochistan. There are 18 river basins in Balochistan. Surface water from Indus basin irrigation system (IBIS) mainly contributes irrigation scheme in Balochistan. In addition, flood flows, perennial base flows in rivers, subsurface flow through river gravels, springs and groundwater also support small scale irrigation schemes. The estimated total perennial irrigated area during the fiscal year 2013-14 was 1.08 million ha of

which 40% is irrigated by the Pat Feeder, Desert and Khirthar canals from the Gudu and Sukkur barrages on the Indus River. Private canals irrigate 0.13 million ha and tubewells and dug wells irrigate 0.42 million ha and 0.05 million ha, respectively. Karezes, springs and minor irrigation sources irrigate 0.05 million ha (Pakistan Bureau of Statistics, 2015).

Spate irrigation (traditionally known as Sailaba farming) remains common as is rainwater harvesting (Khushkaba). Area under Sailaba and Khushkaba irrigation is about 0.87 million ha (Agricultural Statistics of Pakistan, 2011). Therefore, the total irrigated areas become about 1.95 million ha. Sailaba and Khushkaba farming are dependent on occasional rainfall and floods. There are significant opportunities exists for spate irrigation if additional floodwaters are effectively diverted; prospects exist at Nari, Porali, Kaha, Hingol, Zoab and Rakhshan River basins. Spate Irrigation has dual purposes, it can support agriculture production and also recharges groundwater and helps mitigate flood damages. There is huge potential for rainwater harvesting across Balochistan to the benefit of poor remote settlements.

Need for improvement in Water Resources Management. The poor coverage and reliability of hydro-meteorological data is preventing effective planning and management of water resources. Much of Balochistan has no groundwater monitoring network, despite the critical status of the groundwater resources, and the surface water data monitoring network is inadequate. The institutions lack expertise in hydro-meteorological monitoring, field sites are remote, field staffs are under supervised and data transmission infrastructure are inadequate.

Annual average rainfall in Balochistan is less than 200 mm, with as few as 7 rain days per year in the desert areas and a maximum of 28 rain days in the mountain areas. Annual average surface water generated in Balochistan is around 10.8 billion m^3 of which around 21% is utilized. This low utilization of surface water is due to the lack of limited storage and diversion infrastructure especially for the episodic flood flows. Under the Water Apportionment Accord of 1991, Balochistan has a water allocation of around 5.7 billion m^3 of floodwaters and a further allocation of 4.8 billion m^3 from perennial canals of the Indus Basin Irrigation System.

Due to the inadequate and poorly maintained canal infrastructure, only 36% of this combined allocation is utilized. Major portion of the water is lost along the inefficient conveyance and on-farm application. Unreliability of surface water and the dilapidated water infrastructures, groundwater became a critical water resources in Balochistan. Intense rainfall events, deforestation, and virtually no mechanism to naturally recharging groundwater table and episodic and over-exploitation of groundwater is leading to rapid decline of groundwater tables. Investing in new water infrastructure and rehabilitation of existing facilities are urgently needed to address critical state of agriculture, food security, and economic development in the province.

Severe drought condition with a 4-5 year frequency is dominant in Balochistan. Intense dry periods take heavy toll on the livelihood patterns of the local population as irrigation and potable water resources run dry. Water availability is drastically reduced during extended droughts.

Loss of life and destruction of settlements and irrigation infrastructure during the 2010 floods and 2007 and 2011 cyclones led to significant reduction in agricultural production. The lack of adequate water storage facilities, flood retention areas as well as flood protection dykes exacerbated the damages experienced during those years – and will cause damages again in the future. To minimize flood risk, construction of storage facilities and flood protection works are very urgent.

To improve the long-term sustainability of the environment and livelihoods of local communities, changes in current landuse practices and associated resource use are required. Currently, watersheds in the province are in a very poor and derelict state. Major investments are required to rehabilitate the watersheds in close collaboration with local communities and the Departments of Agriculture, Irrigation, and Forestry. This will make major improvements on rangeland and ground water recharge. Environmental protection activities through

community involvement is needed to conserve protected areas especially Juniper forests and Mangrove forests, and protecting riverine flora along major rivers and streams.

Inefficient irrigation practices, such as, flooding orchard fields, by reducing water use efficiency to below 30% and unlined water conveyance channels from the source to the farms, causing seepage losses of up to 45 to 50% in the system are some of the bottlenecks of the water productivity.

Effective water management in Balochistan is highly dependent on governance, institutional capacity, institutional set up, and political will and commitment by the public sector. Irrigation service delivery is currently managed independently among the agriculture and irrigation sectors without proper collaboration. At the community level, little interaction or information exchange among communities and the Government of Balochistan (GOB) are present, on available options to them to increase water productivity in a long-term.

River flows are highly dependent on the global climate change, including changes in glacial melt, temperature, and precipitation patterns. This phenomenon tends to increase the frequency of floods and droughts. Analyses conducted by various projects concluded that all rainfall/snow-fed rivers will have significant reduction in long-term discharge. Glacier-fed rivers will increase their discharges by 10-15 percent through 2050 but thereafter also significantly reduce their discharges due to the disappearance of glaciers in the Hindu Kush-Himalayas.

Climate change and the issues highlighted above on inadequate water management, followed by the population growth, urbanization, mining, and industrialization in the future will exacerbate scarcity of water in Balochistan. With a 3% population growth, Balochistan's population will grow by 50% and the urban population will double by 2025. In addition, the mining sector, which is the driving force of future economic growth in Balochistan, will require water, further aggravating the resource scarcity. In this context, the GOB adopted the IWRM approach in 2005 for formulating a policy including sixteen policy thrust areas, which are essential for improving and sustaining the management of surface and groundwater resources in the province.

1.2 The Proposed Project

Scarcity of fresh water resources is a major impediment in development of almost all sectors of human life and economy. The Government of Balochistan (GoB) intends to address the issue of water scarcity and management of limited water resources in the fragile environments of the Province in an integrated manner and at the same time develop new livelihoods using the available surface water resources with the support of Asian Development Bank (ADB) through the implementation of Balochistan Water Resources Development Project (BWRDP).

Four basins viz. Hingol, Mula, Pishin Lora and Zhob were indicated initially for selecting two basins with the availability of water per unit of land for the development of irrigated agriculture using available water for future development of command area. During project preparation, two (Zhob and Mula) out of these river basins were selected and 11 potential subprojects were selected for ADB financing based on factors such as water & land availability, economic viability and a balanced approach to extending development support to geographically wider spread under the selected basins. The subprojects selected for further development under this projects from both rivers basins are listed below:

- **Zhob River Basin Sub-projects** include (i) Ahmed Zai PIS (ii) Muslim Bagh Flood Dispersal (iii) Siri Toi Dam (iv) Killi Sardar FIS.

- **Mula River Basin Sub-projects** include (i) Churri Infiltration Gallery (ii) Pasht Khana & Garambawad (iii) Karkh River Development (iv) Killi Sardar FIS (v) Manyalo Raiko

Out of the above sub-projects, Feasibility studies were conducted for the following three sub-projects (termed as Core Sub-projects). The Consultants will update feasibility studies,

undertake detailed design, tender documents, bidding process and construction supervision for these sub-projects.

Core Sub-Projects

1. Siri Toi Dam, Sub-project, Zhob Basin
2. Karkh Valley Development, Sub-project, Mula Basin
3. Kharzan Hatachi Infiltration Gallery, Sub-project, Mula Basin

Pre-feasibility studies for the following sub-projects have been carried out and these are termed as non-core projects. Feasibility Studies and detailed design will be carried out under the proposed project for these sub-projects.

Non-core Sub-Projects

Zhob River Basin

1. Ahmedzai PIS + FIS
2. Muslim Bagh Flood Dispersal
3. Killi Sardar Akhtar PIS
4. Farmers Managed PIS/FIS Scheme Improvement

Mula River Basin

5. Churri Infilteration Gallery
6. Pashta Khan & Garambowad OIS
7. Manyalo, Raiko & Rind Ali PIS

The proposed project will construct and improve irrigation land of about 17,225 hectares (ha) and benefit about 42,866 farmers in the Balochistan province. This Project is expected to benefit 15,753 ha of command area through construction of a dam, weirs and infiltration galleries and about 276 km of irrigation network including head works, offtakes, aqueducts, culverts, sluice gates, drop/fall structures, guide bunds, domestic water storages, washing structures, livestock drinking facilities, and flood protection works to protect canals and command area.

1.3 The Environmental Assessment

Studies and basic data: This EA is based on field studies and data collected by the consultant team charged with the feasibility study and design of the project and their report on Environmental Impact Assessments (EIA) of both Zhob and Mula River Basins under the Balochistan Water Resources Development Project.

Contents of the present document: This EA document contains a project description as presented in Chapter 2, followed by a description of the Balochistan and Pakistani legal and administrative framework and the applicable Asian Development Bank policies, and gap analysis between local legislation and Asian Development Bank policies in Chapter 3, followed by a discussion of project alternatives in Chapter 4. A description of the physical, biological and socio-economic baseline is presented in Chapter 5. Potential adverse effects of the project including climate change impacts and risks are described in Chapter 6 and potential cumulative impacts and concerns associated with selected valued environmental components are presented in Chapter 7. Possible mitigation measures to offset, reduce or compensate potential negative impacts of the project are included in the Environmental Management Plan (EMP) that is summarized in Chapter 8. Finally, Chapter 9 provides an overview of all stakeholder consultations and activities for disclosure and access to the information.

1.4 Study Area

The project area consists of two river basins Zhob and Mula.

Zhob River basin starts near Kan Mehterzai hills, about 70 kms north-east of Quetta and runs through plains of Qila Saifullah and drains into Gomal river towards north-east, which ultimately joins Indus river. Total length of Zhob River is 406 km and elevation ranges between 3077 to 704 m from head to tail. The catchment area of basin is about 16,173 km^2.

Mula River originates from peaks of Herboi Mountains in Kalat district. It carves its course through hilly terrain and runs through plains of Jhal Magsi till it drains out into Hammal Lake at Shambani. Total length of Mula River is 301 km and elevation ranges between 2,500 m to 47 m from head to tail. The river basin covers 15,082 km^2.

1.5 Necessity of the EIA

The apex Pakistani law governing the subject of environment is the Pakistan Environmental Protection Act – 1997 (PEPA-97). Under Section 12 of the Act, it is mandatory for the proponents of the projects1 to execute the IEE and / or EIA (where warranted), and get the approval from federal agency (i.e. Pak-EPA). This function has been delegated under Section 26 to provincial EPAs.

After the 18th amendment to the constitution of Pakistan, environment became a provincial subject, and the environmental law governing the Sri Toi Water Storage Dam Irrigation project is now the Balochistan Environmental Protection Act 2012. This act also provides for IEE or EIA (as the case maybe) for projects under its clause 15.

The EIA / IEE regulations of 2000 provide categories of projects for which IEE or EIA needs to be conducted. The proposed project falls under the category of “Water management, dams, irrigation & flood protection”. Due to cumulative nature of the proposed project, an EIA is being conducted.

Based on the above requirements of national and provincial regulations, an Environmental Impact Assessment of the proposed project is being carried out.

1.6 Objectives of the EIA

The overall objective of EIA study is to study the interaction of project components among each other & the environment and to access anticipated environmental impacts in order to propose necessary mitigation measures against adverse impacts. To achieve this objective, an assessment of the existing environmental status of the project site is a prerequisite and, therefore, included in this study by collecting and reviewing the baseline data of various environmental attributes.

This EIA is being prepared to ensure adequate environmental and social management during development and implementation of BWRDP. It will provide mechanisms for ensuring that potential environmental and social impacts of the current program are identified, assessed and mitigated as appropriate, through an environmental and social screening process. The EIA will, therefore, comply with the Pakistani EIA procedures for meeting the environmental and social management requirements, as outlined in EIA Guidelines.

More Specific Objectives of this EIA Report

- Meet the statutory requirements set forth by the Pakistan Environmental Protection Act (PEPA) 1997 and the Balochistan Environmental Protection Act 2012.
- Comply with ADB policies and safeguards for environmental and social management of projects
- Facilitate proponents and financiers of the project in ensuring environmental and social acceptability of the project

- Establish a baseline of existing environmental status at the project site prior to project initiation by collecting secondary and primary data/information on physical, biological and socio-economic environment of the project area.
- Help the project proponents to incorporate necessary measures for legally compliant and socially acceptable environmental performance of their project.
- Identify significant environmental impacts (both positive and negative) during all stages of the project implementation and propose mitigation measures for negative impacts.

The scope of the assignment is derived from the PEPA guidelines. As per scope of work reflected in the PEPA guidelines.

1.7 Composition of Study Team

Environmental and social study team (Feasibility and Design Consultant): The study was conducted by a team of specialists in environment, social and gender of NESPAK-RHC-EGC JV Consultants.

1.8 Organization of Report

This report contains a total of eight chapters. Besides

- **Chapter 1**, which contains introduction and background of the report, other chapters are described as under:
- **Chapter 2** – "Description of Project" furnishes an overall description of the Project, including its background and key components for design, construction and O&M phases;
- **Chapter 3** – "Policy, Legal and Administrative Framework" elucidates the current legal framework which is applicable on the proposed project in context of environment and sustainable development;
- **Chapter 4** – "Project Need and Alternatives" provides details on alternatives considered for the proposed interventions, location and design;
- **Chapter 5** – "Baseline Conditions" comprises a detailed documentation of the existing (baseline) conditions of the Project Area, with respect to its physical, ecological and socioeconomic environment;
- **Chapter 6** – "Potential Environmental Impacts & Mitigations" documents the likely impacts of the Project on the physical, ecological and socio-economic environment during the construction and operation phases and lays down the proposed measures to mitigate the adverse impacts of the Project; and
- **Chapter 7** – "Environmental Management Plan" provides the proposals on mechanism to be adopted for the implementation and monitoring of the environmental measures.
- **Chapter 8** – "Stakeholder Consultation" provides details of consultative sessions with the local community as well as with other stakeholders including local politicians, local government officials, policy makers and NGOs for their opinions and suggestions on the Project;
- **Chapter 9** – "Conclusions and Recommendations" conclusions of the environmental impact assessment study and recommendations to be adopted.

2 PROJECT DESCRIPTION

2.1 Introduction

Balochistan lies in a hyper-arid to semi-arid region characterized by low rainfall, frequent dry spells and persistent droughts. The scarcity of water is one of the most critical issues of Balochistan. The Province is facing acute shortage of fresh water. The increase in population and demand for economic development has resulted in indiscriminate abstraction of groundwater, which is only 9% of the total water resource available in Balochistan. Now the deep groundwater is being used through drilling of tubewells up to a depth of 300 m and water table is lowering at a rate of 2-6 m per annum in different areas.

Scarcity of fresh water resources is a major impediment in development of almost all sectors of human life and economy. Conservation and efficient utilization of fresh water, therefore, deserve and demand top priority for overall well-being of the inhabitants of the Province. The Government of Balochistan (GoB) intends to address the issue of water scarcity and management of limited water resources in the fragile environments of the Province in an integrated manner and at the same time develop new livelihoods using the available surface water resources. This will reduce dependence on meagre and diminishing groundwater resources with the support of Asian Development Bank (ADB) through the formulation of Balochistan Water Resources Development Project (BWRDP). This Project is expected to pioneer a series of oncoming investments in water sector.

The project outcome will be the increased agricultural production. The project outputs will be (i) irrigation infrastructure and watershed protection constructed and/ rehabilitated; (ii) command area expanded and improved; and (iii) institutional capacity strengthened. The project will adopt an integrated water resources management approach for the irrigation development activities. The project will support implementation of the IWRM policy, and in turn supports and strengthens several principal elements of ADB's water policy, including: (i) improving the efficiency of water use and delivery; (ii) fostering water conservation and sustainability of infrastructure; and (iii) improving governance through beneficiary participation and capacity building. In addition to irrigation infrastructure, the project will help establish water resources information system for improved water resources management and monitoring, address watershed degradation by improving vegetative cover and undertaking physical interventions to reduce erosion in critical areas through integrated and participatory approaches. It will further seek to strengthen the capacity of and coordination between the agencies in charge of watershed management through the project implementation process. Improved on-farm water management is critical to raising cropping intensities and optimizing productivity increases from the investments in irrigation infrastructure. In addition, the project will support high value agriculture which is essential to improve farmers' income in Balochistan. These aspects also form an integral part of the project design and will help to achieve benefits that would not be possible through investments in water resources infrastructure alone.

2.2 Background

The Irrigation Department, Government of Balochistan (GoB) is executing the Balochistan Water Resources Development Sector Project (BWRDSP) to support the implementation of the integrated water resources management policy of the Government of Balochistan. The Asian Development Bank (the Bank) is financing the BWRDSP through a Loan (3700-PAK) to the Government of Islamic Republic of Pakistan (GoP).

The project preparatory technical assistance (PPTA) consultant prepared the Balochistan Water Resource Development Sector Project (2016-2018) followed by ADB's approval of a loan in the amount of $100 million from its Ordinary Capital Resources, and by JFPR a grant of $5.0 million (administered by ADB) in 2018.

The PPTA Consultant assisted the GoB in the screening and ranking of the five potential river basins (Hingol, Mula, Pishin Lora and Zhob) and selecting the two river basins and identifying 11 subprojects. The PPTA Consultant carried out feasibility study of three high ranking core sub-projects and pre-feasibility studies of remaining eight non-core subprojects as given in Table 1

Table 1: Status of Core and Non-core Subprojects

Sr.	Name of Subprojects	Core/ Non-core	River Basin	To-date Readiness Status of the Subprojects
1	Siri Toi Dam	Core Subproject	Zhob	Feasibility Study available
2	Karkh Valley Development Scheme	Core Subproject	Mula	Feasibility Study available
3	Kharzan Hatachi Infiltration Gallery	Core Subproject	Mula	Feasibility Study available
4	Ahmedzai PIS + FIS	Non-Core Subproject	Zhob	Pre-feasibility study available
5	Muslim Bagh Flood Dispersal	Non-Core Subproject	Zhob	Pre-feasibility study available
6	Killi Sardar Akhter PIS	Non-Core Subproject	Zhob	Pre-feasibility study available
7	Farmers Managed PIS/FIS Scheme Improvement	Non-Core Subproject	Zhob	Pre-feasibility study available
8	Churri Infiltration Gallery	Non-Core Subproject	Mula	Pre-feasibility study available
9	Pashta Khan & Garambowad PIS	Non-Core Subproject	Mula	Pre-feasibility study available
10	Manyalo, Raiko & Rind Ali PIS	Non-Core Subproject	Mula	Pre-feasibility study available
11	Farmers Managed PIS/FIS Scheme	Non-Core Subproject	Mula	Pre-feasibility study available

FIS = Flood Irrigation Scheme; PIS = Perennial Irrigation Scheme

Combined together these core and non-core subprojects on their completion will contribute the three higher-level outputs (irrigation infrastructure, command area and watershed and strengthening of institutional capacity) of the water resource sector development project in the two river basins.

2.3 Project Location

The 11 sub-projects are located in Zhob and Mula River basins.

Zhob River Basin is located in northern Balochistan. It originates in the Kan Metarzai range, runs through the plains of Qila Saifullah and drains into the Gomal River towards the north-east near Khajuri Kach which ultimately joins the Indus River. It passes about 4 km west of Zhob city. Zhob River Basin Sub-projects include (i) Ahmed Zai PIS (ii) Muslim Bagh Flood Dispersal (iii) Siri Toi Dam (iv) Killi Sardar FIS as shown in Error! Reference source not found..

Mula River Basin is located in southern Balochistan. It originates from the peaks of Herboi Mountains in Kalat district. It carves its course through the hilly terrain and runs through the plains of Jhal Magsi till it drains out into Hammal Lake at Shambani. Mula River Basin Sub-projects include (i) Churri Infiltration Gallery (ii) Pasht Khana & Garambawad (iii) Karkh River Development (iv) Killi Sardar FIS (v) Manyalo Raiko as shown in Error! Reference source not found..

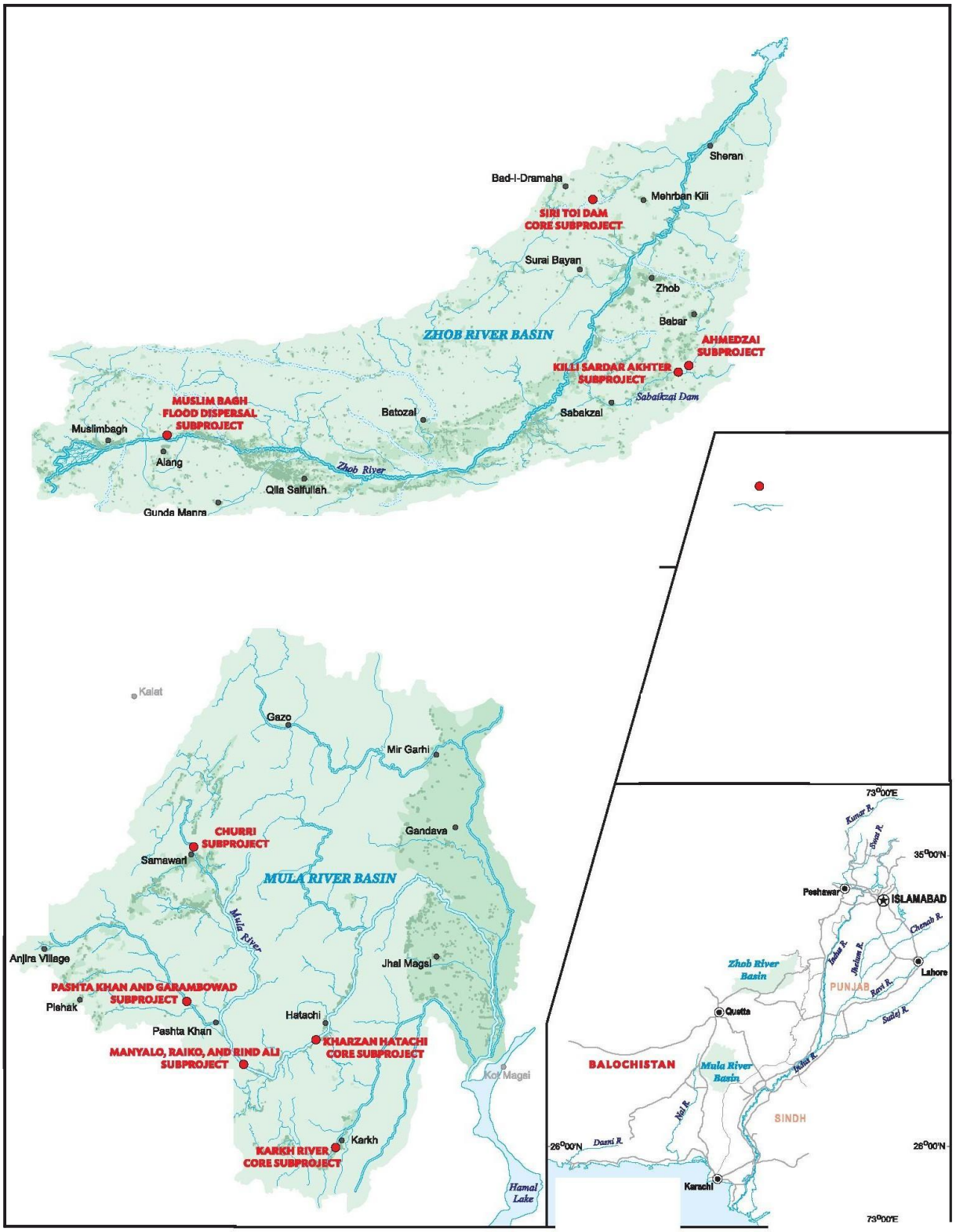


Figure 2-1: River Basins under the Project.

2.4 Salient Features of the Project

The project consists of 11 sub-projects in Zhob and Mula river basins. The salient Features of the 11 candidate sub-projects are given in Table 2

Table 2: List of Candidate Subprojects

Sr.	Name Subprojects	Total Estimated Cost	Area under Subproject (hectares)					
		(Million $)	New Irrigated Command Area	Improved Irrigated Command Area	Total Command Area	Watershed & Groundwater Recharge	Khushkaba Farming Area	Total
1	Ahmedzai PIS + FIS	2.16	180	427	607	52	200	859
2	Muslim Bagh Flood Dispersal	17.90	0	1,724	1,724			1,724
3	Siri Toi Dam	49.50	4,027	0	4,027	3,750	361	8,138
4	Killi Sardar Akhter PIS	0.90	0	230	230	22	0	252
5	Farmers Managed PIS/FIS Scheme Improvement	2.07	0	1,710	1,710	0	0	1,710
Subtotal Zhob Basin		**72.53**	**4,207**	**4,091**	**8,298**	**4,091**	**561**	**12,683**
1	Churri Infiltration Gallery	2.91	685	115	800	8	350	1,158
2	Pashta Khan & Garambowad PIS	4.43	377	456	833	6	50	889
3	Karkh Valley Development Scheme	6.73	250	2,000	2,250	210	75	2,535
4	Kharzan Hatachi Infiltration Gallery	6.05	106	575	681	85	378	1,144
5	Manyalo, Raiko &Rind Ali PIS	6.28	364	314	678	13	425	1,116
6	Farmers Managed PIS/FIS Scheme Improvement	2.68	0	2,213	2,250	0	0	2,213
Subtotal Mula Basin		**29.08**	**1,782**	**5,673**	**7,492**	**321**	**1,278**	**9,054**
Total		**101.61**	**5,989**	**9,764**	**15,753**	**4,145**	**1,839**	**21,737**

FIS = flood irrigation system, PIS = perennial irrigation system. Note: Subprojects with highlight are core-subprojects.

2.5 Sub-projects in Zhob River Basin

A total of four sub-projects are selected in Zhob River Basin. The sub-project names and locations are given in

Table 3. Graphical locations of the sub-projects in Zhob River Basin is given in Figure 2-2**.**

Table 3- Location of Selected Sub-Projects - Zhob River Basin

Sub-project	Latitude	Longitude
1. Ahmadzai Perennial and Floodwater Irrigation Sub-project	69° 32' 26.35" E	31°03' 59.87" N
2. Muslim Bagh Sub-project	67° 55’ 16.37” E	30° 50’ 30.33” N
3. Siri Toi Water Storage Dam Irrigation Sub-project	69° 15' 58.77" E	31° 35' 51.57" N
4. Killi Sardar Akhter Perennial Irrigation and Floodwater Sub-project	69° 30' 31.91" E	31° 03' 5.31" N

The selected package of sub-projects will irrigate 4,207 ha new command areas and shall improve 4,091 ha existing command areas. It will benefit 2,272 households in the basin. The cost of the sub-projects package is estimated at $72.53 million. Table 4 shows the main features of each sub-project, while a brief[1] description is given in the following sub-sections.

Table 4 Details of Selected Sub-Projects - Zhob River Basin

Sub-project	Catchment Area	Intervention Type	Conveyance System	Area Irrigated
1. Ahmadzai Perennial and Floodwater Irrigation Sub- project	237 km^2	Weir	Canal 11 km	607 ha
2. Muslim Bagh Sub-project	1,249 km^2	Weir	Canal 6.35 km	1724 ha
3. Siri Toi W ater Storage Dam Irrigation Sub-project	971 km^2	Dam	Canal 55.5 km	4,027 ha
4. Killi Sardar Akhter Perennial Irrigation and Floodwater Sub-project	353 km^2	Infiltration Gallery	Canal 3.3 km	230 ha

1249.50

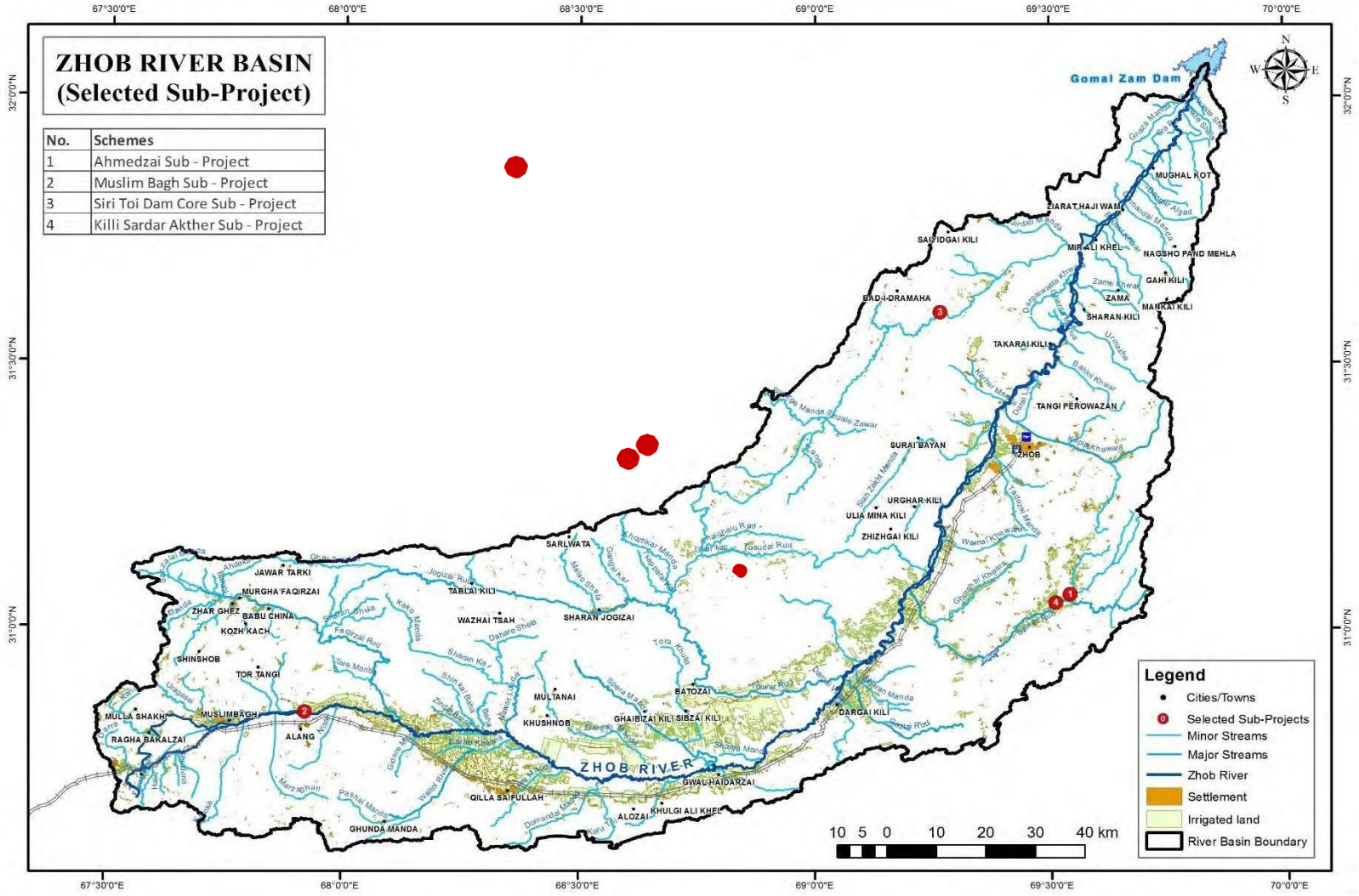


Figure 2-2: **Selected sub-projects of Zhob River basin in BWRDP**

2.5.1 Ahmadzai Perennial and Floodwater Irrigation Sub-project

The existing weir at Sawar Rud (river) shall be rehabilitated and raised to irrigate 607 ha - where 427 ha is the existing command area which will be improved. The sub-project is estimated to cost $2.16 million.

Ahmedzai weir was constructed in the early 1960s. It was damaged by floods in 1962, then reconstructed in 1984. The weir was again damaged in 2010. The weir walls and head-regulator stands damaged today (see Figures 3 and 4). Agricultural land on either side of the Sawar Rud is intermittently farmed through karez and infiltration gallery[2] water. Crop productivity is extremely low due to the low availability of water.

The proposed works, as shown in Figure 4, include:

(i) the raising of existing weir,

(ii) installation of new head-regulator

(iii) construction of left guide bund upstream of the weir

(iv) construction of canals in a length of 3.5 km for perennial irrigation, and

(v) construction of flood canals for in a length of 7.5 km for spate (sailaba) irrigation.

2.5.2 Muslim Bagh Sub-project

A 214-m weir shall be constructed on Zhob River near Muslimbagh to irrigate 1,724 ha – all of which is currently being irrigated and shall be improved. The sub-project is estimated to cost $17.90 million.

There is sufficient water in Zhob river, which is available only during the flood months. This water flows un-utilised, and the farmers instead rely on groundwater for irrigation. The abstraction is costly, and only limited water can be abstracted. Crop productivity is low due to low availability of water.

The proposed works, as shown in Figure 5, include:

(i) Construction of a 214 m weir on Zhob River with a curved scour channel[3],

(ii) Construction of protection embankment on right side of the weir,

(iii) Construction of two storage tanks (500 x 700 m) with 1.48 MCM capacity each to store floodwater for irrigation throughout the year,

(iv) Construction of flood canals from weir to storage tanks in a length of 6.35 km,

(v) Construction of distribution canals in a length of 10.4 km from storage tanks to command areas.

2.5.3 Siri Toi Water Storage Dam Irrigation Sub-project

A 66 meter high dam shall be constructed on Siri Toi River to irrigate 4,027 ha – where no irrigation is being practiced at present. The sub-project is estimated to cost $49.50 million. Siri Toi River floods frequently, often damaging local roads and low lying settlements. There are vast tracts of flat lands which lie barren due to their higher elevation. Cropping and other agricultural activity are non-existent due to nonavailability of water.

The proposed works, include:

i. Construction of 66 m high earth-fill dam to store 36.49 MCM,
ii. Construction of 32 m high earthen dike to close reservoir rim up-to dam level
iii. Construction of 135 m ogee spillway to safely discharge excess flood away from the dam,
iv. Construction of multi-level intake to convey water from the reservoir to the outlet pipe,

v. Construction of outlet pipe from the dam in a length of 1.1 km,
vi. Construction of main canals in a length of 43.8 km to convey 2.37 cumec to command areas.

2.5.4 Killi Sardar Akhter Perennial Irrigation and Floodwater Sub-project

Infiltration galleries shall be constructed across Sawar River and its tributary to irrigate 230 ha – all of which is currently being irrigated and shall be improved. The sub-project is estimated to cost $0.9 million.

Surface water is low in Sawar River. The River mostly flows below ground level. There is extensive land available in the area. Farmers rely on 5 No. open wells and an unlined channel from Cheena Viala spring for irrigation. A large portion of land in the area is barren, it is used for rain-fed (khushkaba) farming. Crop productivity is negligible due to non-availability of water.

The proposed works, include:

(i) Construction of two infiltration galleries in a length of 450 m across Sawar River and Nahara River, to divert subsurface flow,
(ii) Construction of canal from infiltration gallery to command area in a length of 2.7 km,
(iii) Construction of flood protection bund in a length of 164 m,
(iv) Lining of canal from natural spring – Cheena Viala

2.6 Sub-projects in Mula River Basin

A total of five sub-projects are selected in Mula River basin. The sub-project names and locations are given in Table 5. Their location in Mula River basin is given in Map 2-2.

Table 5: Location of Selected Sub-Projects - Mula River Basin

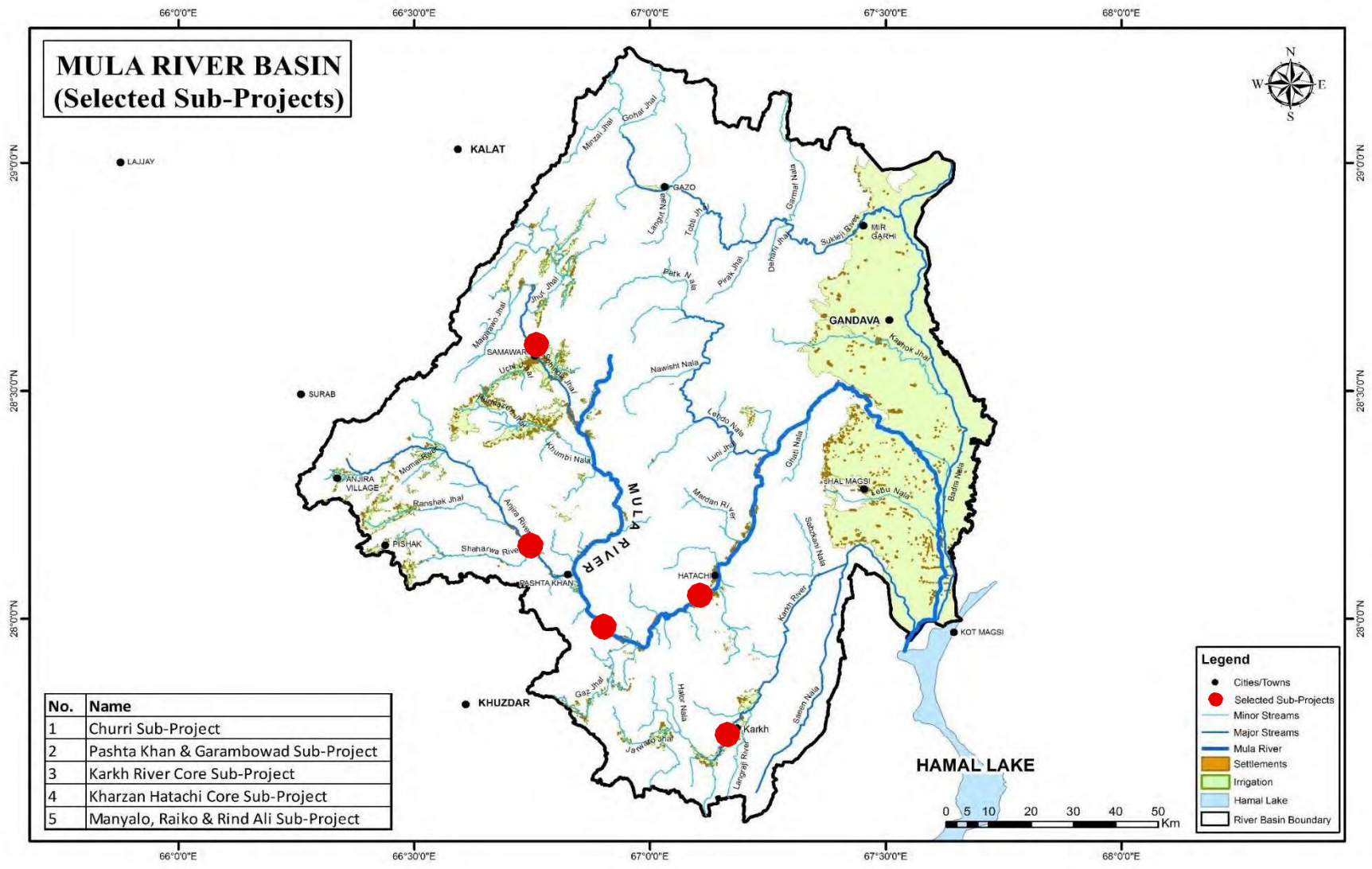
Sub-project	Latitude	Longitude
1. Churri Infiltration Gallery Sub-project	66° 45' 44.22" E	28° 35' 48.22" N
2. Pashta Khan and Garambowad Sub-project	66° 47' 10.50" E	28° 06' 38.71" N
3. Karkh River Development Sub-project	67° 09' 20.58" E	27° 43' 17.45" N
4. Kharzan Hatachi Infiltration Gallery Sub-project	67° 06' 21.61" E	28° 02' 50.15" N
5. Manyalo, Raiko and Rind Ali PIS Sub-project	66° 54' 16.84" E	27° 58' 39.60" N

The selected sub-projects will irrigate 1,782 ha new command areas and shall improve 5,673 ha existing command areas. It will benefit 5,287 households in the basin. The cost of the sub-projects package is estimated at $29.08 million. Table 6 shows the main features of each sub-project, while a brief[4] description is given in the following sub-sections.

Table 6 Details of Selected Sub-Projects - Mula River Basin

Sub-project	Catchment Area	Intervention Type	Conveyance System	Area Irrigated
1. Churri Infiltration Gallery Sub-project	1,070 km^2	Infiltration Gallery	Canal 12.35 km	800 ha
2. Pashta Khan and Garambowad Sub-project	2,600 km^2	Weir	Canal 22 km	833 ha
3. Karkh River Development Sub-project	635 km^2	Weir	Canal 22.55 km	2250ha

4. Kharzan Hatachi Infiltration Gallery Sub-project	5,219 km^2	Infiltration Gallery	Canal 18.5 km	681 ha
5. Manyalo, Raiko and Rind Ali PIS Sub-project	4,390 km^2	Weir	Canal 22 km	678 ha



No.	Name
1	Churri Sub-Project
2	Pashta Khan & Garambowad Sub-Project
3	Karkh River Core Sub-Project
4	Kharzan Hatachi Core Sub-Project
5	Manyalo, Raiko & Rind Ali Sub-Project

Map 2-1 Selected sub-projects of Mula River basin in BWRDP

2.6.1 Churri Infiltration Gallery Sub-project

An infiltration gallery shall be constructed across Sohinda River to irrigate 800 ha where 115 ha is the existing command area which will be improved. The project is estimated to cost $2.91 million. Surface water is very low in Sohinda River. The river mostly flows below ground level. There is extreme land available in the area. The existing infiltration gallery at Churri diverts 0.2 cumec of subsurface water through an unlined channel. It does not meet the irrigation requirement. Crop productivity is low due to low availability of water.
The proposed work, include:

- Construction of Infiltration Gallery in a length of 270 m across Sohinda river to divert subsurface flow.
- Construction of underground RCC conduit in a length of 1.2 km from infiltration gallery
- Construction of canal from RCC conduit to command area in a length of 4 km.
- Construction of flood protection bund in a length of 2km.

2.6.2 Pashta Khan and Garambowad Sub-project

A weir shall be constructed at Pashta Khan on Anjira River, and an off-take well at shall be constructed at Garambowad to irrigate 833 ha - where 456 ha is the existing command area which will be improved. The subproject is estimated to cost $4.43 million. Surface flow is significant in Anjira river. The river is presently diverted through a temporary arrangement of stone and debris[5]). The diverted flow is conveyed to the command area through unlined channels. The arrangement provides a very small quantity of water. Crop productivity is low and unreliable due to low availability of water and flood prone diversion system.
The proposed works, include:

Pashta Khan

(i) Construction of weir on Anjira river in a length of 120 m at Pashta Khan,
(ii) Construction of canals in a length of 16.5 km to convey water from weir at Pashta Khan to the command area,
(iii) Construction of flood protection bunds in a length of 4.27 km at Pashta Khan,

Garambowad

(i) Construction of off-take well at Garambowad,
(ii) Construction of canals in a length of 5.5 km to convey water from off-take well at Garambowad to the command area,
(iii) Construction of flood protection bunds in a length of 0.55 km at Garambowad

2.6.3 Karkh River Development Sub-project

A weir shall be constructed at Jhalaro on Karkh river, while existing weir at Chutta shall be rehabilitated, to irrigate 2,250 ha - where 2,000 ha is the existing command area which will be improved. The sub-project is estimated to cost $6.73 million.
Surface flow is significant in Karkh river. A cascade of five weirs6 on the river diverts surface water, which is conveyed to the command area through lined channels. Details of weirs:
(i) The weir at Chutta needs reconstruction, (ii) at Acherwand and Sinjori the weir sluice gates are dysfunctional, (iii) at Jhalaro, the river is diverted through a temporary arrangement of stone and debris, and (iv) at Wanderi and Khadri, the weirs are functional. In general, the cascade of weirs does not provide the required amount of water for irrigation. Crop productivity is medium-low due to insufficient availability of water.
The proposed works, include:
i. Construction of weir on Karkh river at Jhalaro in a length of 106 m,
ii. Rehabilitation of upstream cut-off wall of weir on Karkh river at Chutta,
iii. Construction of lined canals[8] in a length of 16.89 km in Karkh river area,
iv. Rehabilitation of lined canals in a length of 1.81 km in Karkh river area,
v. Construction of flood protection bunds in a length of 5.24 km in Karkh river area.

2.6.4 Kharzan Hatachi Infiltration Gallery Sub-project

Infiltration galleries shall be constructed across Mula River to irrigate 681 ha - where 575 ha is the existing command area which will be improved. The sub-project is estimated to cost $6.05 million. Surface flow is significant in Mula river. The river is diverted through a temporary arrangement of stone and debris. The diverted flow is conveyed to the command area through lined channels. Hatachi village is downstream of Kharzan, it therefore receives its due share only when the irrigation demand of Kharzan has been met. There exists an infiltration gallery at Kharzan, which is blocked and non-functional since the 2005 flood. Crop productivity is medium-low due to insufficient availability of water.
The proposed works, include:

Kharzan
i. Construction of Infiltration Gallery at Kharzan in a length of 475 m across Mula River to divert subsurface flow,
ii. Construction of pipe conduit in a length of 120 from infiltration gallery at Kharzan to start of lined canal,
iii. Rehabiliation of lined canals in a length of 597 m at Kharzan,
iv. Construction of lined canals in a length of 530 m at Kharzan,
v. Construction of flood protection bunds in a length of 3.46 km at Kharzan,

Hatachi
i. Construction of Infiltration Gallery at Hatachi in a length of 740 m across Mula River to divert subsurface flow,
ii. Construction of pipe conduit in a length of 2.28 km from infiltration gallery at Hatachi to start of lined canal
iii. Rehabiliation of lined canals in a length of 3.70 km at Hatachi,
iv. Construction of lined canals in a length of 4.24 km at Hatachi,
v. Construction of flood protection bunds in a length of 3.14 km at Hatachi.

2.6.5 Manyalo, Raiko and Rind Ali PIS Sub-project

A weir shall be constructed on Mula River at Manyalo to irrigate 678 ha –where 314 ha is the existing command area which will be improved. The sub-project is estimated to cost $6.28 million. Surface flow is significant in Mula River at Manyalo. The river is diverted through a temporary arrangement of stone and debris[9]. Crop productivity is low due to low availability of water.
The proposed works, include:
i. Construction of weir on Mula River at Manyalo in
a length of 250 m,
ii. Construction of lined canals in a length of 22 km to command aras in three villages – Manyalo, Raiko and Rind Ali

3 POLICY, LEGAL AND ADMINISTRATIVE CONTEXT

National Policy, international treaty obligations and Asian Development Bank guidelines relevant to environmental and social issues associated with the Project are described in the sections below.

3.1 Applicable National Environmental Policies and legislation

3.1.1 National Conservation Strategy

The National Conservation Strategy (NCS, 1993-98) provided a broad framework for addressing national environmental concerns through three main objectives: conservation of natural resources, promotion of sustainable development and improved efficiency in the management and use of available resources. Coming at an opportune time, it was a "call for action" to central and provincial governments, businesses, nongovernmental organizations (NGOs), local communities, and Pakistanis. The NCS recommended fourteen priority action areas ranging from soil management to the preservation of cultural heritage.

3.1.2 National Environmental Policy

The National Environmental Policy (2005) is the overarching framework for addressing environmental issues in Pakistan. It provides directions for addressing the underlying causes of environmental degradation, cross sectoral issues and meeting international obligations. It builds on the goals and objectives of the NCS and other related national policies

3.1.3 Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act (1997) is the basic legislative tool empowering the government to frame regulation for protection of environment. It established a Provincial Sustainable Development Fund and allows for protection and conservation of renewable resources, establishment of Environmental Tribunals and appointment of Environmental Magistrates, and for conduct of Initial Environmental Examinations and Environmental Impact Assessments. According to Section12 (1) of the Act, no development program involving construction activities or any change to the physical environment can proceed without an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA), with both requiring approved by federal and provincial Environmental Protection Agencies (EPAs). Section 12(6) of the Act states the provision is only applicable only to prescribed categories of projects, which are defined in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations (2000). Under these regulations projects are classified according to the expected degree of environmental impact. Project types listed in Schedule-I are potentially less damaging and only require IEE; those types listed in Schedule-II are potentially more damaging and requires an EIA. The proposed Balochistan Integrated Water Resources Management Development (BIWRMD) Project falls under Schedule-II (Section D) of the Regulations, hence an EIA has been conducted.

3.1.4 Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations

The Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations (2000) define the categories of projects for which an IEE and EIA are required. The Regulations classify projects on the basis of expected degree of adverse environmental impacts. Schedule I lists projects that require IEE while Schedule II presents the list of projects that require an EIA. The proposed BIWRMP Project falls under Schedule II (Section D) of the Regulations.

3.1.5 National Environmental Quality Standards

Under the provisions of Pakistan Environmental Protection Agency (PEPA), the National Environmental Quality Standards (NEQS) specify the following standards:

- Maximum allowable concentration of pollutants (including pesticides, herbicides, fungicides and insecticides) in municipal and liquid industrial effluents discharged to

inland waters, sewage treatment and sea.
- Maximum allowable concentration of pollutants in gaseous emission from industrial sources.
- Maximum allowable emissions from motor vehicles.
- Drinking water standards.
- Ambient air quality standards.
- Noise standards

3.1.6 Guidelines for sensitive and critical areas, 1997

These guidelines provide identify protected areas in Pakistan and provides detailed guidance on the approach to adopt. The protected areas include wildlife reserves and forests, and cultural heritage sites. It presents the requirements for the consideration of sensitive and critical areas during environmental assessment, as well as a list of nationally protected natural and cultural heritage.

3.2 Other applicable national policies and legislations

3.2.1 The Land Acquisition Act, 1894

The Land Acquisition Act, 1894 (LAA) regulates land acquisition for public purpose. However, each province has its own interpretation of the LAA. The LAA and its accompanying regulations require that, following an impact assessment and valuation effort, land and crops are compensated in cash at market rate to titled landowners and registered land tenants/users, respectively. The legal requirement is that such land valuation should be based on the latest 3-5 years average registered land sale rates. Because of widespread under-valuation by the Revenue Department, a 15% Compulsory Acquisition Surcharge is now often applied to current market rates. Each province has its own interpretation of the LAA, and some provinces have issued provincial legislations.

Only legal owners and tenants registered with the Land Revenue Department or possessing formal lease agreements, are eligible for compensation. Users of Rights of Way (RoW) are not considered "affected" by project activities and thus not entitled to any mitigating measure, compensation, or livelihood support. There is no legal obligation to provide: (i) titles to landless users and unregistered tenants, (ii) rehabilitation for encroachers or informal settlers either in the form of house-for-house or land-for-land replacement, or in form of cash. There are, however, precedents where legally ineligible affected parties (APs) have been compensated or rehabilitated.

The LAA also does not mandate specific rehabilitation and/or assistance for the poor, vulnerable groups, or severely APs, nor does it automatically provide for income/livelihood losses or resettlement expenses rehabilitation. However, provincial interpretations are made to suit operational requirements, local needs and socio-economic circumstances. *Ad-hoc* arrangements, agreements and understandings for resettlement are often made in difficult situations.

Exceptions to the rules can be explained by the fact that the LAA is broadly interpreted at the provincial level depending on operational requirements, local needs, and socio-economic circumstances. Recourse is often taken through ad-hoc arrangements, agreements and understandings for resettlement in difficult situations. This is also influenced by the fact that the Ministry of Environment is considering an amendment to the LAA to widen the scope of eligibility for compensation and tighten up loopholes (i.e. regarding definitions of malpractice, cut-off dates, political influence on routing, etc.).

Land ownership in the intervention areas of the proposed BIWRMD Project, the project areas are of the following main types: (i) self-owned property or (ii) Government property or (iii) Shamilat communal land. Relevant communities are all supportive of the proposed and if any land is required, appropriate compensation will be made. The costs of resettlement will be included at the scheme level.

3.2.2 Forest Act, 1927

The Forest Act (1927) authorizes Provincial Forest Departments to establish and protect forest reserves. For forest reserves, it prohibits the (i) lighting of fires, (ii) removal of forest produce and (iii) any damage to the forest. The Khost sub-basin area is the most sensitive forest reserve in the Project and is home to the second largest juniper (*Juniperus excelsa*) forest in the world.

The Project activities will respect the provisions of the Act and no activities will be carried out in any protected forests.

3.2.3 Antiquity Act, 1975

The Antiquities Act of 1975 ensures the protection of Pakistan's cultural from destruction, theft, negligence, trade and illegal export. The Act prohibits new construction within 200 feet of protected sites. It further stipulates that if archaeological discoveries are made during construction, these should be protected and reported to the Department of Antiquities. It also empowers the Government of Pakistan to prohibit any excavations in any area that may contain objects of archaeological significance.

3.2.4 Mines, Oilfields And Mineral Development Act, 1948

This Act provides procedures for quarrying and mine construction material. Beji sub-basin schemes areas are located under coal mines. In the proposed project this Act will be applicable.

3.3 Applicable provincial environmental policies and legislations

3.3.1 Balochistan Environmental Protection Act, 2012

Balochistan Environmental Protection Act of 2012 provides the overarching provincial framework for the protection of the environment in Balochistan. It builds on the provisions of PEPA and localizes them to the provincial context.

For projects such as the BWIRM, it provides a framework for managing water resources (Section 20), through consideration for the protection of aquatic ecosystems and biodiversity and achieving minimal pollution levels for water resources. It requires that project proponents prepare water resource management plans taking into account the following points:

- Provisions for integrated watershed management;
- Regulation of sustainable abstraction of groundwater;
- Regulation of the use of ground or surface water for agricultural, industrial, mining and urban purposes;
- Measures to protect human health and ecosystems;
- Any other provision necessary for the sustainable use and management of water resources.
- An land owner or individual who uses the land on which any activity or process is performed or undertaken which causes or is likely to cause significant pollution of a water resource must take measures to prevent any such pollution.

3.3.2 EIA Approval Procedure

The Federal EPA has jurisdiction over all EIA/IEE and may delegate its power to the provinces. As per law, the relevant body that is to review the EIA is the Government Agency (GA). The GA in turn is defined as the division, department, attached department, bureau, section, commission, board office or the unit of the federal or provincial government; a development or local authority or a company controlled or established by government; Provincial Environmental Agency or any other body. Prior to devolution of the environment to provinces, Provincial EPAs were entrusted to review EIAs for projects in provinces and projects shared by more than one province or in federal areas were reviewed by the federal EPA. The Balochistan Act has further devolved the power at district/regional level and allows for district

agencies along with a provincial EPA (Para 8 of the Act). The Balochistan EPA is vested with the authority of reviewing IEE/EIAs, in line with the institutional administrative structure.

3.3.3 Balochistan Wildlife Protection, Preservation, Conservation and Management Act, 2014

This legislation is guided primarily by the principle of ensuring the protection, preservation, promotion, conservation, management and sustainable development of wild animals in recognition of their position as key components of biological diversity with social, cultural, economic and ecological significance for the present and future generations. In recognizing various levels of protected wildlife areas, it domesticates the provisions of the international conventions and treaties to which Pakistan is member. It further encourages the active participation of local communities in the protection of wildlife resources in the Province. Community participation is further encouraged through economic incentives and benefit sharing. The Act embraces the principle of co-management of protected areas and the promotion of livelihood activities in protected areas.

The proposed project activities will be conducted in compliance with the requirement of this Act.

3.3.4 Canal and Drainage Ordinance, 1980 (amended in 2000 and 2006)

The Balochistan Canal and Drainage Ordinance, entitles the Provincial government to use and control, for public purposes, water of all rivers and streams flowing in natural channels, of lakes, sub-soil and other natural collection of still water. The Ordinance empowers the government to define, in identified areas, a cropping pattern for the purpose of controlling waterlogging and soil salinity. The government may also impose a ban on cultivation of certain crops in lands situated outside the canal command area and can, in the event of any violation, impose penalties in terms of punishment and fine. The government may also compel land tenants, occupiers or owners to grow particular crop in order to comply with the designed parameters for concerned canal systems or any good reason to control and save water.

The latest amendment (2006) – guided by ADB technical assistance – is relevant to the BIWRMD Project, as is the Irrigation Manual Order (2006) that guides O&M of the irrigation system and water management.

3.3.5 Irrigation Manual Order, 2006

The Irrigation Manual Order of 2006 provides guidelines to the engineers and staff of the Irrigation Department implementation, operation and maintenance of the irrigation, drainage and other related infrastructure in the Province. It provides detailed guidance and instructions on personnel assignments, expenditure and accounting, housing for department activities, land sales and acquisition, and miscellaneous other issues which could come under the purview of the implementing agency. It prescribes the necessary measures to take in the event of land acquisition for public purposes. Excluded from acquisition are lands associated with places of religious worship, shrines, tombs, graveyards or any immovable property attached to any such institution and the boundaries of which are continuous with the site of the same. The prescriptions connect with the requirements of the Land acquisition Act and provide guidance for staff of the Department of Irrigation regarding the necessary steps under the requirements of the Land Acquisition Act.

3.3.6 Balochistan Irrigation and Drainage Authority Act, 1997

The Balochistan Irrigation and Drainage Authority (BIDA) Act of 1997 transformed the Irrigation wing of the Irrigation Department into an autonomous Authority for development and management of irrigation, drainage and flood control infrastructure. BIDA exercises powers under the Balochistan Canal and Drainage Ordinance and the Balochistan Groundwater Rights Administration Ordinance to formulate and implement policy guidelines regarding water management and use. It is responsible for developing a sustainable irrigation and drainage

network through equitable distribution of irrigation water to improve the efficiency of water utilization while minimizing drainage surplus.

The proposed BIWRMD Project will need to be cognizant of BIDA (1997) regulations, especially for organizing and registering farmer organizations. The regulations for registration of farmer organizations were approved and issued in 2000. A registrar appointed by BIDA is responsible for registering and maintain the operations of registered farmer organizations.

3.3.7 Balochistan Water and Sanitation Authority Act, 1989

This Act provides for the establishment of the Water and Sanitation Authority. The Authority is responsible for providing an adequate supply of potable water and for eliminating water-borne diseases through the provision of effective sewerage and sanitation systems. The Act defines the composition of the Authority and its powers and functions. The Authority is empowered to issue licences, set charges and recover revenues for the services provided, authorize the discharge of industrial waste into sewerage or sanitation systems, and protect water resources and water supply systems from sources of contamination or pollution.

3.3.8 Community Irrigation Farmers' Organization Regulation, 2000

Despite the prevalence of minor irrigation schemes in Balochistan, there was no appropriate legislation for registration of Farmers' Organizations (FOs) except the Water Users Association Ordinance of 1981 that provided a framework for improving watercourses in canal command areas. The Community Irrigation Farmers' Organization Regulations provides a legal status for entities that may be established on community irrigation schemes, outside the Indus basin irrigation system, and which are responsible for operation and monitoring of community irrigation schemes. The Regulations were approved and issued by BIDA in April 2000. A BIDA-appointed registrar is responsible for registering and maintaining the operations of the Registered FOs. The Registrar issues model bye-laws and relevant guidelines to foster efficient functioning and prudent management in CIFOs and Associations and approve the bye-laws of CIFOs or Associations. He can issue the certificate of registration only when he is satisfied to the authenticity or correctness of any element in the demand for registration otherwise he may issue a notice of refusal of registration to the applicants concerned, stating the detailed grounds for such refusal.

3.3.9 Water Users' Association Ordinance, 1981

The Balochistan Water Users' Association (WUA) Ordinance provides for the formation, operation and promotion of WUAs in the province. The Ordinance makes it obligatory for farmers to organize themselves into WUAs for collective action related to watercourse rehabilitation and its systematic maintenance. The main shortcoming of this Ordinance is that it is applicable only to WUAs in canal-irrigated systems and not small-scale irrigation schemes operated by farmer- or community-based organizations.

3.3.10 Balochistan Agricultural Produce Markets Act, 1991

The Balochistan Agricultural Produce Markets Act, 1991 provides better regulations of purchase and sale of agricultural produce and establishment of markets for agricultural produce in the Province. The Government may, by notification, declare an area to be a notified market area and shall exercise control over the purchase and sale of such agricultural produce. By the same measure of notification, the Government shall establish a market committee for every notified market area. The market committee concerned is responsible for issuing licences to dealers. Powers and duties of the market committees and their composition are set out in the Act. A market committee may levy fees on the agricultural produce bought or sold by or through a dealer in the notified market area. The Act further provides for the establishment of Market Committee Funds. The Government may direct that all or any of the disputes, arising in a notified market area, shall be referred to a Board of Arbitrators constituted under this Act. The Act contains also penalty provisions and provisions of miscellaneous nature.

3.3.11 Groundwater Rights Administration Ordinance, 1978

The Groundwater Administration Ordinance (1978, amended 2000) regulates groundwater use and administers the rights of various persons at the provincial and district levels. A Provincial Water Board was constituted for administering groundwater rights and to establish policies for conservation and development of groundwater. The Ordinance established the procedures and framework within the district level administration to issue permits for the development of new *Kareze*, dug wells and tubewells by the District Water Committee. This committee also has the right to stop groundwater extraction by unauthorized persons. The Ordinance provides a legal and institutional framework for resource management by the local administration together with tribal leaders, allowing flexibility in determining rules for groundwater use as a common property. However the Provincial Water Board has supreme power to call for record of any case relating to water rights to satisfy itself as to the regulatory, propriety and legality of the proceedings and can set aside and quash the proceedings, if it considers that any material irregularity has occurred. The main shortcoming of Ordinance has been the lack of involvement of local communities and poor overall enforcement by District Water Committees. The proposed BIWRMD Project will need to take account of the Groundwater Administration Ordinance (1978, amended 2000).

3.3.12 Balochistan Culture Heritage Preservation Act, 2010

This Act empowers the Provincial Government to protect cultural heritage in the Province. It empowers the government to compulsorily acquire any heritage that could be lost to various threats. It states punitive action for the wilful destruction of protected cultural heritage.

3.4 Balochistan Integrated Water Resources Management (IWRM) Policy

3.4.1 The IWRM Approach

The IWRM concepts and principles are globally well accepted. However, IWRM implementation remains a challenge in many countries including Pakistan. In the province of Balochistan the situation is complex and challenging, given the lack of adequate capacity for integrated water management and the entrenched prioritization of irrigation infrastructure construction above all other water sectors. Establishment of effective IWRM will require significant capacity building of public-sector institutions.

The Balochistan IWRM Policy was prepared in 2004 under the ADB-funded Balochistan Resource Management Program, and approved by the provincial cabinet in 2006. The key policy foci are:

- Water availability and potential for development
- Water resources assessment and monitoring
- Managing water demand
- IWRM for agriculture and other sub-sectors
- Environmental water management
- Cost recovery of irrigation infrastructure and high-efficiency irrigation systems
- Cost effectiveness of water conservation interventions
- Promoting inter-provincial cooperation and fostering participation
- Institutional restructuring and strengthening

The Policy endorses a river basin approach and emphasizes the need for an integrated approach across all water sources and all water-using sub-sectors of the economy. It stresses the need for demand management and reduction of water losses. It advocates for small multi-purpose dams to store floodwater for both spate irrigation (Sailaba) and supplemental irrigation supply during the dry periods, and for enhanced groundwater recharge.

Poverty is higher in Balochistan than other provinces of Pakistan. The general aridity, frequent droughts and fragile environment require resource management to be linked to poverty-reduction and environmental protection. The IWRM Policy and reforms thus consider poverty-

reduction and environmental management in order to improve productivity and sustainability of water without affecting the resource base.

IWRM requires basin-level planning to guide water resources management and development. This should consider watershed dimensions (as well as downstream irrigation) from both livelihood and ecological perspectives.

3.5 Environmental Regulatory Authorities

The Pakistan Environmental Protection Council (PEPC) is the apex environmental authority in Pakistan. Its membership is made up of representatives of trade and industry, non-governmental organisations, educational institutions, journalists and concerned ministries. The Prime Minister, or his nominee, is head of the Council.

3.5.1 Pakistan Environmental Protection Agency

The Pakistan Environmental Protection Agency (Pak-EPA) was established under the provisions of the 1997 Act. It is an autonomous department of the Ministry Pakistan Federal Ministry of Environment is responsible for planning, coordinating, promoting, protecting and oversight of national environmental and forestry programmes.

It is an enforcing agency that reviews Environmental Impact Assessments and Initial Environmental Examinations (IEE). It issues certificates for establishment of environment labs in the Islamabad Capital Territory. Pak-EPA is mandated to prepare, establish and revise the National Environmental Quality Standards (NEQS) with approval of Pakistan Environmental Protection Council (PEPC). It is involved in the promotion of research and the development of science and technology which may contribute to the prevention of pollution, protection of the environment, and sustainable development. It identifies the needs for, and initiates, legislation in various sectors of the environment; provide information and guidance to the public on environmental matters. The Agency is charged with specifying safeguards for the prevention of accidents and disasters which may cause pollution. It is charged with fostering an inclusive approach to environmental management by encouraging the formation and operations of nongovernmental, community and village organizations to prevent and control pollution and promote sustainable development. Pak-EPA may undertake inquiries or investigation into environmental issues, either of its own accord or upon complaint from any person or organization.

3.5.2 Balochistan Environmental Protection Agency

Balochistan Environmental Protection Agency (BEPA) is a department headed by the Secretary of Environment and Sports. It is the sole environmental regulatory body for Balochistan Province, responsible for implementing National and provincial laws, improving the protection of environmental and natural resources of the Province, while developing policies for improvement and sustainable use of natural resources.

3.6 Obligations under International Treaties

Pakistan is signatory of several Multilateral Environmental Agreements (MEAs), including:

- Basel Convention
- Convention on “Biological Diversity, Convention on Wetlands” (Ramsar)
- Convention on “International Trade in Endangered Species” (CITES)
- UN Framework Convention on Climate Change (UNFCCC)
- Kyoto Protocol
- Montreal Protocol
- UN Convention to Combat Desertification
- Convention for the Prevention of Pollution from Ships (MARPOL)
- UN Convention on the Law of Seas (LOS)
- Stockholm Convention on Persistent Organic Pollutants (POPs)

- Cartina Protocol.

These MEAs impose requirements and restrictions of varying degrees upon the member countries, to meet objectives of these agreements. However, the implementation mechanism for most of these MEAs is weak in Pakistan and institutional setup mostly non-existent.

The MEA most applicable for the Project is the Stockholm Convention on Persistent Organic Pollutants (POPs), under which certain pesticides such as dichlorodiphenyltrichloroethane (commonly known as DDT) cannot be used.

3.7 Asian Development Bank Requirements

GTC is funded by ADB, hence ADB's requirement would be complied in all aspects.

ADB's Requirements for Preparation of Environmental Assessments of Projects

The EIA in hand is fully committed to the requirements determined in the "ADB Safeguard Policy Statement". The environmental works carried out by the Consultant on behalf of project proponents have been essentially guided by these rules as enunciated in the "Outline of an Environmental Impact Assessment Report".

A project is classified as Category A if it is likely to have adverse environmental impacts that are irreversible, adverse or unprecedented. In the light of significance devoted by ADB to various environmental impacts, GTC is to be assigned Category A, wherein an EIA is required.

Main reasons to assign category A is that G T C expands over larger area having total length of main canal and distributaries of 450 km, which entails significant civil works to be carried out. The project may cause adverse impacts on local communities, drainage patterns, soil stability etc. Furthermore, the area is currently under rain-fed irrigation, and the proposed project could significantly alter the life of local population. Finally, land acquisition and some localized resettlement might be required.

During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the borrower/client will achieve whichever is more stringent.

Thus, a full EIA of the project has been conducted, through the following documents:-

- Updated EIA report including an updated EMP (this document);
- Land Acquisition &Resettlement Plan (LARP) for involuntarily relocation of the impacted villages and communities (companion document); and
- Initial Poverty & Social Assessment (IPSA) (companion document at the PPTA stage).

ADB's Safeguards Policy Statement 2009

ADB affirms that environmental and social sustainability is a cornerstone of economic growth and poverty reduction in Asia and the Pacific region. ADB's Strategy 2020 therefore emphasizes assisting Developing Member Countries (DMCs) to pursue environmentally sustainable and inclusive economic growth.

The objectives of ADB's safeguards are to:

- avoid adverse impacts of projects on the environment and affected people, where possible;
- minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- help borrowers/clients to strengthen their safeguard systems and develop the

capacity to manage environmental and social risks.

- ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:
- environmental safeguards;
- involuntary resettlement safeguards; and
- Indigenous Peoples safeguards.

To achieve the policy objectives and deliver the policy principles, ADB carries out the actions described in the subsection i.e. "B. Policy Delivery Process". To help borrowers/clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers/clients are required to meet in addressing environmental and social impacts and risks. ADB staff, through their due diligence, will review, supervise and ensure that borrowers/clients comply with these requirements during project preparation and implementation. These safeguard requirements are as follows:

Safeguard Requirements 1: Environment (*Appendix 2 of SPS, 2009*);
Safeguard Requirements 2: Involuntary Resettlement (*Appendix 3 of SPS, 2009*);
Safeguard Requirements 3: Indigenous Peoples (*Appendix 4 of SPS, 2009*); and
Safeguard Requirements 4: Special Requirements for Different Finance Modalities (*Appendix 5 of SPS, 2009*).

The GTC will need to comply with all the ADB's Safeguard Policies in all aspects and activities i.e. for the subproject as well, irrespective of whether or not they are being funded in whole or in part by the ADB, the GoP, or any other donor. A brief synopsis of these policies and their relevance for the proposed project is given in the Table 7**.**

Table 7: ADB Safeguard Policies 2009 Relevant to project

Sr. No.	Safeguard Policies	Key Requirements	Remarks
1.	**Environment**	Projects and subprojects need EIA to address important issues not covered by any applicable regional or sectoral EA.	Applicable to proposed project.BWRDP categorized A for environment
2.	**Involuntary Resettlement**	Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs. Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher	As of now, involuntary resettlement is not envisaged for the proposed project and LARP is under preparation.
3.	**Indigenous Peoples**	Measures to avoid potentially adverse effects on the Indigenous People's communities; and when avoidance is not feasible, minimize, mitigate, or compensate for such effects. Bank-financed projects are also designed to ensure that the	As per the ADB definition, there are no groups of people in the project area who could be categorized as indigenous people,

		Indigenous Peoples receive social and economic benefits that are culturally appropriate and gender and inter generationally inclusive.	therefore this policy does not apply to the proposed project.

3.5. International Protocol/Conventions

As Pakistan is a member of a number of international organizations such as United Nations Organization (UNO), Organization of the Islamic Conference (OIC), South Asian Association for Regional Cooperation (SAARC), Economic Cooperation Organization (ECO) etc., so it has to follow the international protocols and obligations related to the environment. The major protocols, ratification dates by Pakistan and obligations related to the proposed project are given in Table 8

Table 8: International Agreements/Conventions Relevant to the Project

Sr. No	Agreement/Convention	Ratification	Description/Relevance
1.	**Convention on Biological Diversity, 1994** Web Link: https://www.cbd.int/	Pakistan signed this treaty in 1992 and it was ratified by cabinet in 1994.	The Convention on the Biological Diversity (CBD) has three main goals: Conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources. The law is relevant as CBC is proposed intervention on natural resource management and it is in natural habitats/game reserve in project AOI
2.	**The Rio Declaration, 1992** Web Link: http://www.unep.org/documents. multilingual /default.asp? documented =78 & articled = 1163	Pakistan signed the treaty on 13 Jun 1992 and ratified on 1 June 1994	The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the earth's ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption. The law is relevant as G T C has been proposed with a focus on protection of natural environment.
3.	**Kyoto Protocol, 1992** Web Link: http://unfccc.int/kyoto_protocol/items/ 2830.php	Pakistan has ratified Kyoto Protocol in 2005	The Kyoto Protocol is a protocol to reduce Greenhouse gasses that cause climate change. It was agreed on 11th December, 1997 at the 3rd Conference of the countries to the treaty when they met in Kyoto, and entered into force on 16th February, 2005. As of November 2007, 175 countries have ratified the protocol. One hundred and thirty seven (137) developing countries have ratified the

			protocol, including Brazil, China, India and Pakistan but have no obligation beyond monitoring and reporting emissions.
			GTC has been proposed with an objective to fulfill the protocol by putting no change to climate.
4.	**Stockholm Convention on Persistent Organic Pollutants (POPs), 2004** Web Link: http://chm.pops.int/TheConvention/Overview/tabid/3351/	The Stockholm Convention on Persistent Organic Pollutants was signed on 22 May 2001 and entered in to force on 17 May, 2004. Pakistan signed the convention on December 6, 2001	Convention seeks to protect human health and the environment from POPs as set out in Article 1, which are chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife. The law would be relevant at later stages of GTCII due to increase in agricultural activities and use of pesticides.
5.	**UN Convention to Combat Desertification (UNCCD), 1994** Web Link: http://www.unccd.int/en/Pages/ default.aspx	Pakistan signed the Convention on 15th October 1994 and ratified it on 24 February, 1997	The UNCCD is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements. With implementation of GTC, major portion of barren land would come under cultivation.
6.	**Convention on the International Trade of Endangered Species (CITES), 1975** Web Link: https://www.cites.org/	Pakistan signed the Convention in 1973 and ratified it in April 1976.	The convention entered in to force on 1 July 1975. The principal obligations of contracting parties to the CITES are to safeguard the trade in rare or endangered species and it established a permit system to control imports and exports of wild fauna and flora. According to this convention species threatened with extinction whose movement between countries is prohibited except for conservation purposes such as captive breeding, species whose commercial trade is permitted but export permits are needed. GTC AOI provides natural route and habitat for migratory species. During implementation of GTC, construction camps would be established nearby the game reserve.
7.	**UNESCO Convention on the Protection of the World's Cultural and Natural Heritage, 1972** Web Link: http://whc.unesco.org/en/ convention text/	Pakistan ratified this convention on 23 July 1976.	Convention concerning the Protection of the World Cultural and Natural Heritage - requires parties to adopt a general policy on the protection of the natural and cultural heritage, to set up services for such protection, to develop scientific and technical studies, to take appropriate legal, technical, scientific and administrative measures and to

			foster training and education for such protection. GTC design and EIA team paid due attention to archaeological sites and local norms. Both of these factors will also be considered During implementation of GTC.

Comparison of International and Local Environmental Legislations

The ADB's SPS 2009 requires application of pollution prevention and control technologies and consistency with international good practice, as reflected in internationally recognized standards. The SPS states that when host country regulations differ from these standards, the EA will achieve whichever is more stringent.

In order to select the most stringent standards applicable, a comparison of local (PEQS) and international i.e. International Financing Corporation (IFC)/ World Health Organization (WHO) and United States Environmental Protection Agency (USEPA) regulations have been made, as shown in Table 9 below. For air quality, comparison was only possible for pollutants having same averaging periods in PEQS, IFC and WHO. PEQS for ambient air quality are more stringent in comparison to USEPA and WHO/IFC standards, in the case of most pollutants. The applicable and most stringent parameters for each respective pollutant are highlighted in yellow.

Similar to the standards for air quality, the comparison of noise standards provided Table 10 clearly shows that PEQS for noise are more stringent in comparison to the WHO/IFC standards. The only exception is the daytime noise level standard for Industrial areas where the WHO/IFC standard is more stringent (70 dB(A)) in comparison to PEQS (75 dB(A)) and so for this particular parameter, the WHO/IFC standard will be used.

As far as regulations regarding other environmental parameters are concerned such as acceptable effluent disposal parameters, the local regulations i.e. PEQS are more stringent and would be preferred over any other international regulations such as WHO/IFC.

Table 9: Comparison of International and Local Air Quality Standards

Pollutants	USEPA		WHO/IFC		PEQS	
	Avg.Time	**Standard**	**Avg.Time**	**Standard**	**Avg.Time**	**Standard**
SO_2	3 hrs 1 hr	0.5 ppm 75 ppb	24 hr 10 min	125 µg/m³ (IT-1*) 500 µg/m³	Annual Mean 24 hr	80 µg/m³ 120 µg/m³
CO	8 hrs 1 hr	9 ppm (11 mg/m³) 35 ppm (43 mg/m³)	-	-	8 hrs 1 hr	5 mg/m³ 10 mg/m³
NO_2	Annual Mean 1 hr	100 µg/m³ (53 ppb) (100 ppb)	1 yr 1 hr	40 µg/m³ 200 µg/m³	Annual Mean 24 hrs	40 µg/m³ 80 µg/m³
O_3	8 hrs	0.07 ppm (148 40 µg/m³)	8 hrs	100 µg/m³	1 hr	130 µg/m³
PM_{10}	24 hrs	150 µg/m³	1 yr 24 hr	70 µg/m³ (IT-1*) 150 µg/m³ (IT-1*)	Annual Mean 24 hrs	120 µg/m³ 150 µg/m³
PM_{25}	Annual Mean	15 µg/m³	1 yr	35 µg/m³	Annual Average	15 µg/m³

	24 hrs	35 µg/m^3	24 hr	75 µg/m^3	(IT-1*) 24 hrs (IT-1*) 1 hr	35 µg/m3 15 µg/m^3

*IT- 1 as specified by WHO=AQG, 2005

Table 10 Comparison of International and Local Noise Standards

Category of Area/Zone	**Limit in dB(A) Leq**			
	PEQS		**WHO/IFC**	
	Day Time	**Night Time**	**Day Time**	**Night Time**
Residential area (A)	55	45	55	45
Commercial Area (B)	65	55	70	70
Industrial Area (C)	75	65	70	70
Silence Zone (D)	50	45	55	45

4 ANALYSIS OF ALTERNATIVES

This chapter intends to present the justification and feasibility of the selected sub- project scheme among a total of 5 sub-project schemes. Furthermore, this chapter intends to present the different alternatives considered by the team design for the particular Sri-Toi Water Storage Dam and irrigation system.

4.1 No Project Alternative

The Project Area can be considered as poor from an economic perspective. Subsistence farming is the economic mainstay. In case the proposed project is not implemented, the socio-economic conditions will not change as such. With the increasing population and scarcity of resources, residents are forced to abandon their homes in search of livelihood and grazing grounds for their cattle stock.

From the environmental perspective, the project site comprising of dam pondage area as well as irrigation channel and proposed land for irrigation are arid in nature having little or no rain and too dry to support vegetation. Water availability is scare in area hence the proposed project will contribute positively to the project area.

4.2 Sub-Projects Alternative

Based on the five stages selection process, the following five sub-projects, valued at US$ 51.92 million were selected for pre-feasibility study:

- Ahmedzai Perennial and Floodwater Irrigation
- Sabakzai Dam Irrigation Project
- Sri Toi Water Storage Dam and Irrigation
- Killi Sardar Akhter - Perennial and Floodwater Irrigation

Sri-Toi water storage dam, valued at US$ 31.94 million was selected as the Core Sub- project from the selected five sub-projects. Feasibility and engineering design are being carried out for the selected core sub-project, and will be duly submitted in a subsequent report.

The summary of the pre-feasibility results at the basin level are presented in the following sections.

The available water at the sub-project level estimated using the catchment area in the Arc SWAT Model is given in **Table 11.**

Table 11 Water Available for Potential Sub-projects in Zhob River Basin

No	Sub-project Name	Surface Water Availability (MCM)
1	Ahmedzai Perennial and Floodwater Irrigation	7.41
2	Sabakzai Dam Irrigation Project	18.1
3	Sri Toi Water Storage Dam and Irrigation	34.71
4	Killi Sardar Akhter - Perennial and Floodwater Irrigation	2.94

It is evident that the potential for water availability at Sri Toi Dam Sub project is greater than the remaining sub-projects.

Command area development has been included as an integral part of all sub-projects which includes: a) watercourse improvement and lining; b) precision land levelling; c) farm and field layout using surface irrigation hydraulics; d) Katcha tracks for disposal of produce; e) service and supply providers and strengthening; f) productivity enhancement demonstrations; and g) social organization and capacity building of male and women organizations.

Watershed development activities under a sub-project included development of earthen micro-catchments (eyebrow terraces), digging of pits, addition of compost, and termite treatment and plantation of timber/forest/arid fruits trees, shrubs and grasses. In steep slope areas, the eyebrows will be strengthened using loose stones. As far as possible, the check structures and gabion structures must be avoided and only incorporated in critical locations. The proposed and existing command areas in the selected sub-projects are given in Table 12

Table 12: Land use wise area under five sub-projects of Zhob River Basin

S. No.	Sub-Project	Improved Irrigated Commands		Watershed Area	Khushkaba Area	Total Area
		New	Existing			
1	Ahmed Zai Perennial and Flood Irrigation	180	427	52	200	859
2	Sabakzai Dam Irrigation Project	0	3,000	350	0	3,350
3	**Sri Toi Water Dam Irrigation**	**4,027**	**0**	**400**	**361**	**4,788**
4	Killi Sardar Akhter Perennial Irrigation	0	230	22	0	252
5	Improvement of Farmers' Managed Irrigation	0	4,370	0	0	4,370
Total		**4,207**	**8,027**	**824**	**561**	**13,619**

The bold section demonstrates that the Sri Toi Water Dam and Irrigation System will provide the most benefits in comparison to other sub projects.

It is expected that in the command area of sub-projects, cropping intensity of 120 percent would be achieved within initial 2-3 years after the operation of the irrigation sub- project.

4.3 Economic and Financial Justification

Among the selected sub-projects, **SRI TOI WATER STORAGE DAM**_had highest annual Net Value Production (NVP) as compared to the other sub-projects in the Zhob river basin largely because of the larger command area. However, the beneficiaries are reduced by one-half to one-third due to higher unit cost per hectare.

Detailed economic analysis is presented in Table 13 and Table 14.

Table 13 Cost of development of sub-projects in Zhob river basin sub-projects

Sub-Project	Cost (Rs. In million)						
	Infrastructure	Command Area Development	Watershed and Groundwater	Khushkaba Farming	Gender	Capacity Development	TOTAL
Ahmedzai Perennial and Floodwater Irrigation	183	25	4	15	5	5	236
Sabakzai Dam Irrigation Project	490	75	25	74	5	5	673
Sri Toi Water Storage Dam Irrigation	2,970	79	280	15	5	5	5,445
Killi Sardar Akhter Perennial Irrigation	83	13	2	-	5	5	108

Farmers Managed Irrigation Sub-Projects Improvement							525
Total	**3,726**	**192**	**311**	**104**	**20**	**20**	**6,987**

It is evident from the above figure that the cost of development of Sri Toi Project is the most at Rs. 5,445 Million followed by Sabakzai Dam Irrigation Project, Farmers Managed Irrigation Sub-Projects Improvement, Ahmedzai Perennial and Floodwater Irrigation and Killi Sardar Akhter Perennial Irrigation.

Table 14 Economic analysis of selected sub-projects

S. No.	Sub-Project	Cost/ha (Million Rs. /ha)	Benefit-Cost Ratio	NVP (Million Rs.)	FIRR (%)	EIRR (%)
1	Ahmedzai Perennial and Floodwater Irrigation	0.28	1.38	82.10	17.59	18.48
2	Sabakzai Command Area Development	0.20	1.10	290.30	12.83	14.46
3	Sri Toi Water Storage Dam Irrigation	0.70	1.50	901.50	15.33	16.27
4	Killi Sardar Akhter Perennial Irrigation	0.43	1.21	31.30	16.29	16.63

The preliminary cost estimates were prepared for Sri Toi Dam's infrastructure works including source development and irrigation network, command area development, watershed management and groundwater recharge, Khushkaba farming development, gender development and service/supply providers capacity development works and summarized in **Table 15.**

Table 15 Estimated cost and target of selected sub-projects in Zhob river basin

S. No.	Sub-Project	Estimated Cost (Million $)	New Command Area (ha)	Improved Command Area (ha)	Number of Households
1	Sri Toi Water Storage Dam Irrigation	51.8	4,027	-	853
2	Farmers Managed Irrigation Sub-Projects Improvement	4.47		4,370	1500

4.4 Justification of Dam Design at Sri Toi

Table 16 below provides comparison of alternatives with respect to design of different irrigation schemes:

Table 16 Comparative analysis of different irrigation schemes

OptionReasons for selection/Rejection	
	Since perennial flow is available at Sri Toi, initially a weir diverting water to
Perennial and Flood Irrigation Scheme (PIS+FIS)	**Infiltration Gallery**

frequently in this area and the floodwater cannot be reliably utilized for the design command area without proposing a storage structure. Therefore, this option was abandoned.

a flood and perennial channel was considered as an economical option. However, the river has subsurface flow during few months which cannot be intercepted through construction of a weir during low flow seasons. Furthermore, flash floods occur

As a second design alternative, an infiltration gallery was considered. But the abundant surface water particularly during high flow seasons and in floods will pass un-utilized and the total command area would be significantly reduced. The topography of the area is very mild therefore; the conveyance conduit from the infiltration gallery would lose a huge patch of cultivable land till the daylight point. Therefore, this option was also not selected.

The option of three small cascade dams was also considered. Each dam was set 15 meters high. The combined area capacity curve of these dams was developed. It showed that the combined storage of only 1 MCM which is negligible as compared to the proposed dam of 36.5 MCM. Since, this option was not able to fulfil the requirements of command area, therefore, it was also not considered.

A storage dam was evaluated as the best option based on the project location hydrology, topography and available land. A dam will fulfill all the necessary requirements to utilize the potential of the area which include; storage of flood water for reliable perennial irrigation, protection of command area from severe floods, maximum utilization of area for command area development. Several options and axes where compared for the most optimum dam configuration which also included cascades of three 15-m high dam. However, the final selected option is a single 66-m high earthfill dam with one dyke and an overflow spillway. The details of the selected option are discussed below:

4.5 Justification of Dam Location at Sri Toi

Selection of dam axis: The dam axis has been selected after reviewing the general topography of the area through site visits and analysis of satellite based imagery and terrain. The selected dam axis has sound rock on both abutments. The foundation geology will be confirmed through geotechnical investigation currently in progress by the design team through boreholes along the axis to verify the selection.

At the proposed axis, a dam with considerable storage would be constructed. The dam crest length is nearly 231 m with two additional dykes. This option was selected because of its adequate storage capacity of 36.5 MCM and overall project economics.
Two alternate options were also considered for the dam axis. One option is upstream of the selected dam axis. This option would require additional dykes with lesser storage capacity of 25 MCM, which will not fulfil the requirement of command area.
The residents of Sri Toi are mainly depending on agriculture and livestock. They rely on traditional irrigation techniques like sailaba and khushkaba. The supply of water is not assured in these systems. The construction will provide perennial water to the command area. The perennial supply of water will enable the farmers to grow not only seasonal crops but also fruits which are suitable to regional climatic conditions.

4.6 Justification with respect to Environment

An **embankment dam** is created by the placement and compaction of a complex semi-plastic mound of various compositions of soil, sand, clay, or rock. It has a semi-pervious waterproof natural covering for its surface and a dense, impervious core. This makes such a dam impervious to surface or seepage erosion.[1]
Earthen Dam or Earth-filled dam is a type of Embankment dam that is made of compacted earth. Most have a central section of an impermeable material to stop water from seeping through the dam. Such dams are a good choice at sites with wide valleys and can be built on hard rock or softer soils. The geotechnical investigation for dam foundation at the site will confirm the availability of hard rock as foundation and hence the structural stability of the infrastructure. Preliminary Stability Analysis of the Dam has been carried out. Once the geotechnical investigation results in the form of borelogs are made available to the design team, a final Stability Analysis will be checked.
Since the tributary is ephemeral in nature i.e. lasting for a short period after rains, the proposed project aims to elongate time frame and in due course the water storage dam would support ecology in longer time span. The construction of dam will change land use of the project site. Presently the project site is a barren land with low to no vegetation, shrubs or non- migratory ecology species. The terrain is laid with large sized boulders to fine silt. The provision of pondage area will store water and ensure water is available for irrigation purposes to the adjacent villages for a longer period of time in a year. The unlined irrigation canals would recharge ground water.
Since this tributary is ephemeral in nature, there will not be any fragmentation / compartmentalization of environment up-stream or down-stream of the tributary.

4.7 Justification of Design as Earthen Dam

Siltation is a major issue for all dams. The rate of sedimentation in Balochistan is relatively high as compared to other parts of the country. Sedimentation Analysis has been carried out by the design team.

[1] "Dam Basics". PBS. http://www.pbs.org/wgbh/buildingbig/dam/basics.html#emb

The result of this calculation is given as follows:

Table 17: Dam Sedimentation Analysis

S.No.	Description	Condition	Result	
			(MCM)	(acre-feet)
1	Gross Storage	Ungated	36.49	29579
2	Dead Storage		6.49	5261
3	Live Storage	Ungated	30	24318
4	Total Depletion of Dead Storage			10 Years
5	Life of the Dam			80 Years

It has been estimated that the dead storage capacity that will deplete in the **early 10 years** which is computed as **6.49 MCM (5,216 acre-ft)**. The annual sediment load has been computed as **0.901 Million Short Tons (MST)**. The life of the dam has been estimated as approximately **80 years.**

The provision of multi-level intakes for this dam is proposed. This design provision will allow inclusion of multiple gates at different levels. In case of silt deposition at the lower level, middle and higher-level intakes will be functional. The factor of silt deposition is considered during the dam life of 80 years.

The design life of the proposed Earth Dam is taken as 80 years with due considerations to reservoir sedimentation and provision of multi-level intakes for this dam. Provisions of chimney and horizontal filter are considered to counter the piping erosion effect of water through the dam embankment.

Selection of the dam type as discussed above for any particular site is primarily governed by the foundation conditions and availability of construction material. The geology and foundation conditions at the dam site usually dictate the type of dam suitable for that site. Competent rock foundations with relatively high shear strength and resistance to erosion and seepage offer few restrictions to select the type of dam that can be built at any site.

Geo-technical studies have been carried out at the Sri Toi site to analyze the conditions and quality of bedrock for dam foundation and abutments. The boreholes at the dam axis represent alluvium deposits of 3-4 m deep. The rock cores obtained at the dam axis are assigned values based on Core Recovery percentage (CR %) and Rock Quality Designation (RQD) during geotechnical investigation which are used to decide the dam type based on foundation conditions. After the completion of geotechnical investigation following four alternate types of dam have been analyzed for the selection of dam. These alternate options are:

A clay core earthfill dam has been preferred over other options for the following reasons:

- The concrete faced rockfill dam has advantages over clay core earthfill dam only where:

  a) earthfill material is not readily available,
  b) rainfall is high,
  c) extensive grouting is required and
  d) excessive settlements are not expected.

- These conditions do not exist at Sri Toi dam site:

  1. At Sri Toi, the narrow river valley and moderately hard foundation makes the selection of a rigid type concrete gravity dam a workable option. However, geotechnical investigation carried out identified the presence of horizontally layered alternate strata of fractured and weak strength shale indicating that concrete dam is not favorable due to chances of settlement.

2. Materials for the construction of a clay core earthfill dam are readily available in the vicinity of the proposed dam site. Judicious use of material from excavations such as from spillway, intake and outlet structure will be used as dam fill material in designated embankment zones. The bulk quantities of sandy gravel and sandstone obtained from excavations will be effectively used to provide stabilizing zones on both upstream and downstream shoulders of the embankment dam. Sand available in the riverbed may be utilized as fine filter and gravels which will be used in drainage blankets. The coarse filter, gravel and rip-rap may economically be obtained from nearby borrow areas. On the other hand, the cost of concrete or suitable rock construction in the area is high.

3. Requisite level of expertise has not been achieved by the local contractors yet. Only few major concrete face rock fill dams have been constructed in the country. On the other hand, numerous clay core earthfill dams have been constructed in the country. Local contractors possess necessary expertise for this type of dam construction. Therefore, it has been proposed that the central clay core will be acting as an impervious barrier in the dam body.

4. Packer test has been carried out to determine rock permeability and expected dam Underseepage. The water tightness of dam foundation can be achieved by taking the clay core or cutoff down to the impervious bedrock. Furthermore, adequate level of grouting will be performed in the fractured rock based on the rock lugeon value and other geotechnical test results.

4.8 Alternate Analysis of other two Core Sub-Projects

a) Project Need and Justification

Karkh

Karkh Subproject includes the extension of lined channels, repair and raising of existing weirs, cleaning of grass and weeds along the river way and channels, extension of flood protection bund to protect a command area of 2,250 ha.

This subproject will help to meet the project target for improvement of 20,000 ha existing irrigation lands. All of the six selected schemes are located on main Karkh River.

Kharzan-Hatachi Infiltration Gallery

Although Kharzan is already receiving its required irrigation water, but there is conflict on the water use among the two villages (Kharzan and Hatachi). Construction of the infiltration galleries for each village will resolve this issue.

Furthermore, as Hatachi is downstream of Kharzan Village it receives irrigation water only when the water requirement of Kharzan has been met by Mula River flow. This causes an unreliable situation of irrigation supplies in Hatachi.

The existing off-take well, constructed under BCIAP (1997) is dysfunctional since the last major flood in 2005. Presently, flow from Mula River is being diverted through a temporary arrangement to Kharzan and onwards to Hatachi. The system has a low capacity and fails to fulfill the irrigation water requirements of both villages.

This project will assure water supplies to 575ha existing commands, and also adding 106 ha new command area in Hatachi, Flood protection for Kharzan and Hatachi villages with proper distribution of readily available water with little investment and optimum productivity.

Owing to the above argument, conceptual plans were developed for determining the feasibility of the subprojects. During the pre-feasibility stage phase in the project cycle

several alternatives were evaluated. Following alternatives were discussed to finalize the conceptual design of the subprojects:

b) No Project Alternative

Six weirs at Karkh River

Weirs at the Karkh River were constructed over 20 years ago and have been operating successfully over the passage of time. The lack of maintenance has damaged the existing infrastructure and have become useless for irrigation works.

Due to this reason, the existing command area will reduce and cause a decline in the socio-economic aspect of the 6 villages at Karkh Rriver.

Hatachi - Kharzan Infiltration Gallery

An intake structure and water channel has been constructed about 20 years ago with protection wall of gabion. Over the years, some part of gabion wall has been damaged due to flood flows in the Mula River. The intake structure is damaged and not supplying water to the supply channel. Absence of proper flow diversion structure restricts the villagers to use the perennial flow and is adversely affecting the irrigation capability of the command area.

c) Alternatives Interventions at Karkh River

Weirs at the Karkh River were constructed over 20 years ago and have been operating successfully over the passage of time. The lack of maintenance has damaged the existing infrastructure and have become useless for irrigation works. The rehabilitation of existing structures with minor additional works and cleaning of weeds is proposed because of its success in the past. Therefore, alternative analysis of Karkh River interventions is not carried out. Minor additional works at all the six locations have been proposed as following:

- Irrigation network rehabilitation and lining
- Extension of flood protection bund
- Rehabilitation of Chutta weir i.e. The upstream cutoff wall of the existing weir at Chutta is damaged. The computed upstream and downstream cutoff wall is 2 m deep from the structure's base which will be rehabilitated.
- Construction of weir at Jhalaro

As discussed in para 122 that Karkh River intervention mainly focused on rehabilitation works therefore alternative analysis is not required. However, at Jhalaro a new weir is to be constructed consequently the alternative analysis for the same is required. Table 18 below provides comparison of alternatives with respect to design:

Table 18 Comparison of Alternatives for Jhalaro

Sr. No.	Option	Reasons for selection/Rejection
1	Offtake well	Since, the perennial flow is available at Jhalaro, offtake well is considered as the most economical option. However, the river axis is very wide and the active streams change their path after every flood. It was assumed that the offtake well would be left abandoned after one of two years. Therefore, this option was not selected.
2	Infiltra-tion	As a second design estimate, infiltration gallery was considered as most economical head regulator to irrigate the command area of Jhalaro Village. But the topography of the area is very mild. The conveyance conduit from the infiltration gallery would lost a huge patch of cultivable land till the daylight point. Therefore, this option was also not selected.

3	**Weir**	The surface flow is available at Jhalaro. Therefore, construction of weir was considered as the best option. The weir would create the required head which can divert the water to the command area. To save the cost, the material of the weir is replaced from concrete to gabion.

Comparison of alternative as mentioned in Table 18 shows that the infiltration gallery is the best alternative with respect to availability of water for the whole year.

Interventions at Mulla River (Hatachi - Kharzan Infiltration Gallery)

Alternatives

The following two options were considered at Hatachi-Kharzan:

- A water intake structure, as head works, with proper flood protection works for canal system and lining the entire water channel to the command area including drainage structures.
- An infiltration gallery along with lined irrigation channel up to the command area.

It was duly noted during field investigations that the surface water would not be available during the entire year however the subsurface water (river back flow) is available all year round hence the selection of an Infiltration gallery across the entire river bed has been proposed.

The objective of the project is to provide more irrigation water to the existing and available command area in Kharzan and Hatachi Villages.

The subproject will also provide with the protection bund along some reaches of command area to preserve it from flood water. The provision of permanent infrastructure will improve system efficiency by reducing losses and conveyance times between the source and outlets. Availability of water round the year will increase productivity of the area and enhance income generation activities in the area.

Table 19 below provides comparison of alternatives with respect to cost, design and environment:

Table 19: Comparison of Alternatives

Parameters	Weir	Infiltration Gallery
Cost	700 Million PKR	535.4 Million PKR
Design	Weir can only be operateable during surface flow of river.	Infiltration gallery can provide water to agricultural field around the year
Perceived Environmental Impacts	Soil erosion, loss of natural vegetation, deployment of external labor force.	Soil erosion, loss of natural vegetation, deployment of external labor force.

Comparison of alternative as mentioned in Table 19 shows that the infiltration gallery is the best alternative with respect to cost and availability of water for whole year.

6 DESCRIPTION OF ENVIRONMENT

Balochistan comprises about 44% of the total land area of Pakistan. Out of the total geographical area of 34.72 million ha, only 17.16 million ha are reported. The reported area is classified as rangelands, agricultural lands, forests, barren and unproductive mountain slopes. There are 4.35 million ha under cultivation and reported forests and rest is used for grazing (productive and non-productive rangelands and barren lands). Mountains dominate the province, and valley floors and piedmont plains make up only 15% of the landscape. It is these two landforms on which most human settlements, farms, and roads are developed.

The proposed works of the Balochistan Water Resources Development Project will be carried out in the Zhob River Basin (ZRB) and Mula River Basin(MRB), which feature diverse physical and biological characteristics. These River Basins provide wide variety of biodiversity. Variations in physical features and climatic conditions have produced diverse landscapes, ecosystems and habitats that are important to the national and global heritage. As four Irrigation Schemes of Zhob River Basin are present in District Zhob and Fiver Irrigation Schenes of Mula River basin are present in district Khuzdar so baseline conditions have been described respectively.

The flora and fauna as well as their habitat are directly or indirectly threatened by human activities which lead to their degradation, displacement and, in most severe cases, even extinction.

6.1 Physical Environment

6.1.1 ZRB geophysical layout

Zhob means Oozing Water. Zhob is the 2nd oldest district of Balochistan Province after Quetta. It was given the status of District in 1890 and was named as Fort Sandeman in deference of Sir Robert Sandeman. The district was renamed as Zhob, by Zulfiqar Ali Bhutto, the then Prime Minister of Pakistan, in 1975. The district is located in the Northeast of provincial capital Quetta at a distance of 260 km (crow flight) and 320 Km (ground distance). Geographically the district lies between 67°48'41"-69°44'43" East longitudes and 30°26'54"-31°57'8" North latitudes. The total geographical area of the district, according to 1998 Census was 20297 Sq. Km until it was bifurcated into two districts, Zhob and Sherani. Presently the Geographical area of the district is 12400 sq. Km (District Development Profile 2011). For administrative purpose the district has been divided into Two Tehsils and 24 Union Councils.

Zhob district is situated in the extreme north-east of Balochistan province. Afghanistan lies to the north-west, while South Waziristan Agency (FATA) lies to the north of Zhob. The eastern boundary is marked by the Suleiman range and D.I. Khan district, Sherani District on North-east, Loralai and Musa Khel district border on the south and south west and Killa Saifullah district on the immediate west. Topographically, the district is covered with mountains and hills, which are intersected by broad valleys of Zhob River and its tributaries. The district lies between Toba Kakari Range and Suleman Range extend on Western and Eastern boundaries of the district, respectively. The lowest point of the district is 1500 meters above sea level. People live up to 2500 meters. The highest peak in the district is Takht-i-Suleiman (Solomon's throne) at 4000 meters.

6.1.2 MRB Geo-physical layout

District Khuzdar comprises various types of soil known as *matt, karkats, rikpoad, halli and sarah* in which mattis best and richest clay natured soil, consisting of silt washed down from the hills. *Karkat* is considered second best. It is harder, cracks when dry and requires breaking up after ploughing, and requires less water than *matt*. Both *matt* and *karkat* are suitable for spring crops and are found in Surab, Gidar, Pandran, parts of Baghwana, Tutak, Nal, Kalo, Karkh, Korask and Jan. *Rikpoad* is a light sandy soil found in Wadh. It is suitable for wheat, barley and *jaur* but the crops are considered substandard to those grown on *matt* or *karkat*. It is also well suited for melons, onions and vegetables. *Halli* is a gravely soil, found in the

irrigated areas of Surab and Khuzdar, on the skirts of hills and along the banks of rivers. It is suitable for vegetable but the crops cultivated on it are thin and need great care. Sorah or salt land is the lowest quality soil among all and is found in large tracts at Hisar, Zehri, Gidar, Nondrav valley and between Mir-na-Shaher and Bajoi in Baghwana.

6.1.3 Geology and Landform

The geological setting of Balochistan is characterized by zones of convergence and oblique faulting. In fact, Balochistan possesses unique place where the principles of plate tectonics, subduction, convergence collision, transformation can be studied. Tectonics of Balochistan is characterized by well-developed and exposed example of interaction of major fault systems in a regime of convergence where one type of fault terminates against another. The Chaman transform fault zone traverse the entire province interacts with the central Zhob and the Makran convergence zones. These fault systems are of direct relevance to hydro- geological control on groundwater reservoir (**Figure 3)**. In this context twenty-six important faults have been identified in the province

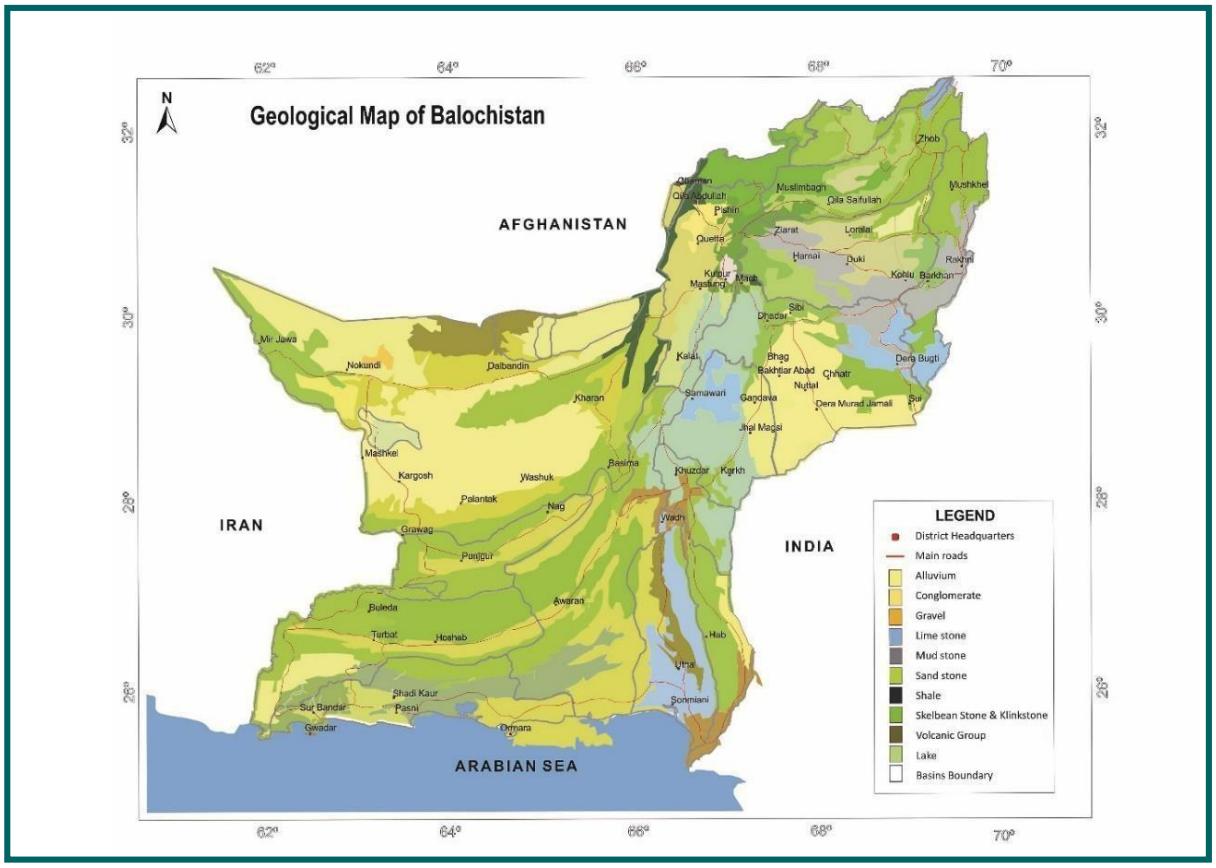
6.1.3.1 ZRB Geology and Landform

In terms of depositional basins, the province has been divided into five zones. The rocks exposed range from Perm carboniferous to recent age and are largely of sedimentary origin. Rocks of igneous origin predominate in parts of Zhob region in the north and of Lasbela region in the south. The sedimentary sequence is composed of calcareous and arenaceous rocks. Most of the sedimentary rocks stem from marine environment and others particularly in the south and south-western parts of the province are fluviatile, deltaic, littoral or paludal (swamp). No sedimentary rocks of deep origin are known and perhaps all the marine sediments were deposited in shallow waters.

Deposits of Aeolian origin are confined to surficial accumulation of sub-recent to recent age represented by the dunes and sandy tracts of the deserts. Glaciation is not marked in either the Pleistocene deposits or in the older strata.

Unconformities are common within certain well-defined zones. The unconformities individually are of small areal extent but collectively represent a shifting scene of emergence. Nearly the whole, if not all, of the interval of time from the late Palaeozoic to the Recent is represented by stratified rocks exposed in the province, but perhaps not in any individual, uninterrupted surface section.

Rocks of igneous origin occur in autochthonous and allochthoneous forms. Eruptive rocks of Chagai volcanic and Koh-e-Sultan are the product of the subduction process and the rocks of igneous origin exposed in Zhob, Bela axial belt and in Raskoh range are the ophiolites-allochthonous bodies of fragmented oceanic crust abducted on continental margin.



(Source: Geological Survey of Pakistan and ADB TA-4560 PAK, 2007)

Figure 6-1: Geological map of Balochistan, Pakistan

6.1.3.2 MRB Geology and landform

Geographically, Khuzdar District is mountainous consisting of numerous ridges and valleys of varying width. The important hill ranges are Jhalawan, Moda, Pab and Kirthar. Moola, Mosina, Nal and Kalachi are the main rivers in the district. Khuzdar city's elevation is about 1,237 meters above sea level.

6.2 Climate

Climatic variability, water management and economic development are intricately linked. Vulnerability to natural disasters affecting water supply hampers economic performance and undermines poverty reduction goals and achievement of the Millennium Development Goals (MDGs) (UNESCO 2012). Variation in temperature and rainfall may affect water availability, increase the frequency and intensity of floods and droughts, and disrupt ecosystems that maintain water quality (IPCC 2007a, b). IPCC has projected that productivity of rain fed agriculture could decrease by 50% by 2020. The understanding of the climate and variability of climatic parameters for an area is foremost important to precede for the hydrological outgrowth and watershed management strategies. The climatic parameters include temperature, precipitation, relative humidity, sunshine hours, wind speed etc. Amongst the aforementioned parameters, temperature and precipitation play vital role in analyzing the trend and variability of climate for proceeding with management practices.

The climate of Balochistan is generally arid (Rasul et al., 2012; Burke et al., 2005). The province can be divided into three broad climatic zones:

- Hyper-arid (<100 mm/year) - Chaghai, Makran coastal areas and south-east of Lasbela
- Arid (100-250 mm/year) - Northeast of Zhob, Loralai, Sibi, Kachhi, Lasbela plains,

and Pab-Mor ranges

Semi-arid (250 – 400 mm/year) - Suleiman ranges covering Toba Kakari area, Marri Bugti areas, and Pab Khirthar mountain ranges and Brahui ranges.

The climate of District Zhob is pleasant in summers and extreme cold in winters. In autumn season, the weather becomes very dry. Rainy season is mostly in the months of June, July and August accompanied by thunder storms from July to September as a result of diversion of monsoon winds westward from Punjab. The hilly areas at higher altitude receive heavy snow fall and snow storms during winters; however, dust storms blow in summer and winter.

ZRB and MRB Precipitation

Approximately 40% of average rainfall in eastern and southern Balochistan occurs in the months of July and August (monsoon dominated environments). However, less than 10% of average rainfall occurs in monsoon in western parts of the province (temperate climate regions). This makes rainfall dependability throughout upland Balochistan generally low (Rees et al., 1990).

In a report published by Pakistan' National Disaster Management Authority, Monsoon Season 2016 unfolded with five rain spells at regular intervals starting from 28 June to 16 September 2016(Table 20). As per Pakistan Meteorological Department (PMD), Monsoon 2016 remained 25% Above Normal against predicted rainfall of 10 - 20% Above Normal. During the month of August, rainfall was largely in excess across much of the Country while in July, the Country experienced slightly less rainfall

Table 20: Average Rainfall data for Zhob 2016

S. No.	Month 2016	UoM	Average Rainfall
1	January	mm	0
2	February	mm	0
3	March	mm	71
4	April	mm	46
5	May	mm	17
6	June	mm	9
7	July	mm	25
8	August	mm	40
9	September	mm	2
10	October	mm	0
11	November	mm	0
12	December	mm	0

Khuzar precipitation

Table 21Average rainfall data for Khuzdar 2016

S.No.	Month 2016	UoM	Average Rainfall
1	January	mm	0
2	February	mm	0
3	March	mm	66.7

4	April	mm	1.0
5	May	mm	2.1
6	June	mm	37.1
7	July	mm	37.6
8	August	mm	14.9
9	September	mm	37.0
10	October	mm	0
11	November	mm	0
12	December	mm	0

Source: Pakistan Meteorological Department

The Table 22**1** shows that March received the maximum rainfall in 2016, while June, July and September received approximately same amount of rainfall (around 37mm).

ZRB and MRB Temperature

The temperature regime in Balochistan is extremely variable and is directly related with the altitude. High altitude areas with cooler temperatures usually experience a mean annual temperature between 10°C to 18°C. Frost and snow prevail during winters. Low altitude temperate climate region has mean annual temperature between 18°C and 24°C. Tropical temperature dominates in the low mountain belt and low land facing the Arabian Sea with a mean annual temperature between 29°C and 37°C (Rees et al., 1990; Burke et al., 2005).

The Zhob province experiences frequent spells of droughts and occasional but torrential floods. Perennial rivers are rare in the region and life is mostly dependent on runoff farming (‘Khushkaba’) or Spate irrigation (flood water harvesting or ‘Sailaba’). Approximately 40% of irrigation water in Balochistan comes from the Indus River which irrigates only 5% of the province. This is because of rugged terrain and poor infrastructure. Average monthly temperature of Zhob and Khyzdar for 2016 is given in Table 22 and 23 respectively.

Table 22 Average Monthly Temperature for Zhob 2016

S. No.	Month 2016	UoM	Max. Temp.	Min. Temp.
1	January	°C	22	15
2	February	°C	28.5	-2
3	March	°C	29	4
4	April	°C	27	12.5
5	May	°C	30	15
6	June	°C	40	11.5
7	July	°C	40.5	19
8	August	°C	37.5	18
9	September	°C	37	17
10	October	°C	36	19
11	November	°C	27	10.5
12	December	°C	27.5	1

Khuzdar temperature

Table 23: Average Monthly Temperature for Khuzdar 2016

S.No.	Month 2016	UoM	Max temp	Min temp
1	January	°C	25.5	7.4
2	February	°C	22.4	6.9
3	March	°C	24.2	13.1
4	April	°C	28.1	18.5
5	May	°C	35.1	26
6	June	°C	38.8	20.4
7	July	°C	37.5	24.9
8	August	°C	34.6	24
9	September	°C	36.1	22.9
10	October	°C	35	21
11	November	°C	26.8	12
12	December	°C	25.8	8.2

Source: Pakistan Meteorological Department

6.3 Hydrology and Water resources

Floods and droughts are common phenomena in Balochistan. Droughts are more common and persistent than floods, but the flood damages are intense, affecting the provincial GDP adversely. The suggested approach for the management of droughts and floods is:

- **Floodwater** is a resource and it has to be managed to mitigate the impacts of drought. Management of floods would start from the watershed where improvements in landscape would result in enhanced recharging of groundwater and to provide additional livelihood sources to the watershed users. The excess floodwater can also be stored in a cascade of storage dams to carry and transfer water of a wet year to a relatively dry year.
- **Groundwater** is the only reliable source of water to mitigate the impacts of droughts on the rural economy, therefore recharge to groundwater and generating new shallow aquifers are essential elements of the suggested approach.
- **Diverting floodwater for spate irrigation and creating wetlands** wherever possible to initiate new and additional concepts of livelihood like aquatic food resources (fisheries and aquatic plants) and at the same time generating new shallow aquifers around the periphery of the wetlands demand innovative interventions.
- **Efficient use of water** to address impacts of drought on groundwater by adopting high-value and high-efficiency irrigated agriculture through the introduction of water productive cropping patterns ensuring higher profitability at the farm level.

6.3.1 Surface Water & Ground Water

Potential for Water Resources Development in Mula River Basin

A comprehensive study on 'Water Balance' was undertaken, which indicated that water resources of Mula river basin largely comprised of surface, groundwater and canal water from Indus basin irrigation system. The availability of surface water was estimated using ArcSWAT Model and comprised of internally generated runoff and base flow, as two components of surface water. Surface water and groundwater availability was assessed at sub-basin level using 50% probable rainfall because there was extremely high climatic variability in the

incident rainfall [for details see Report of the 'Water Balance Study']. For pre-feasibility, surface water availability was estimated for selected sub-projects. Balance water available in current scenario for Mula river basin was estimated and presented in Table 24. The balance water available for future development indicated that there is an ample potential available for water development in basin. However, groundwater is overdrawn in some of sub-basins especially in areas having access to national electric grid, whereas some of sub-basins still have potential for development of groundwater in non-grid areas.

Table 24 Balance water available in current scenario for Mula river basin

Water Resource	Surface Water (MCM)	Groundwater Recharge (MCM)
Internally generated surface water in the basin	305	108
Water allowance from Indus basin irrigation system	82	15
Total water availability	387	123
Water use of Mula river basin	134	168
Water use from Indus basin irrigation system	82	-
Total water use	216	168
Balance available for future development	171	-45

Water Availability of Potential Sub-Projects

Measured data is not available at points where water is to be diverted for meeting demand for sub-project. The surface water was estimated at a particular node of sub-project using catchment area as an input to Arc SWAT Model (Table 25).

Table 25 Surface water available for the potential sub-projects using ArcSWAT Model

No	Sub-project Name	Surface Water Availability for Sub-Projects (MCM)*
1	Manyalo, Raiko and Rind Ali PIS	105.77
2	Pashta Khan & Garambowad PIS	14.24
3	Balina Hassoi PIS	116.15
4	Kharzan Hatachi Infiltration Gallery	125.75
5	Bulbul FIS	2.05
6	Churri Infiltration Gallery	37.58
7	Jehan Bent PIS	134.34
8	Sehrki FIS	1.27
9	Shakrani FIS	1.5
10	Mishk Sarap Dam	3
11	Zebra PIS	142
12	Kandh PIS	142.50
13	Haddi PIS	142.67
14	Karkh	20

Water Required for Development of Sub-projects in BWRDP and Pipeline Sub-projects

Water required to irrigate new command area of 5 sub-projects was estimated as 15.2 MCM based on design cropping intensity of 120%. The current availability of surface water in pre-BWRDP scenario for future development of water in river basin is 171 MCM based on internally generated surface water and current utilization. The additional water required to irrigate new commands of five sub-projects is around 15.2 MCM, which is comprised of 6.9 MCM for Churri Sub-project, 2.9 MCM for Pashta Khan & Garambowad PIS, 0.8 MCM for Karakh River sub-project, 1 MCM for Kharzan Hatachi and 3.6 MCM for Manyalo Raiko Sub-project. Currently, no other water sector development project is under implementation in river basin besides Naulong dam, requiring 116.8 MCM of surface water to meet demand of command area using high efficiency surface irrigation systems. This results in balance of 85.6 MCM of surface water for future development of water in basin. Therefore, surplus water available to farmers in wet years would motivate farmers to increase

cropping intensity. Potential for future development in Mula River basin is presented in Table 26.

Table 26 Water balance of Mula river basin in post-BWRDP and post-pipeline sub-projects

Description	Estimated Water Availability (MCM)
Existing Scenario – Pre-BWRDP	
Estimated water availability in Mula river basin	305
Existing surface water use within Mula river basin	134
Existing balance of water in Pre-BWRDP scenario	171
Future Scenario – Post-BWRDP	
Water required for BWRDP sub-projects excluding existing uses	**15.2**
Potential for water development in post-BWRDP scenario	155.8
Future Scenario – Post-Naulong Dam	
Water required to irrigate the command area of Naulong Dam including existing uses	116.8
Existing water uses within the designed commands of Naulong dam	46.6
Water withdrawal from Mula river basin in post-BWRDP and post-Naulong dam scenario	219.4
Balance water available in Post-Naulong dam scenario	85.6

Current Water Balance of Zhob River Basin

Balance water available in current scenario for Zhob River basin is presented in

A comprehensive study on 'Water Balance' was undertaken in PPTA Assignment, which indicated that water resources of Zhob River basin largely comprised of surface and groundwater resources. The availability of surface water was estimated using ArcSWAT Model and comprised of internally generated runoff and base flow, as two components of surface water. Surface water and groundwater availability was assessed at sub-basin level using 50% probable rainfall because there was extremely high climatic variability in incident rainfall [*for details see Report of the 'Water Balance Study'*]. The surface water availability was estimated at level of sub-project.

Balance water available in current scenario for Zhob River basin was estimated and presented in Table 27. The balance water available for future development indicated that there is an ample potential available for water development in basin. However, groundwater is overdrawn in some of sub-basins especially in areas having access to national electric grid, whereas some of sub-basins still have potential for development of groundwater in non-grid areas.

Table 27: Balance water available in current scenario for Zhob River basin

Source of Water	Water availability (MCM)	Water Use (MCM)	Balance Water Available (MCM)
Surface Water	457	123	334
Groundwater	210	343	-133

Water Availability of Potential Sub-Projects

The available water at sub-project level estimated using catchment area in Arc SWAT Model is given inTable 28.

Table 28: Water available for potential sub-projects in Zhob river basin

No	Sub-project Name	Surface Water Availability (MCM)*
1	Badinzai Storage Dam	291.07
2	Ghazlai Multipurpose Storage Dam	4.92
3	Khatol Kot PIS	381.98
4	Killi Sardar Akhter - Perennial and Flood Irrigation	2.94
5	Kozh Kach Irrigation Sub-project	3.65
6	Manzaki Irrigation Subproject	7.60
7	Nawar Storage Dam and Irrigation	7.05
8	Sarob Flood Irrigation	1.74
9	Sharan Jogzai Storage Dam	2.34
10	Sri Toi Storage Dam and Irrigation	39.79
11	Waltoi Storage Dam	12.37
12	Ahmedzai Perennial and Flood Irrigation	7.41
13	Sabakzai Dam's Command Area Development	18.1
14	Brunj PIS	143.00
		Selected sub-projects

Water Required for Development of Sub-projects in BWRDP and Other Pipeline Sub-projects

Water required to irrigate new command area of selected four sub-projects was estimated around 33.11 MCM based on design cropping intensity of 120%. Other pipeline water storage dams in the basin are Khurasan, Gat Shalezai Gravity and Yasini. Water required to irrigate command areas of these three dams was estimated as 9 MCM. In the post-BWRDP scenario, as per water balance, surface water availability in the basin will be around 457 MCM and net withdrawal will be around 172 MCM. Therefore, balance water available in the post-BWRDP scenario will be around 284 MCM, which is sufficient for maintaining environmental flows and continue to contribute to the Gomal Zam dam, as the Zhob River is a trans-provincial river (Table 29).

Table 29 Water balance of Zhob River basin in post-BWRDP and post-pipeline sub-projects

Parameter	Water Availability/Use (MCM)
Water Available (surface)	457
Water use – Existing	123
Water use - sub-projects (proposed)	33.11
Water use – pipeline projects	9
Total W ater Use in post-BWRDP and post-pipeline Sub-projects	165.11
Net Water Available in post-BWRDP and post-pipelines Sub-projects	291.86

6.4 Seismology

The entire province of Balochistan lies in a seismically active region. The province has experienced devastating earthquakes in the past. A powerful earthquake with a magnitude of

7.0 on the Richter scale was recorded on May 31, 1935 and devastated Quetta town and resulting in 35,000 fatalities.Again, on the Nov 28th, 1945, an earthquake measuring 8.6 on the Richter scale hit Balochistan killing almost 4000 people.

A history of recorded earthquakes is attached as Annexure 17.

6.4.1 ZRB seismology

The seismic zoning map of Pakistan, indicates that the project area lies in the zone 3. This zone is classified as Moderate Damage Risk Zone which is liable to Medvedev– Sponheuer–Karnik scale (MSK) VII and also 7.8 on Modified Mercalli (MM) scale. The

Medvedev–Sponheuer–Karnik scale, also known as the MSK or MSK-64, is a macro seismic intensity scale used to evaluate the severity of ground shaking on the basis of observed The effects in an area of the earthquake occurrence. The updated Seismic Zoning Map of Pakistan is shown below as Figure 6-2.

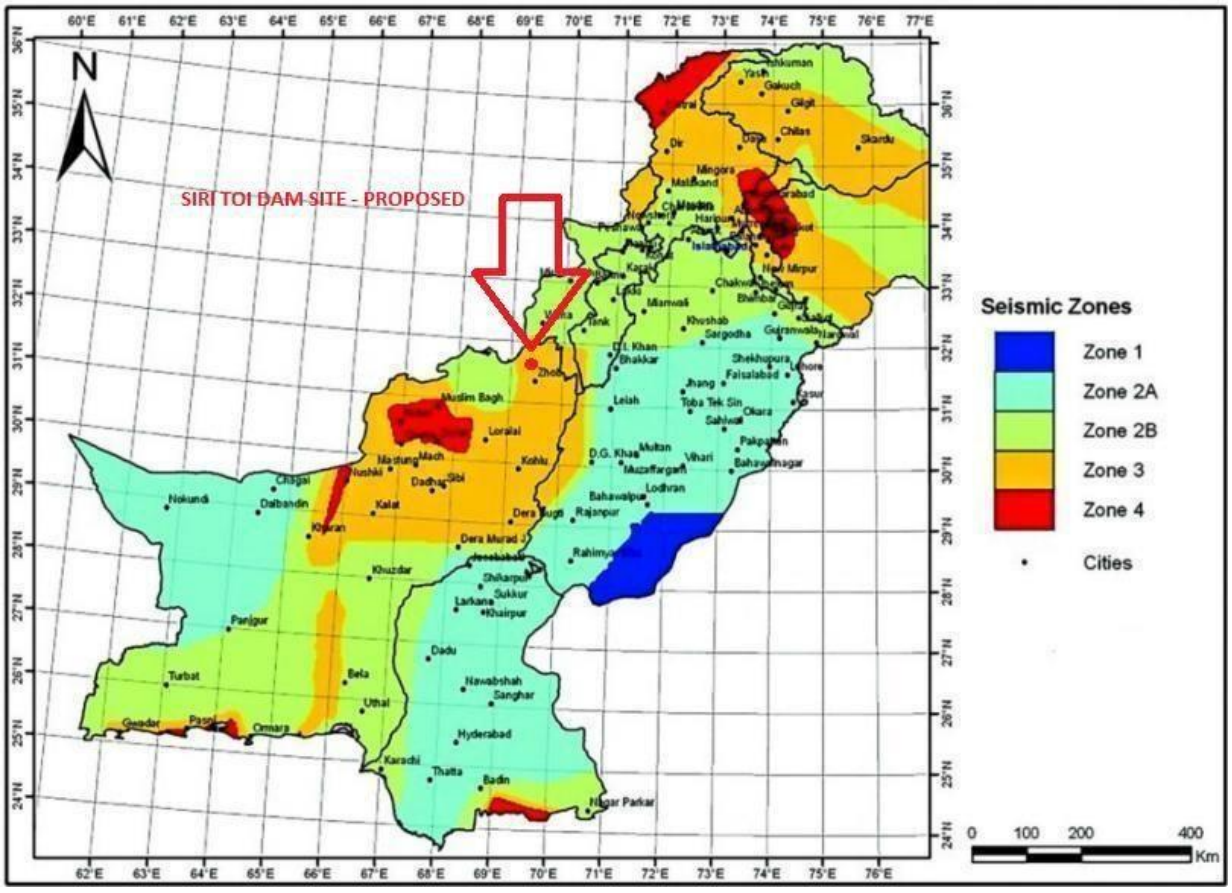


Figure 6-2: Seismic Zoning Map of Pakistan

6.4.2 **MRB Seismology**

The seismic zoning map of Pakistan, indicates that the project area lies in the **zone 2B**. This zone is liable to MSK VI or less and is classified as the Low Damage Risk Zone. The Medvedev–Sponheuer–Karnik scale, also known as the MSK or MSK-64, is a macroseismic intensity scale used to evaluate the severity of ground shaking on the basis of observed effects in an area of the earthquake occurrence. The updated Seismic Zoning Map of Pakistan is shown below as Figure 6-3

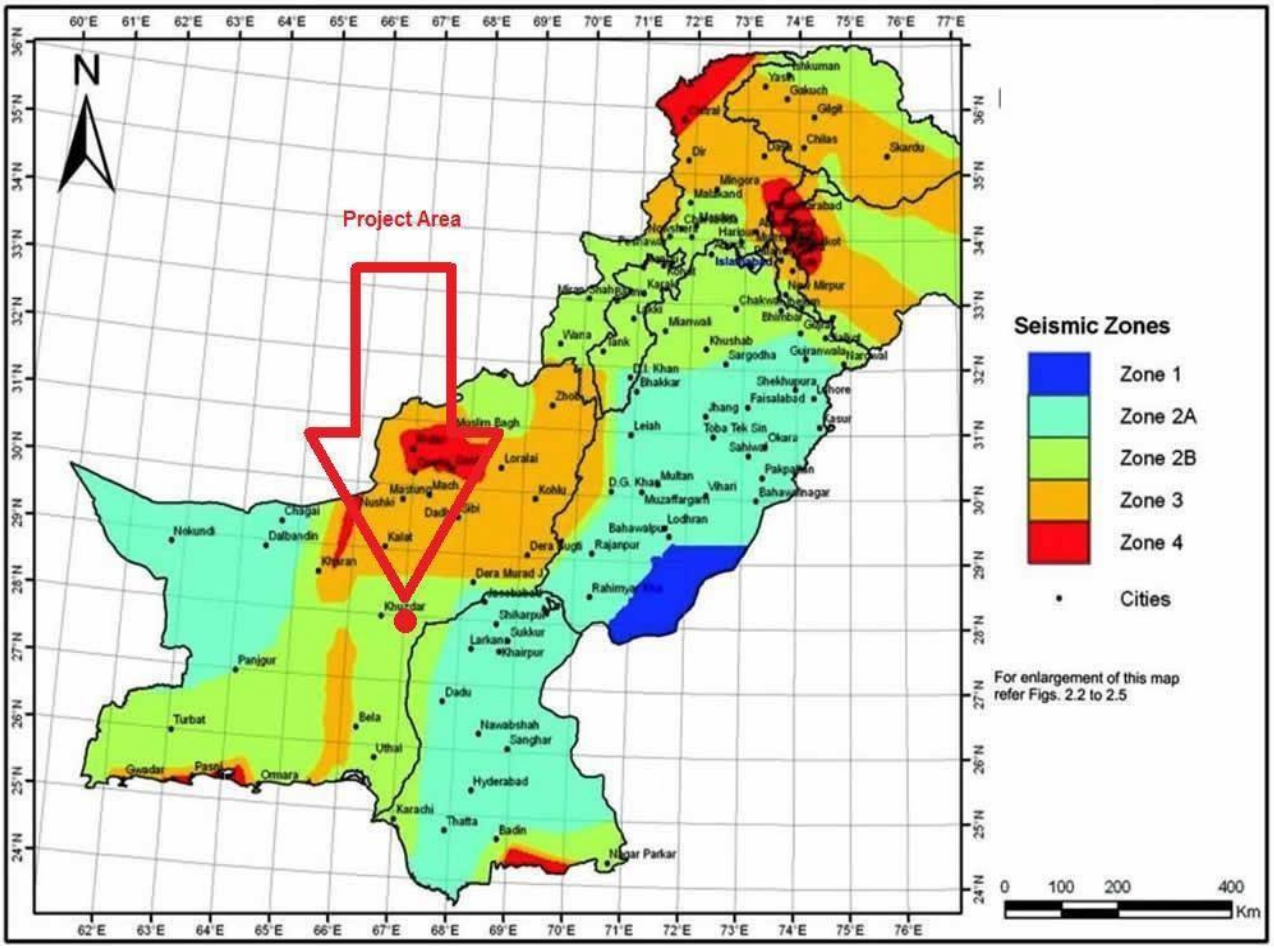


Figure 6-3: Seismic Zoning Map of Pakistan

6.5 Environmental baseline monitoring and Testing

Consultants have performed the instrumental monitoring to record baseline air quality, noise Levels, surface and ground water quality in order to assess the without project situation of such parameters in the project area. PEARC Research and Development foundation lab was hired for sampling and testing of ambient air, background noise levels, and water (groundwater and surface water). The field work for instrumental monitoring of the ambient air and background noise levels was done in the field while samples of the water (groundwater and surface water/ wastewater) were collected and preserved as per standard procedures and transported to the lab for testing. Instrumental environmental monitoring results carried out in winter are attached as Appendix 3

6.6 Environmental baseline monitoring of Sri Toi Dam

6.6.1 Water Quality

Water quality in Balochistan is variable. Surface water is generally favorable to marginal in case of Hingol river with an average TDS and pH of 159 mg/L and 7.16 indicating good quality for agriculture and for drinking. Also, TDS and pH in Karkh river were 640 mg/L and 7.75 indicating good quality. The groundwater quality in northern parts is generally better than in the southern part of Balochistan. Water samples from tubewells of Quetta division are fit to marginally fit for irrigation (Source: Idris M, Vegetable Seed Farm, Sariab). Groundwater quality in coastal parts has marine influence. The Agricultural Farm at Pasni near the bank of Shadikaur river has no other orchard except salinity tolerant date-palm trees, this is due to saline water having estuarine effect. Groundwater in Balochistan has generally high concentration of fluoride, iron and nitrate in many districts (Source: Shima M, Pakistan Council

of Research in water resources, Islamabad). In many cases the HCO_3 contents are much higher than maximum permissible limit of 244 mg/L for crops, this is because the ions leach out and dissolve in groundwater during weathering of rocks.

Groundwater quality as assessed from tubewell water, dugwells and water pumps was generally within permissible limits. However, Sri Toi Manda (surface) and tubewell (ground) waters showed high salinity. Although, no vast soil salinity was observed except in local patches, land levelling is essential to manage root zone salinity. In unlevelled field salts accumulate on high spots. The ground water quality is given in

Table 30.

Table 30 Summary of Ground Water Quality

S. No.	S Source of Water	pH	Soluble salts		Cations	Anions		RSC (meq L^{-1})	SAR
			EC (dSm^{-1})	TSS (mg kg^{-1})	Ca + Mg (meq L^{-1})	CO_3 (meq L^{-1})	HCO_3 (meq L^{-1})		
1	Sri Toi tube well (ground water)	7.9	1.55	1085	6.3	BDL	4.80	1.5	1.69

BDL=Below Detection Level

Surface water stored in depressions during field visits was collected and tested in laboratory. Table 31 presents result of surface water quality.

Table 31: Summary of Surface Water Quality

S. No.	Parameter	Units	Sampling Locations		
			Wall Site 1	Storage Area	Wall Side 2
1	Turbidity	NTU	BDL	BDL	BDL
2	TSS	mg/L	BDL	BDL	BDL
3	TDS	mg/L	2041	1971	1807
4	pH @25°C	-	8.15	8.15	8.30
5	Aluminum (Al)	mg/L	BDL	BDL	BDL
6	Antimony (Sb)	Mg/L	BDL	BDL	BDL
7	Arsenic (As)	mg/L	BDL	BDL	BDL
8	Barium (Ba)	mg/L	BDL	BDL	BDL
9	Boron (B)	mg/L	BDL	BDL	BDL
10	Cadmium (Cd)	mg/L	BDL	BDL	BDL
11	Chromium (Cr)	mg/L	BDL	BDL	BDL
12	Copper (Cu)	mg/L	BDL	BDL	BDL
13	Lead (Pb)	mg/L	BDL	BDL	BDL
14	Manganese (Mn)	mg/L	BDL	BDL	BDL
15	Nickel (Ni)	mg/L	BDL	BDL	BDL
16	Mercury (Hg)	mg/L	BDL	BDL	BDL
17	Selenium (Se)	mg/L	BDL	BDL	BDL
18	Zinc	mg/L	BDL	BDL	BDL

BDL=Below Detection Level

6.6.2 Ambient Air Quality

Ambient air in the Project Area, is generally clean, because only a few houses were visible in the project areas. There are no industrial setups within the area of influence of the Project Area. Vehicular traffic is absent as well as road infrastructure. Spot monitoring of Suspended Particulate Matter was tested and is given as Table 32**.** The monitoring for SPM was done for a period of **2 hours** as there wasn't any sensitive receptor near the proposed project area. Table 32 below shows **average 2 hours** results. The proposed project site is a barren site and the nearest village, Kili Hazart Sahib is location about 16 km from the proposed project site. The equipment used for air monitoring is **Hazdust EPAM 5000** and test method is **USEPA PM_{10}, 2.5 method 201a** Lab reports are attached as **Annexure 2**.

Table 32 Results of Ambient Air Quality

Parameters	Location			
	Wall Side 1	Storage Area	Wall Side 2	NEQS
Suspended Particulate Matter ($\mu g/m^3$)	8	Nil	12	500 (24 hrs. avg)

Source: Monitored in the Project Area by Laboratory Team.

The results presented in Table 32 clearly depicts that the ambient air quality of the Project Area is clean as the values of all monitored parameters are far below the values of NEQS.

6.6.3 Ambient Noise

Ambient noise levels were measured and the **average 2 hours** monitoring results are given as following in Table 33. Noise monitoring was done with a type 1 noise meter.

Table 33 Summarized Results of Noise Monitoring

. No.	Location	Noise Level dB(A)	NEQS Day Time	NEQS Night Time
1	**Wall Side 1**	30.1	50-55	45
2	**Storage Area**	<28	50-55	45
3	**Wall Side 2**	<28	50-55	45

Source: Monitored in the Project Area by Laboratory Team.

Sensitive receptors are people or other organisms that may have a significantly increased sensitivity or exposure to contaminants by virtue of their age and health (e.g. schools, day care centers, hospitals, nursing homes), status (e.g. sensitive or endangered species), proximity to the contamination, dwelling construction (e.g. basement), or the facilities they use (e.g. water supply well). The location of sensitive receptors must be identified in order to evaluate the potential impact[8]. There are no sensitive receptors within the area. The nearest village is Kili Hazrat Sahib which is about 16.5 km from the proposed dam site.

6.7 Environmental baseline monitoring of Hatachi – Kharzan

6.8 Water Quality

Ambient Air Quality

Ambient air in the Project Area, in general, is apparently clean, because no major industrial activity exists in the immediate surroundings of the Project Area and vehicular traffic.

Ambient air quality parameter as per site conditions only includes Suspended Particulate Matters was spot monitored for on all seven interventions (Chutta, Wandari, Khadri, Jhalaro, Acharwand, Sinjhvari, Hatachi – Kharzan). Table 34 below shows **average 2 hours** results. The equipment used for air monitoring is **Hazdust EPAM 5000** and test method is **USEPA PM_{10}, 2.5 method 201a**. The results range from 0 to 15 µg/m^3 details are presented in **Annexure 2** of this report.

Table 34 Ambient Air Quality Results (Suspended Particulate Matters)

S. No.	Location	Test Results (µg/Nm^3)	NEQS (avg. 24 hrs. µg/m^3)
1	Chutta	12	500
2	Wandari	14	500
3	Khadri	15	500
4	Jhalaro	11	500
5	Acharwand	BDL	500
6	Sinjori	4	500
7	Haatachi Khizran Infiltration Gallery	BDL	500

5.1.1 Ambient Noise

Under this assignment, ambient noise levels were measured at all seven locations (Chutta, Wandari, Khadri, Jhalaro, Acharwand, Sinjhvari, Hatachi – Kharzan), which range between 32-41 dB(A). This range corresponds to a low-level noise atmosphere of the rural areas, associated with some of vehicular traffic. The details of the analysis are presented in **Annexure 2** of this report.

Ambient noise levels were measured and the average 2 hours monitoring results are given as following in Table 35 Noise monitoring was done with a type 1 noise meter.

Table 35 Ambient Air Quality Results (Suspended Particulate Matters)

S. No.	Location	Test Results (µg/Nm_3)	NEQS (avg. 24 hrs. µg/m_3)
1.	Chutta	12	500
2.	Wandari	14	500
3.	Khadri	15	500
4.	Jhalaro	11	500
5.	Acharwand	BDL	500
6.	Sinjori	4	500
7.	Haatachi Khizran Infiltration Gallery	BDL	500

Ambient noise levels were measured and the average 2 hours monitoring results are given as following in

Table 36 Noise monitoring was done with a type 1 noise meter.

Table 36 Summarized Results of Noise Monitoring

S. No.	Location	Noise Level dB(A)	NEQS / WHO Day Time	NEQS / WHO Night Time
1)	Chutta	38	55	45
2)	Wandari	41	55	45
3)	Khadri	35	55	45
4)	Jhalaro	36.2	55	45
5)	Acharwand	37	55	45
6)	Sinjori	36	55	45
7)	Haatachi Khizran Infiltration Gallery	32	55	45

Source: Monitored in the Project Area by Laboratory Team.

Sensitive receptors are people or other organisms that may have a significantly increased sensitivity or exposure to contaminants by virtue of their age and health (e.g. schools, day care centers, hospitals, nursing homes), status (e.g. sensitive or endangered species), proximity to the contamination, dwelling construction (e.g. basement), or the facilities they use (e.g. water supply well). The location of sensitive receptors must be identified in order to evaluate the potential impact[18]. There are no sensitive receptors within the area. The nearest villages around the both Core SubProjects are about 3-5 kms away.

6.9 Terrestrial biodiversity

Baseline Faunal survey of Sri Toi dam, a major core core sub-project of BWRDP was carried out in November 5-10, 2017 in representative central and peripheral areas from Sri Toi dam area (Annexure 16). Extensive survey carried out in all ranges and conducted while walking predefined travel routes and from observation points. There is a paucity of recent data on terrestrial biodiversity in the project regions and so in addition to faunal survey, secondary information based on documentation from expert organisations and academic journals was also used

6.9.1 Forests and flora

6.9.1.1 ZRB Vegetation

The major forest type is Sub Tropical Broad-Leaved Evergreen Scrub forests. These forests occupy the altitudes between 2500 to 5500 feet elevation

The major ***forest type*** is Sub Tropical Broad Leaved Evergreen Scrub forests. These forests occupy the altitudes between 2500 to 5500 feet elevation. The main species are Olive (*Olea ferrugenea*), Shina (*Pistacia khinjik*), Uzhgai (*Pistachia cabulica*), Gurgura (*Reptonia buxifolia*), Shang/ Wild Ash (*Fraxinus xanthoxyloides*) and Wild almond (*Prunus eburnean*). Besides these tree species, a number of ***shrubs and herbs*** are also present in these forests, which may include, Barara (*Periploca aphylla*), Anang (*Prunus creasus*), Arghuch (*Scorzonera mollis*), *Datura (Datura fastuosa), Gandarae (Narium odorum), Gangu (Othonnopsis intermedia), Ghuzera (Sophora grifithii),* Injaora (*Allium sphaerocephalum*), Maurai (*Zizyphora clinopolioides),* Nal (*Phragmites communis)*, Khamazurgae *(Withania cougulans*), *Khatol (Malcolmia africana), Makhi (Caragana ambigua), Shezgae (Eremurus aucheriana), shkanpara (Plantago ovata), Shorae (Haloxylon grifithii), Tarkha (Artimesia meritima), Urgalama (Rhazya stricta), Zawala (Achillea santolina), Pamangi (Bouce rosia aucheriana), Raghbolae (Peucedanum sp.), Rakhpatti (Panicum colonum), Sanda (Tillipa stellata), Sandreza (Lactuca sp.), Malaghunae (Daphne oleoides),* Mazari (*Nannorrhops ritchiana*) also known as dwarf palm, and Sanatha (*Dodonea viscose); but Sanatha is usually found on degraded sites.* The ***ground cover*** is constituted mainly by *Stipa pennata*,

Pennisetum orientalis, Chrysopogon aucheri, Barau (Sorghum halepense), Barwaza (Heteropogon contortus), Margha (Poa bulbosa), Bushkae (Sepidium draba), Lukha (Typha angustifolia), and Sargarae (Cymbopogon *jwarancusa).*

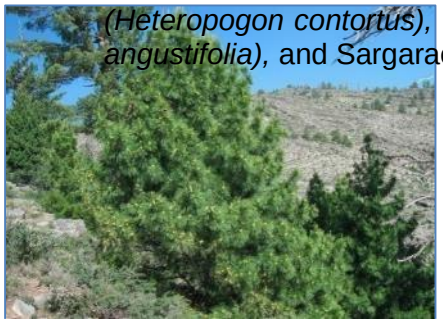


Figure 6-4Trees

Pinus gerardiana

Olea ferrugenea

Reptonia buxifolia

Pistacia khinjik

Pistachia cabulica xanthoxyloides

Figure 6-5Shrubs

Datura fastuosa

Fraxinus

Periploca aphylla

Allium sphaerocephalum

Narium odorum

Achillea santolina

Artimesia meritima

Daphne oleoides

Eremurus aucheriana

Malcolmia africana

Othonnopsis intermedia

Plantago ovata

Reptonia buxifolia

Scorzonera mollis

Sophora grifithii

Rhazya stricta

Figure 6-6 Photographs of few faunal representatives

Hemiechinus auritus megalotis

Canis aureus

Lepus capensis

Capra falconeri

Vulpes cana

Hystrix indica

Ovis vignei

Rangelands:

The type of rangeland present in the district is classified as Suleiman Mountain Ranges. It has species like: *Stipa pennata, Pennisetum orientalis, Chrysopogon aucheri*, and *Cymbopogon sp.* etc. The productivity is good with average productive capacity of 250 kg /hectare. The rangelands in the district belong to communities living around them. Due to communal ownership, usually these are accessible to all members of the community and also to nomads passing through the area on their traditional routes of migration to new areas. On the management side, no one assumes the responsibility for undertaking any activity aimed either at restoration of depleted areas or for improvement to increase the forage production and other tangible and intangible benefits. There is no limit on the number, type, season and period/duration of grazing. This free access to range resource by everyone and absence of responsibility on management side has led to what could be termed as the "Tragedy of Commons". Traditionally, there is also a system in place for the management of rangelands but this system is mostly limited to the grazing management, whereby grazing on the rangelands is regulated through the traditional system of declaring rangelands open and close for grazing. Locally, this system is called as "Pargore" in Pashto, whereby rangelands in one growing season, i.e. spring or monsoon, are declared as close for grazing and at the onset of next growing season they are declared as open for herding. However, there is no limit on the number of grazing animals and period (duration) of grazing. Similarly, range readiness and other facilities necessary for grazing are also not taken into account.

Notified Forests

There are two (02) Notified forests in the district namely: Bahlol and Majawar Shmbozai with total forest area of 6,734 hectare.

Notified Protected Areas

There are no notified protected areas in this district.

6.9.1.2 MRB forest and flora

Some of the ***major tree species*** found in the district include Hapurse (Juniperus excelsa polycarpos), Shishar *(Fraxinus xanthoxyloides),* Zaithoon (*Olea cuspidate*), and Gawan *(Pistacia khinjjak),* which bear a very open cover and occupy favorable sites. These species are found in areas adjacent to Harboi hills, Drakhel and Pharas hills sharing a negligible amount of overall vegetation cover. Other species include Janglee Badaam (*Prunus amygdalus)*, dranna or Jir (*Artemisia maritime)*,Kala Zira (C*arum bulbocastanum), Chitirk (Caragana ullcina), Aur trik (Dodonia viscose),* Archin (*Prunus amygdales*), Aveshk (*Clematis orientalis*), Baibru (*Withania somnifera*), Bakarwali (*Convolvulus arvensis*), Bar (*Solanum indicum*), Bibi Batav (*Pycnoeyela aucheriana*), Birori (*Alhaji maurorum*), Bishkhaf (*Eremo-tachyys viearyl*), Boe-Madran (*Haloxylon grifithii*), Chitirk (*Caragana ullcina*), Dhatura (*Datura fastuosa*), Drab or Drug (*Eragrostis cynosuroides*), Gandil (*Eleusine flagellifera*), Garbust (*lepidium draba*), Ghaz (*Tamarix orientalis*), Get (*Salix acmophylla*), Gorka (*Stipa capillata*), Gulgulab (*Rosa damasccena*), Hatam bai (*Erysimum repandum*), Hawe (*Cymbopogon jwarancusa*), Hashwarg (*Rgazya sricta*), Hum (*Periploca aphylla*), Izghand (*Thymus serphylum*), Jaghun (*Salsola kali*), Jaur (*Narium odorum*), Jhil (*Indigofera pauciflora*), Kahero (*Ehretia obtusifolia*), Kaler (*Caparis aphylla*), Kalpora (*tecurium stocksianum*), Kapet-kawa (*Fumaria parviflora*), Karag (*Calotropis gigantean*), Karwan kushi (*Pterophyrum olivieri*), Kashum (*Saccharum ciliare*), Kasur (*Pistacia mutica*), Kisankor (*Peganum harmala*), Kul (*Typha angustifolia*), Manguli (*Orthonnopsis intermedia*), Marmutk (*Boucerosfa aucheriana*), Matetave (*Salvia nepeta*), Nal *(Phragmites communis*), Naromb (*Ephedra pachyelada*), Panerband (*Withania cougulans*), Parpuk (*Ticoma undulate*), Pathk (*Populus euphratica*),Pipal (*Daphene oleoides*), Pish (*Nannorhops ritchiana*), Piun pulli (*Matricaria lusiocarpa*), Pochko (*Althaea ludwigii*), Purchink (*Mentha sylvestris*), Puzho (*Convolvulus*

microphyllus), Rang (*Astralagalus squamosus*), Righit (*Suaeda monoiea*), Ritach (*Euphorbia caeladenia*), Riza (*Cuminum cyminum*), Rush (*Sisymbrium Sophia*), Sadagh (*Haloxylon grifithii*), Shampastir (*Sophora grifithii*), Shinz (*Alhaji camelorum*), Simsok (*Nepeta glomerulosa*),Tplapissi (*Zizyphus spina)*, *Zarch (Berberis vulgaris)* and Khakshir*(Sisymbrium sophia).* The ***ground cover*** is constituted mainly by (*Stipa himalacia)*, (*Dichanthium annulatum)*, (*Chrysopogon aucheri)* and (*Cymbopogon spp.)* Tamarix and Heliotropium.

6.9.2 Terrestrial Fauna

6.9.2.1 ZRB terrestrial fauna

Wildlife habitat type is *Steppic Forest in Intermediate Latitude*. There are no historical bench marks to determine the status of wildlife in the area. However, according to the community the number of wildlife species has declined; which could aptly be attributed to casual attitude for hunting and habitat degradation. Among key species include:

Table 37: Wildlife Common Species

Wildlife Type	Common Species
Mammals	Fox *(Vulpes cana),* Asiatic Jackal *(Canis aureus),* Cape hare (*Lepus capensis*), Stone Marten (*Martes foina*), Porcupine *(Hystrix indica),* Afghan Hedgehog *(Hemiechinus auritus megalotis),* etc. Moreover, previously Suleman Markhor (*Capra falconeri*) and Urial (*Ovis vignei*) was reported from the area but their present status is unknown.
Birds	Chukar *(Alectoris chukar),* See see partridge *(Ammoperdix griseogularis),* Magpie *(Pica pica),* Houbara Bustard (*Chlamydotis undulate*), a number of sparrows, Finches, buntings, seasonal/migratory waterfowls, hawks, and sand grouse etc. The area also provide corridor to the migratory bird species; the key species like Common Crane *(Grus grus)* and Demoiselle Crane *(Anthropoides virgo)*.
Reptiles	Afghan Tortoise *(Agrionemys horsfieldii),* Brown Cobra *(Naja oxiana),* Saw-scale viper *(Echis carinatus),* Levantine viper *(Macrovipera lebetina)*, Goh *(Varanus griseus),* etc.

Wildlife Statistics

No census report was available regarding status of key wildlife species in the district.

6.9.2.2 MRBr terrestrial fauna

Wildlife habitat type is Dry Steppe. There are no historical bench marks to determine the status of wildlife in the area. However, according to the community, the number of wildlife species has declined; which could be aptly attributed to casual attitude for hunting and habitat degradation. Among key species include:

Figure 6-7 Birds

Passeridae

Emberiza citrinella

Fringillidae

Alectoris chukar

Ammoperdix griseogularis

Pteroclididae

Figure 6-8 Migratory Birds

Figure 6-9 Reptiles

Agrionemys horsfieldii

Macrovipera lebetina

Naja oxiana

Table 38: Wildlife Common Species

Wildlife Type	Common Species
Mammals	Wolf *(Canis lupus),* Hill fox *(Vulpes vulpes grifithii),* Asiatic Jackal *(Canis aureus),* Stripped Hyaena *(Hyaena hyaena)* Cape hare (Lepus capensis), Porcupine *(Hystrix indica),* Hedgehog *(Hemiechinus auritus megalotis), Chinkara (Gazella benettii), Sindh Ibex (Cara aegagrus), Desert cat (Felis silvestris), Porcup[ine (Hysrix indica), Bush rat (Golunda ellioti). Black bear has also been claimed to be sighted in pub range of the district wchi is till subject to confirmation. Similar is the position of Leopard (panthra pardas).*
Birds	*Pterocles indica, Ammoperdix griseogularis, pyconotus leucogenys, emberiza striolata, Bucanetes githagineus, Euodice malabarica, lanius excubitor, lanius schach, Oenanthe alboniger, Saxicoloides fulicata, eremopterix grisea, Ammomanes deserti, Dendrocopus assimilis, prinia gracilis,, Oenanthe xanthoprymna, oenanthe picata capistrata , Coccothraustes coccothraustes,* Chukar *(Alectoris chukar),* See see partridge *(Ammoperdix griseogularis),* Kestrel *(Falco tinnunculus),* Golden eagle *(Aquila chrysaetos daphanea),* a number of Finches, buntings, seasonal/migratory waterfowls, hawks, bustards and sand grouse etc.
Reptiles	Easter dwarf skink *(Ablepharus pannonicus*),Indian desert monitor *(Varanus griseus knoiecznyi),* Reticulate desert lacerta *(Eremias acutirostris),* Caspian desert lacerta *(Eremias scripta),* Chagai desert lacerta *(Eremias aporosceles),* Dark headed dwarf racer *(Eirenis persica walteri*), Tartary sand boa *(Eryx tataricus speciosus),* Spotted desert racer *(Coluber karelini karelini),* Dark headed gamma snake *(Boiga trigonata melanocephalus*), Maynard's awl-headed snake *(Lytorhynchus maynardi*), Afghan Tortoise *(Agrionemys horsfieldii),* Indian Cobra *(Naja naja naja),* Leaf nose viper *(Eristicophis macmahonii),* and lizards like *(Agamura femoralis, Stenodactylus maynardi,* etc.

6.9.3 Aquatic Fauna

Balochistan's overall climate has arid conditions and is identified for the seasonal flash floods which flow during high intensity showers of monsoon and spring.

6.9.3.1 ZRB aquatic fauna

Fish Farming culture has not been developed in District Zhob.

- The construction of Subakzai Dam may divert the attention of local population to fishing means of livelihood.
- Fishery industry is non-commercialized in Zhob therefore no industry regarding fisheries has been developed in the area.
- The group of fish such as Rohu, Morki, Thella and Mali, found in cold and mild cold area of Zhob, and Trout have high fishing potential

6.9.3.2 MRB aquatic fauna

There is a significant amount of fish catch experienced in the streams of Moola, Naal and others but it is for the local consumption not for commercial purpose. Therefore, the fisherires department has not been formally established in the district and the relevant data has not been properly collected and updated.

6.10 Species of Special Concern

The subject of species of special concern will be considered in this section as a cross-cutting issue in both river basins. There are four species of threatened mammals in Balochistan. Table 39 presents the main species, in the two Basins, which are internationally and nationally recognized as threatened.

Table 39: **Threatened species in the project area**

Common Name	Scientific Name	IUCN/National Conservation Status
Mammals		
Baluchistan Black Bear	*U. thibetanus gedrosianus*	Critically endangered
Urial	*Ovis vignei*	IUCN: Vulnerable
Birds		
Houbara Bustards		Threatened

1. Balochistan Black Bear

The Balochistan black bear is found in the higher ranges of the province of Balochistan in Southwest Pakistan and Southeast Iran. Its greatest stronghold is in the hills south of Khuzdar in the PRB. The Baluchistan Black bear is currently confined to the arid sub-tropical thorn forest of the Khuzdar hills (WWF Pakistan, 2015). The main threats to the Baluchistan Black bear are: habitat loss due to expansion of human settlements and development projects; retaliatory killing by herders and poaching for bear pelts.

3. Balochistan Urial

Urial is found in the rich habitats of Torghar, Takatoo & Torgbag in Balochistan Whereas, the Blandford Urial and Sind Ibex are found in Durreji (Balochistan) and also in Sumbuk, Surjan, Halalo, Pachran, Eiri and Hathiano in the province of Sindh. This animal is not found in the project area or area of influence.

6.11 Scheme-Level Baselines for Zhob and Mula River Basins

ZRB scheme-level baselines

Location and spatial spread of 4 sub-projects in the Zhob River basin are shown in Figure 6-10.

The **Ahmedzai perennial and Flood irrigation sub-project** is a weir structure located at UTM coordinates N 3437108 m, E 551554 m Zone 42R on Ahmedzai tributary of Zhob River; which is situated in Zhob district. The sub-project is proposed for improvement in command area. The proposed sub-project would be having water from both perennial and Flood sources. Since perennial flow is limited therefore flood is an integral part of sub-project. Access to sub-project site from Zhob city is through Quetta-Zhob National Highway (N-50), which connects a dirt track to sub-project area on south-eastern part of Zhob River basin. The sub-project would bring 180 ha of land under new command, while 427 ha would be part of existing command. After construction of this sub-project, lands belonging to three villages in Killi Ahmad Zai, Qila Baz Khan and Killi Ali Zai would be commanded.

Physical characteristics

The geological features of Ahmedzai are similar to Killi Sardar as both are located close to each other. The geological map represents that area comprises largely of underlying Cretaceous and Jurassic sedimentary rocks. Central area of the sub-project has partial deposits of alluvium mud. The sub-project is surrounded by Spin Ghar, Mazania Tora and Gudwa Ghar ridges. Terrain is generally flat in sub-project and is suitable for command area development. The average altitude of sub-project's command area is 1,690 m above mean sea level.

Perennial surface flow would be diverted from river to a lined canal, while floodwater would be diverted during high flow season to a flood channel leading to a separate command area. Due to abundance of surface water, it would also be used for livestock, drinking and other domestic uses. According to hydrological study of surface and sub- surface flow at sub-project level, using ArcSWAT Model, annual water availability was estimated as 7.6 MCM.

The results from model were compared with measured flows during site visit. During site visit in November (2016), 0.14 cumec flow was observed in river. The ArcSWAT model for November estimates that river will have 0.06 cumec flow. This shows that order of magnitude estimated by model is in close conformity with actual flows.

The quality of water was tested at proposed sub-project having pH of 8.3 and TDS of 300 ppm. Deep, loam approaching fine sandy loam dominantly exists in command area of sub-project. The quality of water is fresh and highly suitable for irrigation. The soils are largely non-saline and non-sodic, therefore no amendments are needed to manage soils.

The existing command of diversion sub-project is being irrigated by Ghorasa Ali Zai perennial channel from an infiltration gallery. Although, considerable command area is available. However, low discharge from infiltration gallery limits size of command area. The weir on its upstream side was constructed in 1961-62, which was later on washed away by floods. It was rehabilitated by ID in 1983-84 to divert a perennial flow of 0.08 cumec and flood discharge of 14.15 cumec from right and left banks of command covering an area of 202 and 404 ha, respectively. But weir was later on again damaged by floods (Figure 6-10).

Socio-economic profile

The main tribes living in sub-project belongs to Kakar and Kibzai. Main clans of Badin Zai and Qabal Zai dwell in this region are ultimate beneficiaries of sub-project. Pushto is spoken as major language, while small number of people can speak Urdu. The communities are belonging to Muslim ethnic group

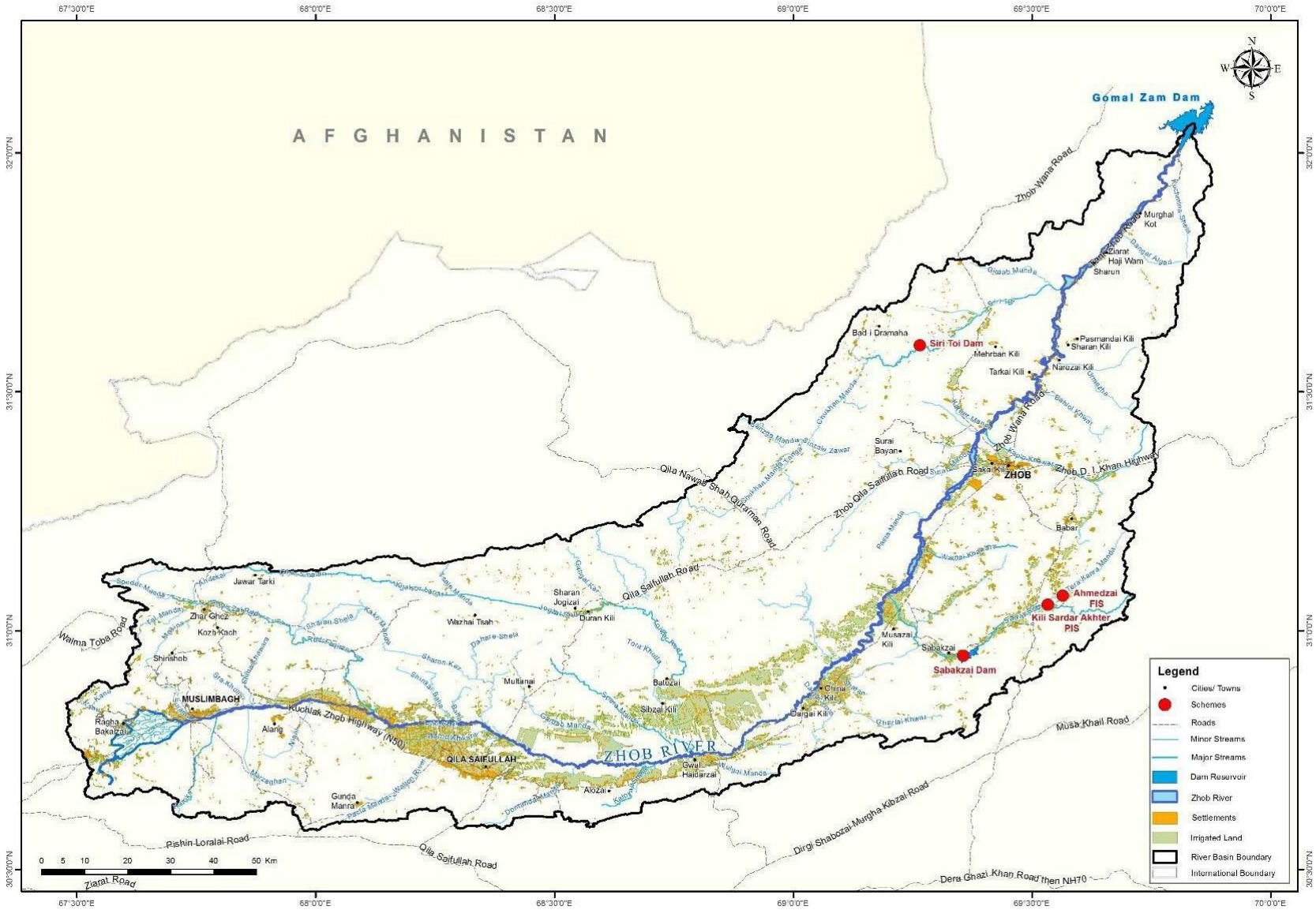


Figure 6-10: Location and spatial spread of 4 sub-projects in the Zhob River basin

Demography of Ahmadzai perennial and flood irrigation sub-project Area

Name of Sub-project	S. No	Village Names	No of Water/Landholding Households	Population	Male	Female
Ahmedzai	1	Ahmedzai	62	677	309	368

The integrated surveys indicated that lands are reported in cadastral records for three villages, which would be part of command area. On left bank of weir, command area for flood irrigation is currently uncultivated and would be commanded from same weir. In the sub-project, land rights are held by individuals, while communal lands are mostly registered as Shamlaat. The share of Shamlaat is inherited from ancestors. There are no landless families in command area. Water rights in spate irrigation are reactive whereas in the perennial commands these are appropriated by the elders. Normally under the concept of prior appropriation, this is being followed in the province. The cadastral record of land and water share for Ahmedzai sub-project is being maintained and last updated in 1968 under cadastral records for land and with Revenue for water rights for Moza Ahmedzai.

At present, water is taken from kareze in watershed and weir is having about 0.03 cumec (1 cusec) of water which is brought to weir and then channelized to command area. Rainfall data of rain gauge stations namely Zhob, Qila Saifullah, Badinzai, Muslim Bagh, Murgha Kibzai and Sharan Jogzai of Zhob river basin was collected from Water Resources Planning, Development & Monitoring Directorate of Balochistan (WRPDMD) and Pakistan Meteorological Department (PMD) for 1980-2014. After filling data gaps from Climate Forecast System Re-analysis (CFSR) data, analysis was undertaken using ARC-SWAT

Farmers have inherited practice of water distribution in which water rights are sold with land. Every farmer has an allocated time at main canal and distributaries. The distribution of water starts from head of channel and ends at tail. Each channel has its own fixed distribution cycle, usually 12 days, scheduled during day and night. Water is diverted through weir built by BID, which was completely damaged in 2010. The weir was built to divert both perennial and flood. The right bank side of weir diverts perennial flows, while left bank side constructed to divert flood. The left side of weir is completely damaged. No conflicts in terms of water distribution and rights were observed during field visits and as reported in integrated field surveys. At present, irrigation is being done though tubewells, and farmers do have rights on surface water according to time allocation based on land and community is ready to follow current rule of water distribution and allocation under a Warabandi concept.

Sub-consultant recruited for integrated surveys organized community consultations at sub-project level after initial design of sub-project to share design and seek full ownership of communities. No dispute was reported on land and water rights and farmers agreed to participate in sub-project development. Community demanded to include construction of a new weir and channel lining for left and right bank command areas. Management of watershed and groundwater recharge and production of fuelwood, arid fruits, shrubs and forages are essential elements in sub-project. Meaningful consultation as per ADB SPS was carried out: (a) once at reconnaissance stage; and (b) second during detailed socio- economic baseline surveys. The second round of public consultations are substantiated with date, location and name of participants, their signatures/thumb impression and views.

Agriculture

Current agricultural productivity is very low in sub-project due to inadequate irrigation facility. The existing cropped area is 427 ha with 70% cropping intensity followed by cropping pattern of vegetables-wheat mix with orchards and other crops. The yield and production are low, which ultimately affects households' income. The agriculture designed for sub-project would change by increasing cropped area, cropping intensity, yield and production as per agronomic field surveys. Development of sub-project would enhance existing cropped area of 427 ha to 728 ha with increased cropping intensity form 70% to 120%. The landowners

proposed high value crops. The gross irrigation requirement and detailed existing and designed agriculture data are given in Appendix I.

The cropping pattern will change and it is expected that farmers will adopt design cropping pattern in a period of 5-6 years of completion of sub-project. The percentage of cropped area will increase for high value crops due to reliable availability of water. The existing cropping intensity is 70%, whereas design cropping intensity is 120%, which would be accomplished in 5-6 years of completion of sub-project. The strengthening of local service and supply providers in terms of capacity, linkages with national companies and provision of land levelling and plantation machinery for furrow-bed irrigation would help to enhance crop productivity and profitability.

Considering agricultural, economic and social needs of community, sub-project has tremendous potential and that's why it is selected as core sub-project. Sufficient water is available for command area. The economic and financial analysis provided EIRR of 25.85% and FIRR of 27.73%. Detailed results of analysis with and without sub-project are presented in Appendix I.

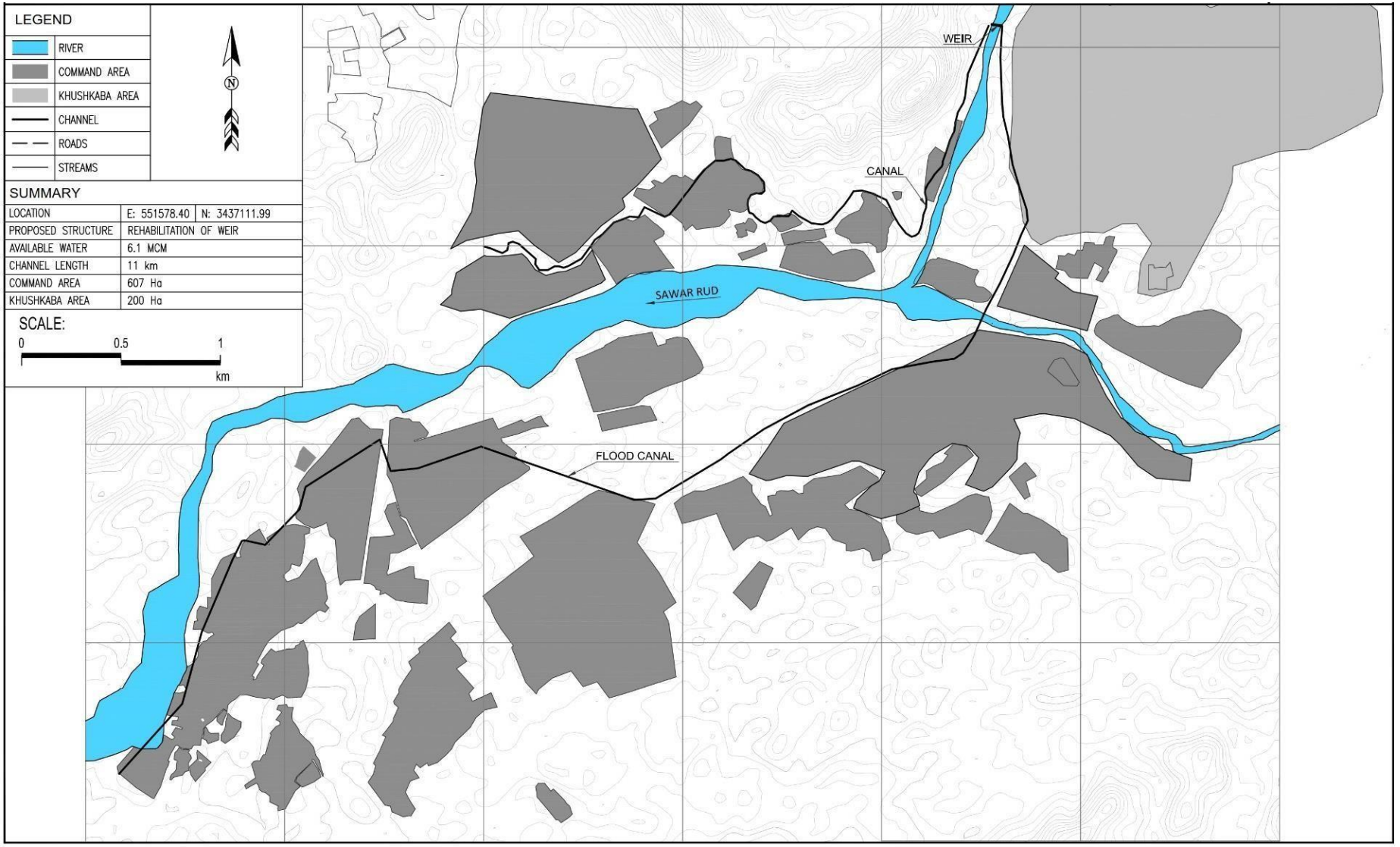


Figure 6-11: Layout plan of Ahmedzai perennial and flood irrigation sub-project

Sabakzai command area is on Sawar River in Meena Bazar area of district Zhob. It lies in UTM Zone 42R at 3423783.55 Northing and 533942.65 Easting. The proposed sub-project will rehabilitate conveyance system of Sabakzai dam. It is located 61 km south of Zhob city. Communication from Zhob to dam site is via Zhob-Kuchlak highway, N50. The journey takes about one hour from Zhob, which is 39 km on N50 highway, and 22 km through the access road of the dam. The command area development works are proposed in Meena Bazar area. The area is gravelly with significant potential for development. There is an improvement potential of 1,000 ha of agriculture. At present, only a fraction of this area is under cultivation.

Physical characteristics

Geological features of Sabakzai command area comprises of Cretaceous and Jurassic Sedimentary Rocks. The area near dam site is marked by gently sloping mountains. The gravel from these low relief mountains are transported to low lying areas during monsoon rains. Meena Bazar area is extremely flat and characterized by gravel bed material. The average altitude of command area is 1510 m above mean sea level.

Perennial surface flow is diverted to irrigate existing command area. Due to abundance of surface water, it is also used as livestock, drinking and other domestic purposes. The live storage of dam is 18.1 MCM. The overall water balance at basin level was carried out through hydrological modeling of whole river basin. Runoff and base flow is predicted for each sub-project by specifying location on particular river reach in a GIS interface supported hydrological model ArcSWAT. The Model is used to simulate groundwater and surface water based on available meteorological, land use and soil data records. The calibration of model was carried out for observed stream flow data for 9 years. The results of water balance study represent proportion of components of hydrological cycle.

The soil and water quality at the sub-project was studied and tested for agriculture suitability. The soil is deep silt loam underlain by gravel. These are non- to slightly calcareous. As regard to water, it has pH 7.8, EC= 0.59 dS/m, Ca+Mg 2.4 mg/l, RSC 1.17 and SAR 1.68 terming it fit for irrigation.

Sabakzai dam was constructed in 2007 by Water and Power Development Authority. The earth fill dam impounds Sawar River, a tributary of Zhob River. The dam is 34.75 m high and stores 41 MCM. The live storage capacity of dam is 18 MCM. Through a tower and gated outlet arrangement, 1 cumec (35 cusecs) is released into irrigation canal for command area which is about 1,000 ha. Schematic map of sub-project is presented in Figure 6-12.

The dam and its spillway are intact. The spillway has a discharge capacity of 1,630 cumec, which is augmented by a 23 m emergency fuse plug. The dam overflows during monsoon season. The dam outlet works are functioning at its design capacity of 1 cumec (35 cusecs). In 2015, NESPAK prepared a 'dam safety report' for Sabakzai. It suggested minor repair works in dam and associated structures. The Resident Engineer reported that rate of siltation in reservoir is high. The dam is rapidly losing its storage capacity. Construction of a series of check dams will reduce rate of siltation, ensuring that dam is functional for its 50- year design life. However, this is not a solution. It is the only intervention, which is designed to reduce siltation but it add to cost and quickly silted up and then it works as a weir to transfer all sediments to dam. The solution lies in bio-engineering in watershed area. However, concepts of bio-engineering are hardly understood in Pakistan.

The main canal conveys 1 cumec (35 cusecs) from dam. It is bifurcated into left and right bank canals. The left bank canal conveys 0.5 cumec (17 cusecs). It is functional and meets required water demand of its design command area. The right bank canal conveys 0.51 cumec (18 cusecs). It is damaged at various stations. The right bank canal was damaged severely by floods in tail reach. It is dysfunctional in this reach. The portion from station 4+000 to 6+000 km is buried underground as a covered concrete conduit. Manholes are

provided at 100 m intervals for underground conduit. The remaining portion of 22 km canal is trapezoidal in section. There are several drop structures along canal length.

Flood has damaged cross drainage works on right bank canal. Majority of cross drainage works are under-designed. A two-cell type aqueduct, with each cell 0.25 m x 0.25 m in size, was adopted for aqueduct, which is inadequate. Larger aqueducts will be required to ensure safe passage of flow through channel embankment. The cross-drainage structures require urgent repair/reconstruction to prevent wash-out of right bank conveyance system in next flood.

Considerable area in tail reach was not included in dam project due to limited water availability. At present, only 2996 ha of land is being irrigated. It is estimated that a total of 8907 ha of land is irrigable. The conveyance system of dam was improved and extended by Agriculture Department in 2012. A link canal from Right Bank Canal at station 4+000 km was constructed under this project. A weir on Sawar River was constructed under BMIAD project in '80s. The weir commands tail reaches of Sabakzai dam in Meena Bazar area. The flow of river in this reach is perennial and low. A channel off-taking from weir conveys 0.14 cumec (5 cusecs) to command area.

Socio-economic profile

The focused area belongs to beneficiaries of 3 main villages called Mina Bazar, Ghurzai and Musazai as other villages are not on main channel and take water from left branch channel bifurcating from main canal just at start, which is in good condition and does not require any rehabilitation works, while many villages including Sabakzai, Yaqoobzai, Dodazai and Khuramzai take water from this channel. However, main channel is damaged at several places and requires considerable rehabilitation. While, Musazai channel at tail end bifurcating from main channel is also in good condition and does not require rehabilitation; therefore beneficiaries also told that they do not require any work. So survey of only two villages Mina Bazar and Ghurzai was conducted. The land and water rights mainly belongs to two clans of Kakar Tribe that is Pukhezai of Mina Bazar village and Ghurzai of Ghurzai village. About 571 households were reported in both villages in which 444 households of Pukhezai and 127 households of Ghurzai were reported (Table 40).

Table 40: Demographic details of sub-project

Name of Sub-project	No	Village Names	No of Water/Landholding Households	Population	Male	Female
Sabakzai Dam	1	Mina Bazar	444	3436	1549	1887
	2	Ghorizi	127	1609	840	769

The land rights are equitable and all shareholders have share in land. The lands are also reported in cadastral record. The cultivated land reported of both clans was about 648 ha (1600 acres). The Pukhezai clan of Mina Bazar village having about 607 ha (1500 acres) of cultivated land, while Ghurzai clan has about 40 ha (100 acres) of cultivated land due to dispute on water rights. The land of Pukhezai is also not fully irrigated and about 405 ha (1000 acres) of expendable land is also available. While, land of Ghurzai clan remain uncultivated due to dispute on water distribution and about more than 810 ha (2000 acres) is available for further cultivation.

The communal source of water is perennial flow of 1 cumec (35 cusecs) released from Sabakzai storage dam for agricultural purposes to irrigate total land of 2,833 ha (7000 acres). However, as only main canal is included in sub-project therefore lands of Mina Bazar and Ghurzai villages would be part of sub-project. The water rights are equitable between Pukhezai clan which is resident in Mina Bazar village and water distribution is also well defined. However, Ghurzai clan of Ghurzai village have dispute on water distribution due to which only few farmers at start of Ghurzai branch channel irrigate some land while, all of

land could not be irrigated and water from their branch channel is wasted in river. The farmers in sub-project have well defined water rights without any conflict and allocation rule is based on time as per land holding. The farmers ensured that they will follow Warabandi system under designed command area.

No dispute was reported on land and water rights in Mina Bazar village between Pukhezai clan. However, during survey serious dispute within Ghurzai clan of Ghurzai village was reported on water distribution. However, farmers were willing for development of sub- project in both villages and Ghurzai branch beneficiaries told that they are trying to resolve the issue. The demands raised by community during consultation are: a) rehabilitation of main canal which is damaged at several places and requires many structures at different locations; b) raising of main canal about 1 m to carry about 2 cumec (70 cusecs) of water.

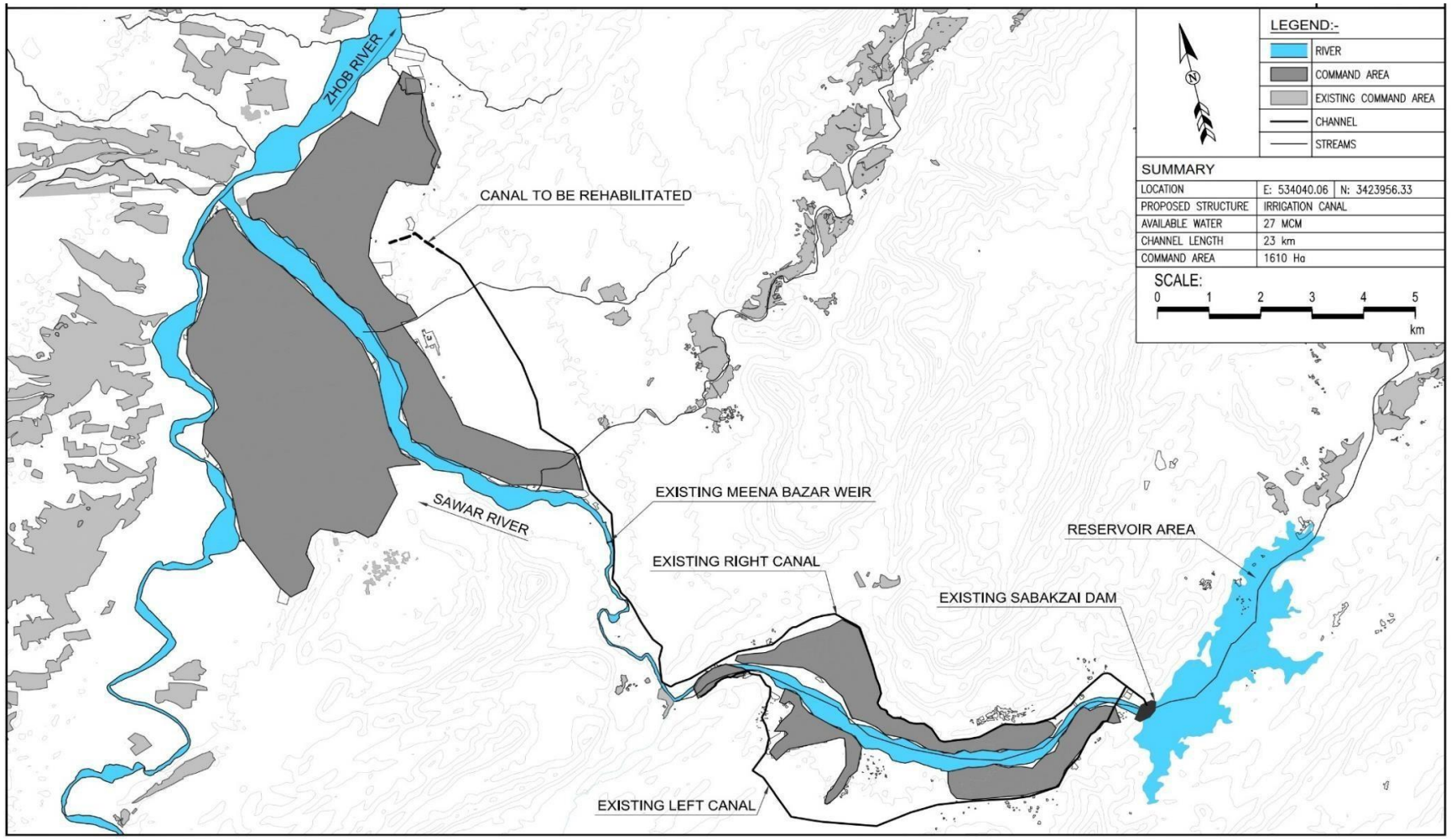
Agriculture

At present, agricultural productivity is low in sub-project. The existing cropped area is 1000 ha with 100% cropping intensity followed by an annual cropping pattern wheat – kharif vegetables – orchard. The existing practices of agriculture for were documented through integrated surveys and field visits organized by pre-feasibility team covering current irrigated cropped area, cropping intensity, yield and production. The proposed cropped area is 1,200 ha with 120% cropping intensity. The gross irrigation water requirement for designed cropping pattern and cropping intensity were estimated using CropWat Model (Appendix II).

It is expected that cropping intensity will increase to 120% within 5 to 6 years after completion of sub-project. The designed cropping pattern includes high value crops to provide higher returns to farmers and higher profitability at farm level. Adoption of crop production and water use practices and technology would help to enhance farmers' income in sub-project.

Considering agricultural, economic and social needs of community, sub-project has tremendous potential. Sufficient water is available for design of command area. The economic and financial analysis provided EIRR of 14.53% and FIRR of 14.92%. Detailed results of economic and financial analysis with and without project are presented in Appendix II.

Figure 6-12: Layout plan of the Subakzai dam and command area



Siri Toi water storage dam site is located in Union Council of Mir Ali Khel, tehsil and district Zhob, about 62 km north-east of Zhob on Siri Toi river, the main tributary of Zhob River near Kili Gul Khan. Latitude and longitude of sub-project are 31° 35' 52" North, 69° 15' 58" East and mean altitude of command area is 1350 m above mean sea level. The location of proposed dam, shown in Location Map. Access from Zhob to dam site is via Zhob-Wana road. Initially in north-east for a distance of 42 km then turning to Samabza road in south-east up to Kili Hazrat Sahab by a link metaled road by travelling 10 km, followed by unpaved shingle/gravel track for 10 km up to dam site. Journey takes 2.25 hours from Zhobtown.

The area is poor, subsistence farming is economic mainstay, so core sub-project will have a major impact on welfare of local people. Agriculture and livestock are main sources of income of local people. The community of core sub-project is composed mainly of Mando- Khel tribe of Pashtoons. However, core sub-project will have a, significant impact on a relatively remote community with a very low income. There are significant markets within reach and area has potential for wheat and vegetables which are able to offer good rates in market.

It is expected that construction of proposed dam will cover command area up to 4,027 ha, beside of sustained water supply to present command area being cultivated on seasonal basis by growing vegetables and grains. The proposed reservoir would recharge subsurface flow of river, shallow wells and tubewells, protect agriculture land and human settlements from devastation of floods during flood seasons and develop grazing zones for livestock. The stored water will support drinking, agriculture purpose and other domestic uses.

Physical characteristics

The geological features of Siri Toi comprise of Eocene and Oligocene Sedimentary rocks. Area adjacent to core sub-project and also some part of command area has underlying Cretaceous and Jurassic sedimentary rocks. High ridges surround core sub- project area which lies at foot of Masa Khel, a prominent rock outcrop about 305 m high in middle of valley. The terrain is generally flat in sub-project and is suitable for command area development. It is located in an environment of degraded rangelands. The average altitude of sub-project command area is 1350 m above mean sea level.

Climate of sub-project is semi-arid and lies in monsoonal belt. Mean annual rainfall varies between 250-400 mm per year. It receives most of its rainfall from July to September. The region observes cold winters and hot summers with temperatures soaring as high as 38°C in summers.Sri Toi dam site is located in northern part of basin on an isolated tributary of Zhob River. There is almost no existing sub-project diversion upstream of this location which indicates substantial potential for development of new sub-project. The annual average availability of water is nearly 57 MCM with a catchment area of 971 km^2. There is substantial perennial flow at this sub-project level with high flood peaks during high flow season. The significant variation in river flow regime envisages a design of a combined perennial and flood in sub-project.

The overall water balance at basin level is carried out through hydrological modeling of whole river basin. Streamflow and base flow is predicted for each sub-project by specifying location on particular river reach in a GIS supported hydrological model ArcSWAT. The model is used to simulate groundwater and surface water based on available meteorological, land use and soil data records.

The results from model were compared with measured flows during site visit. During site visit in November 2016, 0.71 cumec flow was observed in river. The ArcSWAT model for November estimates that river will have 0.96 cusec flow. This shows that the order of magnitude estimated by model is in close conformity with the actual flows.

The quality of water was tested at proposed dam site and pH was 8.31 and TDS was 317 ppm. The upstream command area of sub-project (located on left bank of the river), is presently being sown as khushkaba during Rabi season, and some 16 ha are being cultivated

using groundwater abstracted from open wells/tubewells. The remaining command area is lying barren due to lack of access to surface water. The water table in area varies from 37 to 46 m. In command area, 4 Karezes/springs and 180 open wells/tubewells are functional and providing water for irrigation.

Socioeconomic Profile

The main tribe living in sub-project belongs to Arbzai clan of Mandokhel, list of main villages are given in Table 31. These are ultimate beneficiaries of project. Pushto is spoken as major language in area while small number of people can speak Urdu. The communities belong to Muslim religion group. No issue of resettlement was observed.

Houses are mainly constructed of locally available impermanent materials, typically mud or sub-baked bricks fused with baked mud strengthened with chopped straw. These materials make poorer households susceptible to invasion of vermin and seasonally unstable, needing reconstruction after heavy rainy season. The houses made of impermanent materials, generally do not have border walls. The demographic information of sub-project is detailed in Table 41.

Table 41: Name of villages, total households and population in Siri Toi water storage dam sub-project

Name of Sub-project	No	Village Names	No of Water/Landholding Households	Population	Male	Female
Sri Toi Dam	1	Tora Darga	262	2725	1219	1506
	2	Killi Hazrat Sahib	48	2251	1070	1181
	3	Killi Surghundi	36	273	121	152
	4	**Killi Nave Oba**	75	548	230	318
	5	Killi Bobi Irrabzai	85	618	267	351
	6	Killi Ashai Kasi/Fakhri	15	87	39	48
	7	Killi Omvani Shpa	17	139	62	77
	8	Killi Gada Khel	61	1926	893	1033
	9	Killi Zawai	20	546	268	278
	10	Killi Tor Ghundi	37	559	277	282
	11	Killi Sunkasi	48	894	423	471
	12	Killi Rodh Ahmadkhel	33	595	283	312
	13	Killi Doshana Hazrat Sahib	20	228	109	119
	14	Killi Landi Bobi	45	658	297	361
	15	Killi Loi Mina	29	347	156	191
	16	Killi Shahwaz	10	129	64	65
	17	Killi Qatal Khan	23	388	172	216
Total			**864**	**12911**	**5950**	**6961**

The revenue record is registered in name of Mouza Ahmad Khel and Thappa Gastoi with Revenue Department, Zhob. The revenue record established on 19th November, 1969, reveals that total registered land is 3,981 acres and 34 poles. The irrigated land is 91 acres and 38 poles while un-irrigated land is 3878 acres, 3 rods and 38 poles. The record indicates that most of land under Mouza Ahmadkhel is distributed among landholders.

Nearly all landholders own land in sub-project, which was distributed by Karezai and Irabzai lineage of Clan Ahmadkhel tribe Mandokhel. Almost all land is distributed among sectoral lineage and for further distribution based on household and community is committed that this will be completed before the commencement of physical works. A committee is formed by shareholders to distribute land among shareholders according to tribal traditions. About 4027 ha are available for irrigated agriculture development. Currently, left bank land can't be commanded from same source, therefore farmers have installed tubewells in left bank

command area. However, if sub-project is developed these lands will be commanded. In watershed, no villages were reported by community and there was nearly no access in watershed through vehicle. The land in watershed beyond proposed reservoir poundage belongs to Arbzai clan.

Currently there is no irrigation over Siri Toi River, in rare cases tubewell irrigation was observed. Currently, there is no irrigation over Siri Toi River. However, it is clear that water rights will go to people who had land rights in command area. There are 864 land owners in Siri Toi dam. Water rights will be established with cooperation of EA/ID and IA/ACD. No agriculture is practiced in sub-project therefore most of beneficiaries are dependent on livestock, labor, business and employment with government/private agencies for their livelihood. While in each household some family members are non-residents due to their jobs and other source of income. No dispute was reported on land and water rights during survey of 17 villages and farmers were agreed to participate in sub-project development.

During workshop of ADB on 8th February at Quetta, one beneficiary of sub-project and Officer at Agriculture Department Karim Mandokhel came and objected that land of dam site and rangelands at side of watershed belong to him and having land in command area. Therefore, he would not allow sub-project until whole land of Arbzai Tribe which would come under command is distributed among all shareholders. He was told that matter of distribution of land is fully matter of their tribe and they should resolve this issue themselves, however for compensation of land at dam site it would be surveyed that how much of land would be damaged.

Later on, the complainant sent an email to ADB and EA/ID to express his grievances. In response, the Chief Engineer EA/ID wrote a letter to concerned Commissioner and Deputy Commissioner to intervene and resolve matter amicably. The PPTA team also paid visit to investigate matter.

Agriculture

At present there is no agricultural activity due to absence of irrigation system in sub- project and landowner can't brought command area under cultivation. Thus cropped area is non-existent. The projection of agriculture for sub-project was made keeping in view current situation through findings of field surveys. The landowners were interested to propose profitable crops and fruits in future. The proposed cropped area is 4,832 ha with 120% cropping intensity. The gross irrigation requirement and detailed existing and proposed/projected agriculture analysis are attached in Appendix III. It is expected that design cropping intensity of 120 percent would be completed within 5 to 6 years after completion of sub-project. The cropping pattern will be followed with high yield and profitable

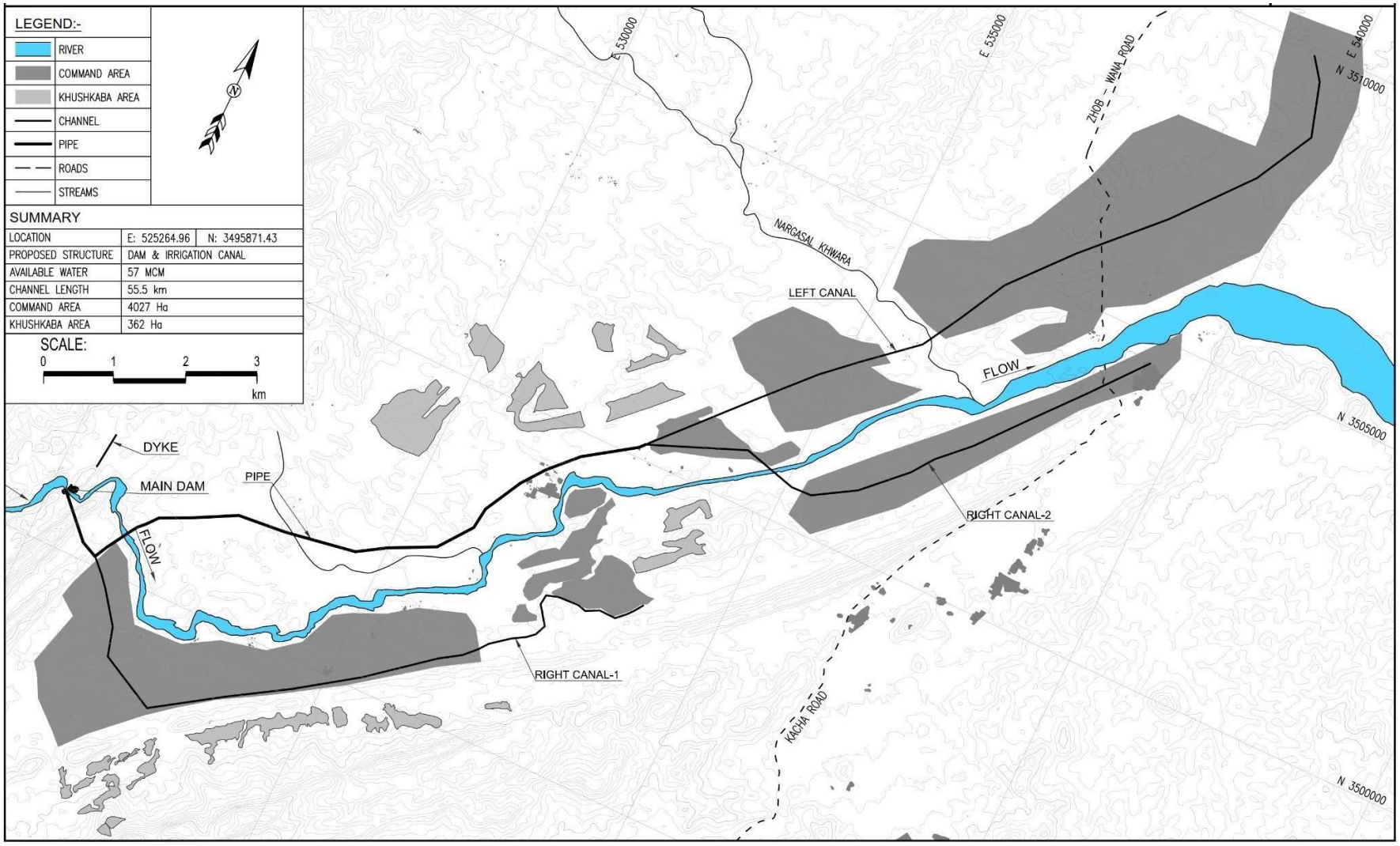


Figure 6-13: Siri Toi water storage dam sub-project – layout plan

Killi Sardar Akhtar Khan perennial irrigation sub-project is located in Union Council of Laka Bund, tehsil and district Zhob, around 49 km south-east of Zhob city in Gosa Kibzai. The sub-project is proposed on flat terrain and a large amount of land is available for cultivation. The proposed sub-project will use sub-surface flow for irrigation. Since available sub-surface water is limited, it will restrict total area that can be developed as compared to available land. Access is through a metaled road initially on Zhob to D. I. Khan road for a distance of 17 kms, then turning to right through link road via Killi Ghurdah Babar by travelling another 32 kms. The sub-project will improve 230 ha of existing command area whereas no new area will be brought under cultivation as land is not available. After construction of sub-project, lands belonging to eight villages in Qila Sardar Akhter Khan, Ghundi, Churmanwala, Zakozai, Baz Khula, Dabari, Kharhpani and Dodazai will be benefitted from irrigated agriculture.

Physical characteristics

The geological features of Killi Sardar comprise largely of underlying Cretaceous and Jurassic sedimentary rocks. Central area of sub-project location has partial deposits of alluvium mud. Kili Sardar Akhter perennial irrigation sub-project has catchment area that mostly falls in a hilly zone. Sawar stream is main tributary of Zhob River which ultimately drains floodwater into Zhob River. Another creek, namely Nahara stream drains into Sawar stream at site of proposed infiltration gallery. Various tributaries confluence into a major tributary before reaching to weir site. Command area is generally flat and has fertile soil.

The climate of sub-project is semi-arid and lies in monsoonal belt. Mean annual rainfall varies between 150-400 mm per year. It receives most of its rainfall from July to September. The region observes cold winters and hot summers with temperatures soaring as high as 40 °C in summers. Perennial surface flow is diverted to irrigate existing command area. Due to abundance of surface water, it is also used for livestock, drinking and other domestic purposes. Although perennial flow exists, flood is also available during high flow season. According to Consultant's hydrological study of surface and sub-surface flow at sub-project level, annual water availability is estimated as 2.94 MCM. Streamflow and base flow is predicted for sub-project by specifying location on particular river reach in a GIS interface of ArcSWAT model to simulate groundwater and surface water based on available meteorological, land use and soil data.

The results from model were compared with measured flows during site visit. During site visit in November 2016, 0.08 cumec flow was observed in river. The ArcSWAT model for November estimates that river will have 0.03 cumec flow. This shows the model under- predicts the flows during 2016.

The quality of water as tested at proposed sub-project of Killi Sardar Akhter comes out with pH value of 7.85 and TDS of 283 ppm. The dominant soil in sub-project is moderately deep silt loam.

There exists a katcha bund constructed by farmers to harness rain-water for irrigating khushkaba lands, as previously water from the Sawar River in this reach was not utilized due to lack of water diversion. There are cultivable areas located on both banks of Sawar River being cultivated as khushkaba, whereas remaining area located on right bank of river is being irrigated by 5 open wells by installing pumps functioning on diesel engines. The existing cropping pattern consists mainly of wheat crop as khushkaba, which is dependent on rainfall and localized runoff. The remaining area of about 60 ha (150 acres) is under cultivation for vegetables including onions, garlic, grains, fodder, and orchards. The project area consists of patches of plain land composed of clay and alluvial soils surrounded by mountainous rock.

Socio-economic profile

The main tribes living in sub-project belong to Kakar and Kibzai, main villages are listed in Table 42, and ultimate beneficiaries of sub-project. Pushto is spoken as a major language in area while few can speak Urdu. The communities are belonging to Muslim ethnic group.

Table 42: Killi Sardar Akhter perennial irrigation sub-project - demographic details

Name of Sub-project	No	Village Names	No of Water/Landholding Households	Population	Male	Female
Killi Akhtar Khan PIS	1	Killi Akhtar Khan	218	2704	1240	1464

Communal lands are mostly registered as Shamlaat. This share is inherited from ancestors. There are no landless families. The cadastral record of water and land share/rights for Killi Sardar Akhter was maintained and last updated in 1968, in which it is registered as Moza Adozai. In sub-project, land rights are held by individuals. The farmers of area have inherited practice of water distribution in which water rights are sold with land. Every farmer has an allocated time at main canal and distributaries. The distribution of water starts from head of channel and ends at tail. Each channel has its own fixed distribution cycle, usually 12 days, scheduled during day and night. At present most of land is irrigated through tubewells, they have equal water rights on surface water without any conflict according to time division rule and they ensured that they will follow this current rule of water distribution/right in future as well.

The community showed willingness for the construction of new headwork. Channel lining for right bank command areas as all 9 villages have command areas mostly on right bank and if possible for some command area on left bank.

Agriculture

At present, agricultural productivity is low in sub-project due to inadequate irrigation system in sub-project. The existing cropped area is 230 ha with 100% cropping intensity followed by annual cropping pattern wheat – kharif vegetables – orchard. The design for agriculture for sub-project was made keeping in view current irrigated cropped area, cropping intensity, yield and production in sub-projects through findings of agronomic field survey in and around sub-project. Sub-project development will enrich existing cropped area from 230 ha to 276 ha and cropping intensity will be enhanced from 100% to 120%. The gross irrigation requirement and detailed existing and proposed/projected agriculture analysis is given in Appendix IV.

It is expected that cropping intensity will increase up to 120% would be completed within **5** to 6 years after commencement of sub-project. The cropping pattern will change with high yield and profitable crops. Efficient crop management can increase profits of local farmers and decrease their costs involved in fruit production. Considering agricultural, economic and social potential sub-project is included in BWRDP. After implementation of this sub-project sufficient water will be available for design command area. The economic and financial analysis indicted EIRR of **25.23%**and a FIRR of **25.37%**. Summary of the economic and financial analysis is given in Appendix IV.

[17] Zhob River starts from Qila Saifullah specifically near Muslim Bagh which is famous for Apples and passes through whole Qila Saifullah and Zhob where they have stands of Wild Olives and Chilghoza which have conservation significance as it is threaten habitat.

[18] Already Gomal Zam Dam is taking water from Zhob River which may cause conflict.

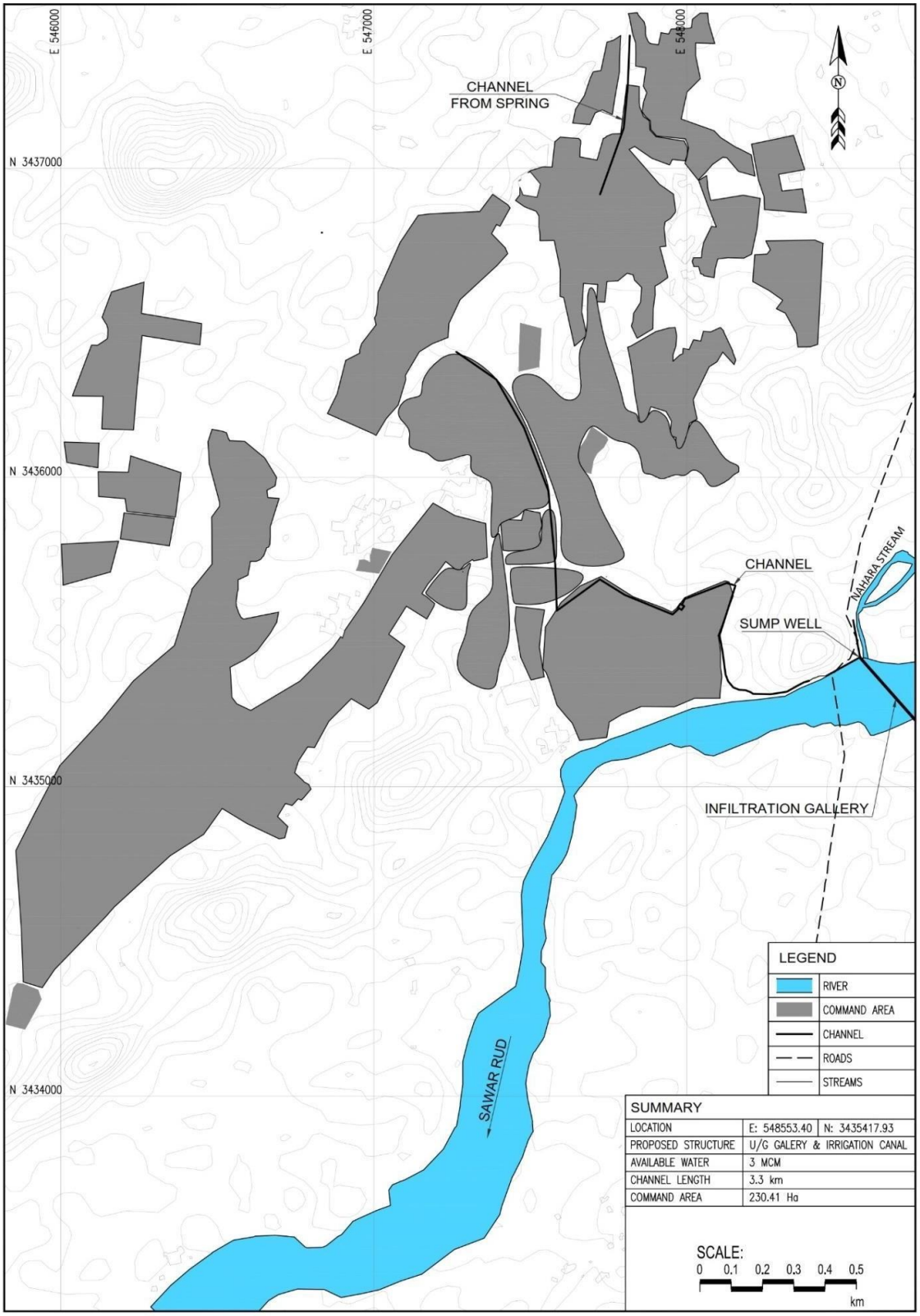


Figure 6-14: Killi Sardar Akhter perennial irrigation sub-project – layout plan

The **Churri infiltration gallery sub-project** is proposed on Sohinda River, a tributary of Mula River, in Zehri area. It is located in tehsil Zehri, district Khuzdar, Balochistan. It lies in UTM Zone 42R at 3165353.56 Northing and 281173.16 Easting. The proposed structure is an infiltration gallery. The sub project is located north-east of Khuzdar at a distance of 137 km, that is 79 km north of Khuzdar via N-25 Highway to Levies Check Post, and then 58 km east to sub-project location. The sub-project is proposed on a flat terrain. There is considerable land available for irrigation. The proposed sub-project will use sub-surface flow for irrigation. The available sub-surface water is limited, which restricts total area that can be developed.

The sub-project will bring 800 ha under cultivation out of which 115 ha are already under cultivation. After construction of this sub-project, lands belonging to two villages in Zehri Area will be benefitted.

Physical characteristics

The geological features of sub-project comprise of alluvium and extrusive mud. Areas adjacent to sub-project location, including some parts of command area, have underlying Eocene sedimentary rocks. High mountains having steep slopes are found in upstream of sub-project. The terrain is generally flat in sub-project area and is suitable for agriculture. At location of proposed infiltration gallery is narrow and only 270 m wide. The river slope in this reach is 1:125. The site is located in north of basin on an isolated tributary of Mula River. The proposed sub-project has a catchment area of 1,070 km^2 with an estimated 37.6 MCM annual water available. The river is non-perennial in this reach, but there is sub-surface flow 3 m below ground level.

The typical soils in sub-project are moderately deep silty clay loam, weakly structured and moderately deep silt loam, and, massive to platy structure. Some area comprises of shallow gravelly soil. The quality of water was tested at proposed sub-project. The water has a pH of 8.1 and 329 parts per million total dissolved solids (TDS), RSC is 1.84 and SAR 2.1. The water is fresh and suitable for irrigation.

Existing irrigation infrastructure

Infiltration gallery exists at proposed location (Figure 11). It diverts sub-surface water to an unlined channel. The arrangement provides 0.2 cumec to command area which does not meet total irrigation water requirement of area. The remaining irrigation water requirement is met through groundwater extraction.

Socio-economic profile

The main tribe living in sub-project is Zehri Tribe; as ultimate beneficiary of sub- projects. Brahvi is main language, while Urdu is used as an alternate language. The communities belong to Muslim religion. The clans in area are Zarakzai, Kehni, Jatak, Terasani, Raisani and Battar. Demographic details of sub-projects are given in Table 43.

Table 43: Demography of Churri infiltration gallery sub-project

Sub-project Name	Village Name	No of Water/Land Shareholding Households	Total Estimated Population	Male Population	Female Population
Churri Sub-project	Churi & Kahan	106	756	416	340

The integrated surveys indicated that lands are reported in cadastral records for three villages, which would be part of designed command. The land under command of source belongs to residents of about 2 villages called Mall and Kahan. The land owners take water from Nawab in Anjira on annual basis and annually provide 180 bags of wheat as

compensation on 12 hours of water. All expenditure is responsibility of land owner and does not provide any share in other crops and orchards except 180 bags of wheat.

If the water is increased after development of sub-project additional land could be brought under command, as land is available and farmers have installed over 500 tubewells at the tail end. However, tubewells are not allowed in source command area. Land rights in whole of Zehri area are not registered in settlement record.

The source is traditional infiltration gallery in Sohinda River (at the downstream called Mula River) just few meters downstream of Zehri perennial scheme. About 0.04 to 0.07 cumecs of water is drawn from source. Rainfall data of 3 rain gauge stations namely Khuzdar, Kalat and Gandawa of the Mula river basin was collected from Water Resources Planning, Development & Monitoring Directorate of Balochistan (WRPDMD) and Pakistan Meteorological Department (PMD) for period of 1980-2014. After filling data gaps from Climate Forecast System Re-analysis (CFSR) data, the analysis was conducted using ARC-SWAT Model for estimating areal mean annual rainfall at level of river basin. ARC-SWAT Model uses Theissen polygon method for distribution of rainfall.

During the site visit, it was learned with consultation of landowners that they have no conflict in terms of water distribution/rights. The available water is being diverted to cultivated land/field as per land capacity/farm size according to time division rule and they ensured that they will follow this current rule of water distribution/right in future as well. The water rights of water source are of Sardar family having about 4-6 shareholders.

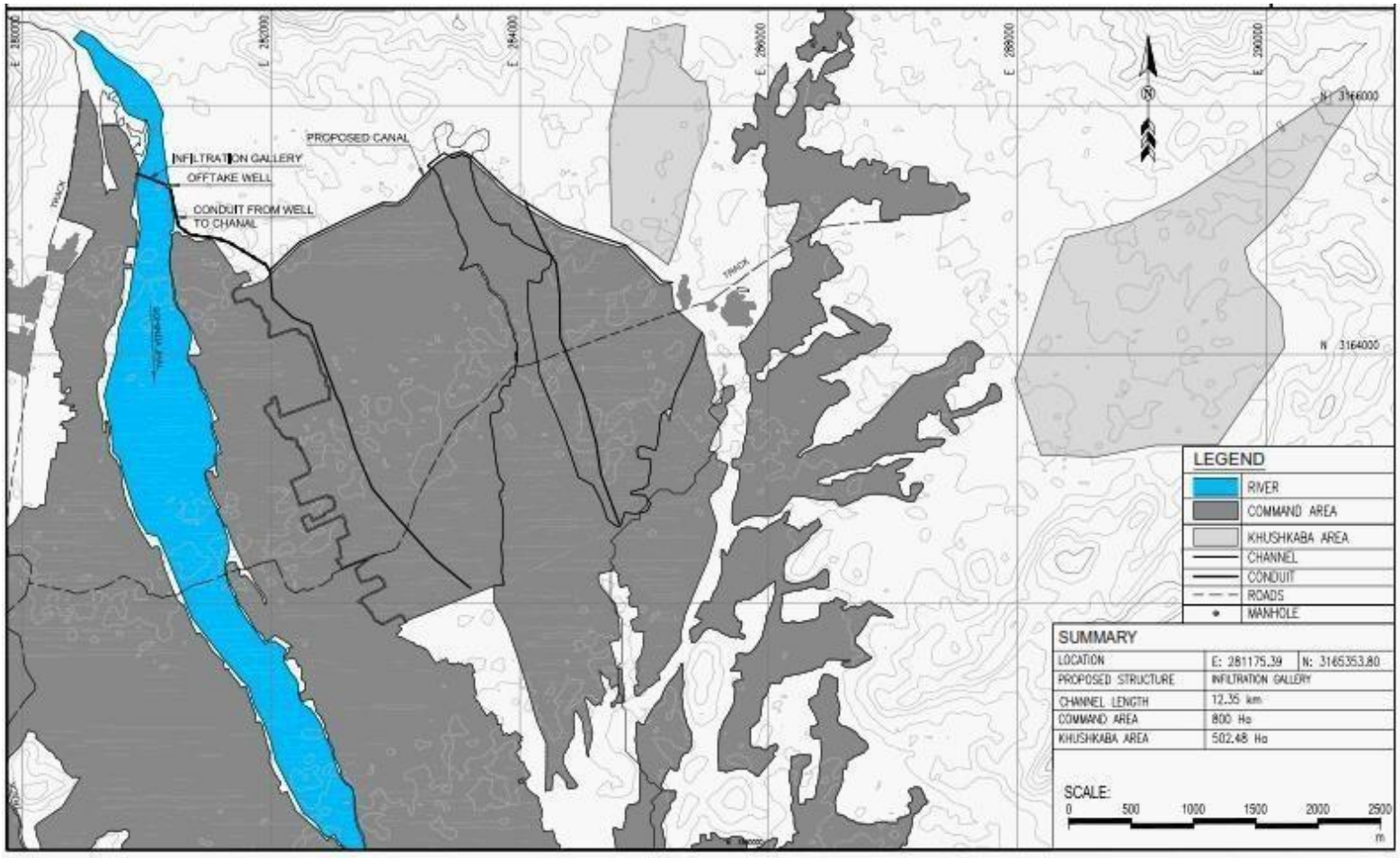
Agriculture

At present, agricultural productivity is low in sub-project due to inadequate irrigation system. The existing cropped area is 115 ha with 14% cropping intensity followed by cropping pattern wheat – *rabi* vegetables – cotton – melon and small number of orchard. The yield and production are not good enough to support landowner to enhance agricultural productivity.

The design agriculture targets for sub-project were made keeping in view current irrigated cropped area, cropping intensity and yield in sub-project through findings of field survey in sub-project area. The landowners are interested in profitable crops and fruits in future as proposed for sub-project development. Existing cropped area will be enriched from 115 ha to 960 ha and cropping intensity will be enhanced from 14% to 120%. The gross irrigation requirement and detailed existing and design agriculture targets are given in Appendix

The cropping pattern will change and it is expected that farmers will adopt design cropping pattern in a period of 5-6 years of completion of sub-project. The percentage of cropped area will increase for high value crops due to reliable availability of irrigation water. The existing cropping intensity is 14%, whereas design cropping intensity is 120%, which would be accomplished in 5-6 years of completion of sub-project. The strengthening of local service and supply providers in terms of capacity, linkages with national companies and provision of land levelling and plantation machinery for furrow-bed irrigation would help to enhance crop productivity and profitability.

Figure 6-15: Churri infiltration gallery sub-project - Layout plan



Pashta khan & Garambowad Sub-project

Areas of Pashta Khan and Garambowad are located at a distance of 7 km from each other on Anjira River which drains into Mula River near Pashta Khan. Schemes were bundled as one sub-project due to close proximity of smaller schemes. The infrastructure including head regulators, channels and other hydraulic structures were designed in isolation. Both the schemes were considered as one sub-project. Pashta Khan perennial irrigation scheme is proposed on Anjira River, a tributary of Mula River, in Pashta Khan. It is located in tehsil Mula, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R at 282531.31 Northing and 3111451.19 Easting. Garambowad perennial irrigation schemes is located on Anjira River about 70 km from Khuzdar via Pashta Khan Road. The proposed off-take well is located at elevation of 1175 m, UTM Zone 42R, 3116793.27 North and 278441.97 East. Garambowad village is located on left bank of river.

The schemes are north-east of Khuzdar in Pashta Khan area at a distance of about 64 km, that is 28 km north via N-25 Highway (RCD Highway) to Baghbana area and 36 km east on unpaved road and hilly track to scheme location. Both schemes are located on bents at both right and left banks of Anjira River surrounded by high mountains having little area on flat terrain. The proposed sub-project will use perennial surface flow for irrigation. As available land is limited, available water will fulfill crop water requirement. Pashta Khan and Garambowad perennial irrigation schemes will bring 833 ha under cultivation out of which 456 ha is already under cultivation, while 377 ha will be additional command area. After construction of sub-project, 8 villages in Pashta Khan, namely Killi Mohd Noor, Kechri, Daraz, Akro, Senar, Sherki and one village of Garambowad will come under cultivation.

Physical Characteristics

Geological features of sub-project comprise of Eocene and Paleocene Sedimentary rocks. Areas adjacent to sub-project, including parts of command area, have underlying Cretaceous and Jurassic Sedimentary rocks. The sub-project is located at tail of Anjira River, a tributary of Mula River. The sub-project is proposed on relatively narrow gorges where river is bounded by high mountains on both sides. At Pashta Khan, river is 185 m wide and at an elevation of 1104 m above mean sea level, while at Goramboward, river is 220 m wide and 1175 m above mean sea level. The river is very steep in this reach, typically on a 1:100 slope.

The bents are bounded by high hills on one side and Anjira River on other. Terrain is generally flat in sub-project and is suitable for agriculture. According to hydrological study of surface and sub-surface flow at sub-project level, using ArcSWAT Model, annual water availability was estimated as 14.2 MCM. The Model results were compared with observed flows. During site visit in November (2016), 1.19 cumec flow was observed in river. The Arc SWAT model for November estimates that river flow of 1.22 cumec. This shows the model estimates close to actual flows.

Soils in area generally comprise of shallow clay and clay loam. The area also comprises of shallow gravelly soil. The soils are slightly or moderately calcareous. No salinity-sodicity was encountered in these soils. The quality of water was tested at proposed sub-project. The water has a pH of 8.2 and TDS of 595 parts per million. RSC is 0.65 and SAR 1.58. The water is slightly saline, but not sodic.

At Pashta Khan, flow to existing commands is diverted through locally constructed head up wall called *ganda*, which is made of stone, debris and bushes. The river flow is guided by an earthen unlined channel to command area. At some places, lined channels were provided (Figure 6-16).

At Garambowad, a ganda was constructed to guide river flow to command area, which is on left side of river. An earthen channel takes flow to command area. The locals have

constructed pipe aqueducts, at river crossings. An earthen pond located in command area stores surplus water for use in dry season.

Socio-economic profile

The land and water rights mainly belongs to different clans of Zehri tribe including Nathkani, Terasani and also some other tribes including Jattak. About 406 landholding households were reported in sub-project, which includes 200 Pashta Khan, 82 Garambowad and 124 Mengalabad (Table 44).

Table 44: Demography of the sub-project area

No.	Sub-project Name	Name of Villages	Total Land/Water Shareholding Household	Total Population	Male	Female
1	Garambowad	Pashta Khan	200	1187	613	574
		Guramabad	82	544	275	269
		Mengal Abad	124	664	353	311

The land rights are equitable and all residents have share in land. The land of Pashta Khan and Mengalabad is reported in cadastral record while land of Garambowad has no settlement record. The cultivated land in sub-project was 833 ha, which includes 753 ha in Pashta Khan and 80 ha in Garambowad. Farmers prefer to use floodwater for irrigation as it brings sediments enriched with nutrients and thus results in reduced fertilizer cost.

The source is Mula river water diverted through kaccha traditional diversion bund. Pashta Khan and Mengalabad share single diversion bund. While Garambowad is 8 km upstream made their own diversion bund. Significant perennial flow can be seen at both diversion sites but farmers can divert only few cusecs in earthen channels. Water is available throughout the year. There is no conflict prevailing in sub-project related to water rights and water distribution. The available water is being diverted to each of farm and water allocation is based on land holding.

The approach of community participation was shard with beneficiaries of each sub- project and no dispute was reported on land and water rights and farmers were agreed to participate in development of sub-project. Community demands include separate head works for Pashta Khan and Garambowad, channel lining of two separate channels for upper and lower command areas for Garambowad, channel lining for command area of Pashta Khan on right bank of river and if possible to khushkaba land across tributary river Amber Zehri, channel lining for left bank lands of Mengalabad, which also includes land owners from Pashta Khan, protection bund for sub-project command area of Garambowad, Mengalabad and Pashta khan (including land of Pashta Khan hit by tributary Amber Zehri) also as well in khushkaba lands, structure to bring water on left bank for Mengalabad command area.

Agriculture

At present, agricultural productivity is low due to inadequate irrigation system in sub- project. The existing cropped area is 456 ha with 55% cropping intensity followed by cropping pattern wheat – *rabi* vegetables – cotton – rice - barley - melon and less number in orchard. The yield and production are not good enough to support landowners to enhance agricultural productivity. The designed interventions for sub-project include cropping intensity of 120% coupled with cropping pattern including high value crops. The designed agriculture interventions in sub-project will enhance existing cropped area to 1000 ha and cropping intensity will be enhanced from 55% to 120%. The landowners are much interested to propose profitable crops. The gross irrigation requirement and detailed existing and designed cropping pattern are given in Appendix II.

Two major interventions are part of agricultural design: a) increase in cropping intensity from 55% to 120%; and cropping pattern is modified by including high value crops. The local service providers (tractor rentals) and local supply providers will be strengthened to provide service to farmers in Laser land levelling and precision planting for furrow-bed irrigation, whereas supply providers will provide quality inputs of seeds, plants, fertilizers, etc.

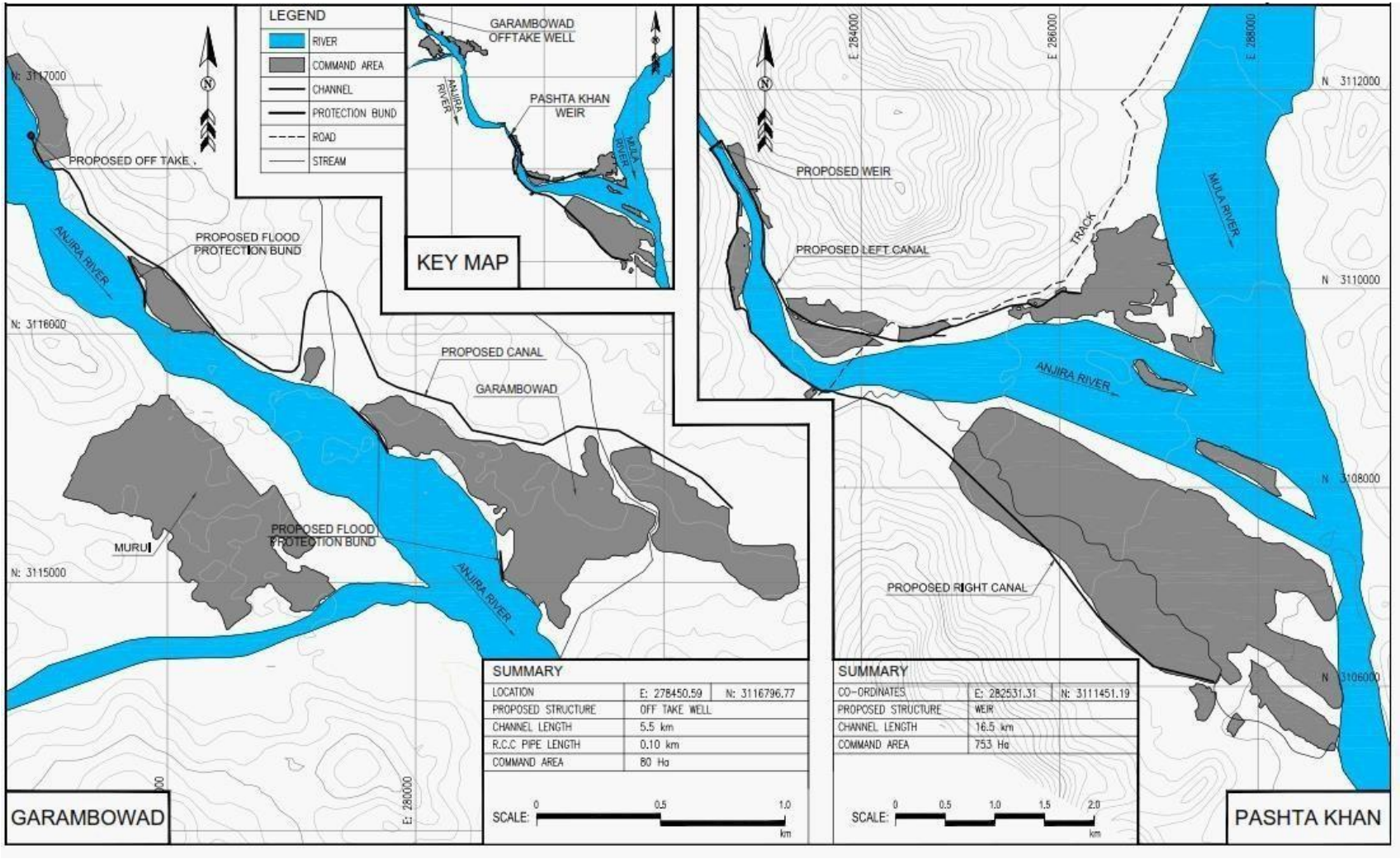


Figure 6-16: Pashta Khan and Garambowad perennial irrigation sub-project – layout plan

Karkh River Development Sub-Project

Area of sub-project

In Karkh area, six sub-projects namely Wanderi, Chutta, Khadri, Jhalaro, Acherwand and Sinjori are located on Karkh River and bundled to make it a core sub-project. The sub-projects are a few km from each other and are therefore being bundled. Wanderi perennial irrigation sub-project is proposed on Karkh River. It is located in Union Council Abad, tehsil Karkh, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R at

3067666.38 Northing and 318230.36 Easting. Chutta perennial irrigation sub-project is proposed on left bank of Karkh River. It is located 42 km from Khuzdar in Union Council

Abad, tehsil Karkh, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R

at 3068483.89 Northing and 318183.44 Easting. Khadri perennial irrigation sub-project is proposed on right bank of Karkh River upstream of Karkh Bazar. It is located 72 km from Khuzdar in Union Council Abad, tehsil Karkh, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R at 3069147.25 Northing and 318735.75 Easting. Jhalaro perennial irrigation sub-project is proposed on left bank of Karkh River upstream of Karkh Bazar. It is located 75 km from Khuzdar in Union Council Abad, tehsil Karkh, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R at 3069450.82 Northing and

318965.12 Easting. Acherwand perennial irrigation sub-project is proposed on right bank of Karkh River upstream of Karkh Bazar. It is located 77 km from Khuzdar in Union Council Abad, tehsil Karkh, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R at 3071029.12 Northing and 319626.61 Easting. Sinjori perennial irrigation sub-project is proposed on right bank of Karkh River upstream of Karkh Bazar. It is located 79 km from Khuzdar in Union Council Abad, tehsil Karkh, district Khuzdar, Balochistan. The proposed weir lies in UTM Zone 42R at 3073729.22 Northing and 320874.34 Easting.

All these sub-projects are bundled in a package and located in Karkh, at a distance of 82.4 km east of Khuzdar on Ratodero-Gawadar Motorway (M8). These sub-projects are located on bents at both left and right banks of Karkh River surrounded by high mountains having a large area on flat terrain. These sub-projects are using perennial surface flow for irrigation. The core sub-project selected for rehabilitation will bring 2250 ha under cultivation out of which 2000 ha are already under cultivation, while 250 ha will be additional command area.

Physical characteristics

The geological features of sub-project area comprise of Oligocene and Eocene Sedimentary Rocks. Area adjacent to sub-project location, and also some part of command area underlying Eocene Sedimentary Rocks. High mountains having steep slopes are found in upstream areas of sub-project. The terrain is generally flat in core sub-project and is suitable for command area development. The sub-projects are constructed on narrow gorges having a river width varies from 100 m to 150 m. The Karkh River has a longitudinal slope of 1:175 in these reaches.

The overall water balance at basin level was carried out through hydrological modeling of river basin. Stream flow and base flow is predicted for each sub-project by specifying location on particular river reach in a GIS interface supported hydrological model ArcSWAT. ArcSwat model was used to simulate groundwater and surface water based on available meteorological, land use and soil data records. The calibration of model was carried out for observed stream flow data for 9 years. The results of water balance study represents proportion of each component of hydrological cycle.

Socio-economic Profile

Residents of 5 villages would be part of core sub-project. As Acherwand and Sinjori are two mouzas having same beneficiaries which are resident in Nokjo village. The land and water rights belongs to different tribes' residents of five villages including Akhundani, Karela, Chutta

Botani, Chandio, Rind, Sasoli, Jamot. About 1200 households were reported in core sub-project area, which will be benefited from core sub-project (Table 45).

Table 45: Demography of Karkh River irrigation sub-project area

No.	Village Name	Estimated No of Households
1	Wandri	256
2	Chutta	130
3	Khadri	259
4	Jhalaro	325
5	Nokjo (Sinjori, Acherwand)	230
Total		1200

The land rights are equitable and all residents of five villages have share in land. The land of all six sub-projects is reported in the cadastral record. While nearly all land in each sub-project have been distributed by the shareholders after the construction of sub-projects in 2001. The cultivated land reported and observed in all six sub-projects altogether is about 2000 ha, while the expandable land is about 250 ha. Flood irrigation is not practiced in all of the six sub-projects.

The source of all six sub-projects is river water. Five sub-projects were constructed by GoB under BCIAP funded by World Bank in 2001 and water is diverted through five weirs built in series. While one of sub-projects, Jhalaro, is completely a new sub-project and water is diverted by *kaccha* traditional diversion bund. The water rights in all of six sub-projects are equitable and well established. The water rights of water source are of Sardar family having about 4-6 shareholders. The farmers in sub-project are not facing and concerns related to water rights of distribution of water. The available water is being diverted to various farms in existing commands according to water allocation fixed for each of farm.

The communities of these sub-projects have experienced with foreign funded projects like World Bank and Balochistan Rural Support Program (BRSP) in past. Therefore; community was very much willing to participate in development of sub-project. While no dispute was reported on land and water rights. The demand of beneficiaries of five sub- projects already constructed was largely repair in weirs headwork, repair in lined channels, lining of new channels for new command areas, protection bunds for command areas of each sub-project. While beneficiaries of new sub-project Jhalaro demanded for construction of new headwork, lining of channel up to last command areas and protection bund for command area.

Agriculture

At present, there is fair agricultural productivity in sub-project. The existing cropped area is 2,000 ha with 89% cropping intensity followed by annual cropping pattern wheat – kharif vegetables – melon – fodder. The planned interventions for agriculture in sub-project will increase command area from 2,000 ha to 2,250 ha and cropping intensity will be increased from 89% to 120% which make cropped area up-to 2700 ha. The high value crops are included in design cropping pattern. It is expected that design cropping intensity would be achieved within 5 to 6 years after completion of sub- project. The design cropping pattern includes high value crops, which will help to enhance farm income. Efficient use of water and production technology would help to increase water productivity and profitability of farming.

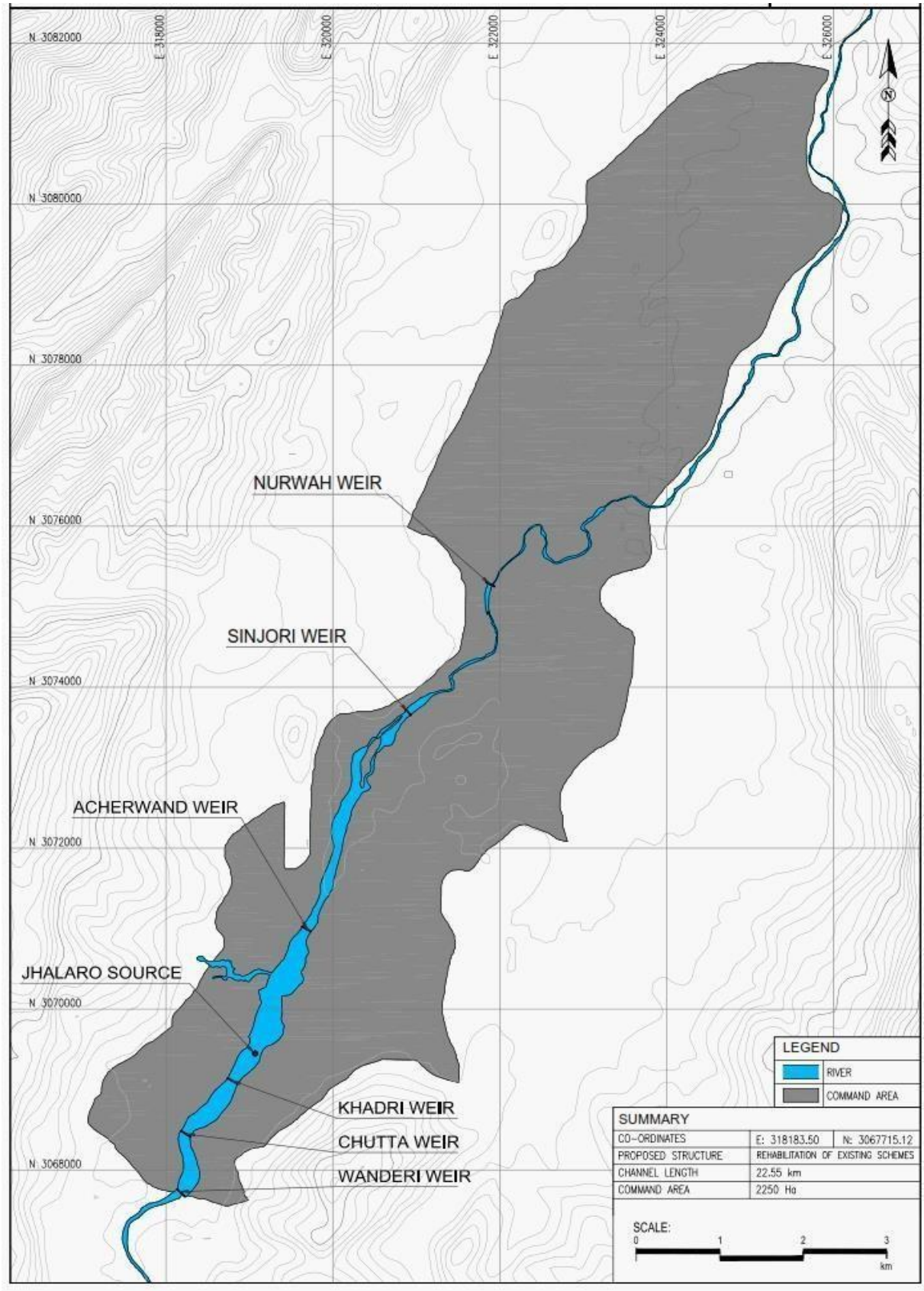


Figure 6-17: Karkh river development sub-project – layout plan

Kharzan Hatachi Core Sub-project

Area of core sub-project

The core sub-project lies in UTM Zone 42R and coordinates of 3103885.09 North and 313839.58 East. The mean altitude of sub-project command area is 600 m above mean sea level. The location of sub-project is shown on Location Map in Figure 14. The Kharzan Hatachi infiltration gallery is located on Mula river about 120 km north-east of Khuzdar via Ratodero-Gawadar motorway. A field visit to site location and adjoining areas was conducted on November 23rd, 2016, to get firsthand information about existing conditions. Visiting team walked through stream bed and adjacent areas for locating most favorable site to provide proposed intervention. In addition to general visual observation of vicinity, local inhabitants were consulted to find out location and extent of command area, Khushkaba area, *sailaba* area, and watersheds. The information was used in GIS environment and related studies to formulate core sub-project. The core sub-project is proposed on river bents and limited land is available for irrigation. The proposed core sub-project will use available surface water as well as sub-surface flows for irrigation. The core sub-project is designed to bring 681 ha under irrigation out of which 575 ha are currently under irrigation facility, while new command area of 106 ha will be developed. After construction of core sub-project, lands of two villages in Mula Tehsil, namely Kharzan and Hatachi will receive irrigation facility. Kharzan is located on right bank while Hatachi is on left bank of Mula River. Kharzan is tehsil headquarter of Mula.

Physical characteristics

The geological features of sub-project comprise of Paleocene sedimentary rocks. Area adjacent to core sub-project, and also some part of command area has underlying Eocene sedimentary rocks. The sub-project is located in middle reach of Mula River. The sub-project is proposed on relatively wide gorge where river is bounded by high mountains on both sides. The river has a width of 530 m and an elevation of 638 m above mean sea level. Moreover, river is very steep in this reach having a longitudinal slope of 1:70. Kharzan and Hatachi are largest bents on river. Both bents are bounded by high hills on one side and Mula river on other side. Terrain is generally flat in core sub-project and is suitable for irrigated command. The new command area is on a degraded rangeland.

The overall water balance at basin level is carried out through hydrological modeling of river basin. Stream flow and base flow is predicted for each sub-project by specifying location on particular river reach in a GIS interface supported hydrological model ArcSWAT. ArcSwat model is used to simulate groundwater and surface water based on available meteorological, land use and soil data. The calibration of model was carried out for observed stream flow data for 9 years. The results of water balance represents proportion of each component of hydrological cycle. The site is located in middle part of basin on main Mula River. There are number of existing sub-project diversion upstream of this location. However, there is substantial potential for a new sub-project having a catchment area of 5,219 km^2. The annual average availability of water is 125.8 MCM. There is perennial surface flow available at site. The results from model were compared with measured flows during site visit. During site visit in November (2016), 5.09 cumec flow was observed. The ArcSWAT model for November estimates that river will have flow of 3.39 cumec. This shows that order of magnitude estimated by model is in close conformity with actual flows.

The soil type is very deep clay. The soils were moderately calcareous. No salinity and sodicity was encountered in soils. The river water quality is fresh in this reach having TDS of less than 500 ppm. Perennial surface flow is diverted to irrigate existing command area in Hatachi and Kharzan villages. Due to presence of considerable surface water, it is also used for stock water and domestic use. Although, perennial flow is used for irrigation, floodwater is also available during high flows.

Socio-economic Profile

The land and water rights belongs to different clans of Zehri tribe mainly Musiani, Jam, Changlani, Naqeeb, Battar and also some other tribes including Jattak, Naqeeb, etc. About 821 household were reported in core sub-project including 411 households in Kharzan village and 410 households in Hatachi village (Table 46).

Table 46: Demography of core sub-project

No	Sub-project Name	Name of Villages	Total Land/Water Shareholding Household	Total Population	Male	Female
1	Kharzan Hatachi	Hatachi	410	2469	1203	1266
		Kharzan	411	2570	1380	1190

The land rights are equitably shared among the residents. The lands of both villages is reported in cadastral record. The cultivated land reported and observed in core sub-project was 575 ha including 250 ha of Kharzan and 325 ha of Hatachi village. The new command area is around 106 ha. There is also considerable khushkaba land in both villages. In Kharzan a tributary to Mula River called Ghurr can irrigate 258 ha which is currently uncultivated. While in Hatachi khushkaba land is located in mountains called Gorani and Ghatti having more than 120 ha of land, which is currently irrigated from localized runoff. There is no access to the site through vehicle. But farmers are trying to develop an earthen road for the area. Flood irrigation is practiced to improve soil fertility as sediments deposited with floodwater are enriched with nutrients.

The source is Mula river water diverted through *kaccha* traditional diversion bund. Both communities share single diversion structure and distribute water equally among both villages. In 2002 Irrigation scheme was constructed under BCIAP funded by World Bank. The scheme consists of intake head works, distribution structure and syphon to cross water for Hatachi command area. In flood of 2007, intake structure become non-functional and farmers again started diverting water through *kaccha* diversion bund. This situation also created tension among both communities on distribution of water. Which was resolved by civil administration by monitoring equitable distribution of water. Kharzan residents also registered a court case on Hatachi farmers on distribution of water. The matter has been settled between communities but court case is still under progress. The design water demand will be diverted to design command area. Water allocations are based on size of farm in terms of time per unit ha.

Kharzan beneficiaries reported that they have no benefit of core sub-project built in the past. Intake structure and protection bund made were washed by 2007 floods. Now they are diverting water from *kaccha* diversion as before and core sub-project is now for Hatachi village as they get all water safely through syphon up to command areas and their channels are *kaccha* due to which more than half of water is wasted. Further, they also told about dispute and court case between both communities. They would only be part of core sub-projects if their demands are met and if not then they have objection to build core sub-project for Hatachi village. They were also told to provide application to enlist their demands. Kharzan notables provided application in which they demanded for weir instead of intake structure in case both villages share single head works, proper distribution structure to share equal water between both communities, flood protection for command area, Channel lining up to their tail end commands.

Firstly, Kharzan notables did not agree initially for surveys but later on they agreed. Hatachi beneficiaries are having 50 % shareholders of water as diversion structure is in their limit and it is responsibility of Kharzan village to construct bund and provide 50 % of water. The community is of the opinion that they would resolves issues shortly and hopefully all of

water users would participate. But they suggested that best way to resolve issue is to construct separate headwork for both villages, if weir is not suggested for core sub-project.

Agriculture

At present, agricultural productivity is fair in sub-project but due to inadequate irrigation system in core sub-project, landowner can't bring command area under irrigation. The existing cropped area is 575 ha with 84% cropping intensity followed by annual cropping pattern of mix vegetables, rice and fodders – wheat. The productivity is low and income is inadequate to support family. The designed interventions for agriculture are aimed to increase cropped area from 575 ha to 817 ha and cropping intensity from 84% to 120%. The gross irrigation requirement and detailed existing and designed gross irrigation requirement are presented in Tables V.1 and V.2 of Appendix-V.

It is expected that design cropping intensity of 120 percent would be achieved within 5 to 6 years after completion of core sub-project. The design cropping pattern includes high value crops to increase farm income.

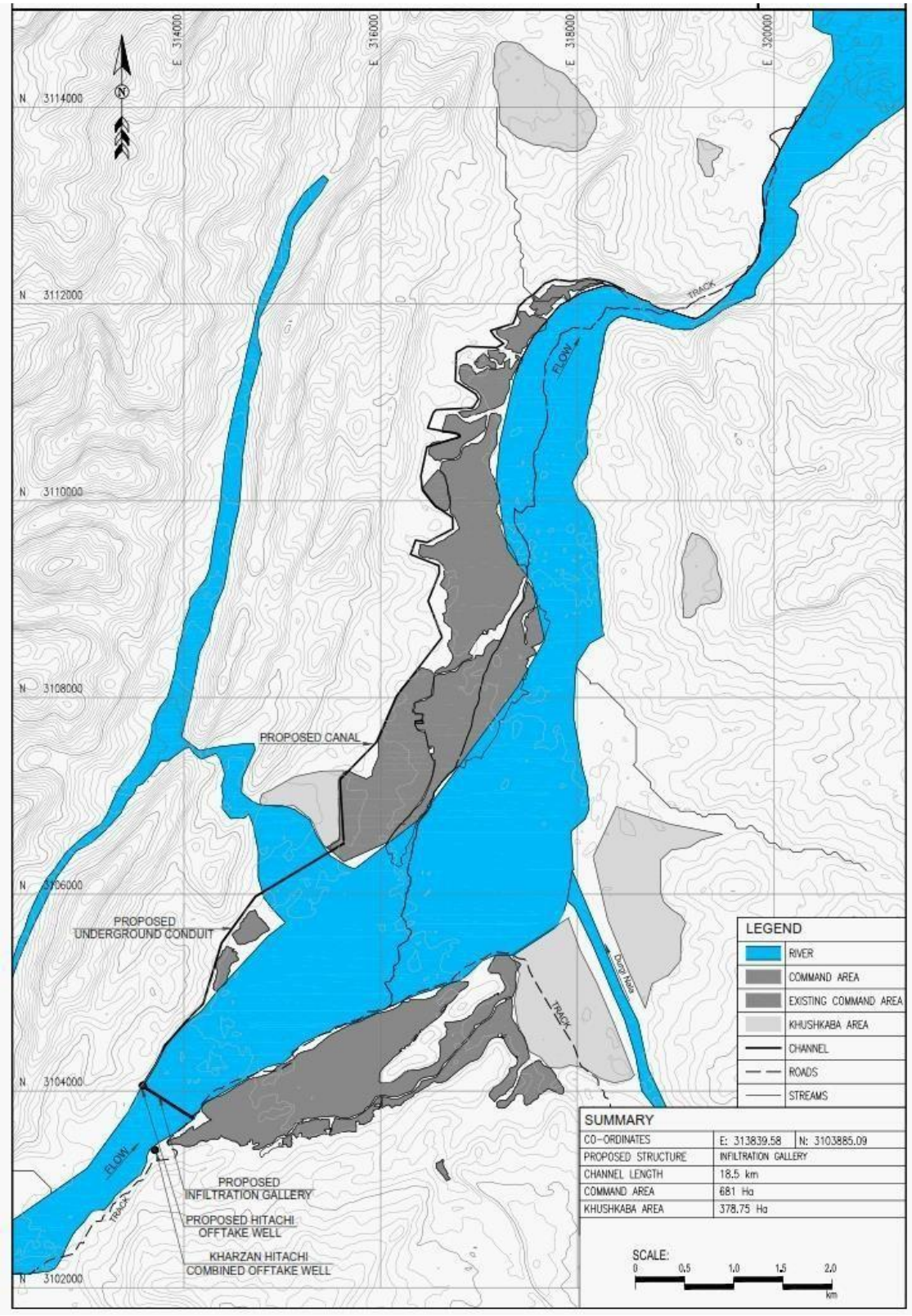


Figure 6-18: Kharzan Hatachi infiltration gallery sub-project – layout plan

Area of sub-project

Manyalo Raiko and Rind Ali perennial irrigation sub-project is located on Mula river, in district Khuzdar, about 50 km north-east of Khuzdar. The coordinates of sub-project are

3096496.83 North and 293914.18 East and average altitude of sub-project's command area

is 850 m above mean sea level. The location of proposed weir, canal and command area of sub-project is shown in Figure 15. Manyalo and Raiko are located on right bank of river, while Rind Ali is located on left bank of river. Access to sub-project site from Khuzdar is through M-8 motorway which connects to a dirt road crossing Mula river basin boundary on north-east side of M-8. A field visit to sub-project site location and adjoining areas was conducted on November 19th 2016, to get firsthand information about area and existing conditions. Visiting team walked through stream bed and adjutants areas for locating most favorable site to provide proposed intervention. In addition to general visual observation of vicinity, local inhabitants were consulted to find out location and extent of command, khushkaba, sailaba and watershed. This information was coupled with GIS and other desktop studies to formulate proposed sub-project.

Physical characteristics

The geological features of sub-project comprise of Eocene and Paleocene Sedimentary rocks. Area adjacent to sub-project location and also some part of commands has underlying Cretaceous and Jurassic Sedimentary rocks. The surrounding area of Manyalo, Raiko and Rind is surrounded by steep mountains having three gorges. Two tributaries confluence into main Mula River from eastern and western gorge just upstream of command area. Terrain is flat at this location which is suitable for command area development.

The water balance at basin level is carried out through hydrological modeling of river basin. Stream flow and base flow is predicted for sub-project by specifying location on a particular river reach in a GIS interface supported hydrological model ArcSWAT. The model was used to simulate groundwater and surface water based on available meteorological, land use and soil data records. The calibration of model was carried out for observed stream flow data for 9 years. The results of water balance study represents proportion of each component of hydrological cycle. The results from model were compared with measured flows during site visit. During site visit in November 2016, 3.39 cumec flow was observed in river. The ArcSWAT model for November estimates that river will have 2.86 cumec flow. This shows that Model under predicts flows.

The soils are deep silt loam, shallow gravelly silt loam, moderately deep to deep silty clay loam and a small area comprises of shallow gravelly soil. The soils were slightly calcareous. Soils are non-saline and non-sodic. The water quality tested at site indicated TDS of 378 ppm and pH of 8.3, which is non sodic and non-saline. Farmers are practicing Sailaba farming (spate irrigation) using earthen diversion structures locally named as *'gandas'* (Table 47), which is used to guide flow to command area. The command area is on both, left and right side of river. Perennial flow is observed on site. An earthen channel takes flow to command area. At some places, this channel is lined. There is considerable perennial flow (around 2 cumecs) that is adequate for irrigation of design command area as well as additional land in neighborhood. Absence of effective and sustainable diversion structure restricts villagers to use perennial flow.

Socio-economic profile

Population and community structures

About 734 households were reported in sub-project, which will be benefited from irrigation facility, details are given in Land and water rights belongs to different clans of Zehri tribe mainly Musiani and Jam. River turns left from Manyalo, a bent is formed on right bank called as Mouza Kericho. This Mouza could come under command from Mula River. Therefore data for Mouza Kericho was also be collected. Altogether 8 villages would be part of sub-project. However, beneficiaries of Mouzas Nurr and Kericho are mostly residents of Manyalo, Raiko, Rind Ali and Sabuz. No dispute was reported on land and water rights and farmers agreed to participate in development of sub-project. Farmers demands that head works consisting of feasible structure enough to facilitate all communities, right bank channel to provide water to Manyalo, Raiko and Kericho, left bank channel to provide water to Maloki, Sabuz, Jhakar, Thutt and Rind Ali, provision of feasible structure on tributary Nurr to irrigate land available at Mouza Kericho, protection bunds for command area of all villages. Khushkaba land is also available in sub-project and belongs to residents of all villages.

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Table 47: Demography of Manyalo, Raiko and Rind Ali perennial irrigation sub-project

Sub-project Name	Name of Villages	Total Land/Water Shareholding Household	Total Population	Male	Female
Manyalo	Manyalo	263	2063	1048	1015
	Raiko	151	961	488	473
	Saboz	78	610	303	307
	Sarwari Karacho	95	728	337	391
	Maloki	67	584	305	279
	Rindli	38	243	131	112
	Jhokar	22	195	100	95
	Thudd	20	199	99	100

The land rights are equitable and all residents have share in land. The lands of all villages are reported in the cadastral record. Residents of all villages have some land in different Mouzas. The cultivated land reported in sub-project was about 678 ha, in which land under new commands was about 364 ha. Flood irrigation brought heavy load of sediments enriched with nutrients and reduce demand for fertilizers.

The source of water is Mula River. The water is diverted through earthen diversion bunds. Manyalo, Raiko and Rind Ali share same bund while for Maloki, Sabuz, Thutt and Jhakar just upstream are using another diversion bund. Significant amount of water can be seen at diversion site but farmers can divert only few cusecs due to absence of proper head regulator structure. The water losses are more in earthen channels. The source is active throughout the year. In consultation with community indicated that they do not have any

conflict on water rights and distribution of water. The available water is being diverted to farm based on water allocations made as per Warabandi designed for command area.

During pre-feasibility study, it was observed that Maloki, Sabuz, Thutt and Jhakar are located on left bank upstream of Rind Ali village. All of land in Jhakar and Thutt belongs to Manyalo residents, while there is considerable land in Maloki and Sabuz. The community demands that while supplying water to left bank command areas of Manyalo that is Jhakar and Thatt and to Rind Ali should also be provided water as they have lands in Maloki and Sabuz villages. The meeting was held with all beneficiaries of left bank along with Manyalo including Sabuz and Maloki. They all agreed to irrigate left bank command area of Manyalo as well as Sabuz and Maloki as most of land owners belong to Manyalo.

Agriculture

At present, agricultural productivity is low. The existing cropped area is 314 ha with 46% cropping intensity followed by annual cropping pattern of cotton mix-wheat mix. The designed interventions for agriculture include: a) increasing cropped area from 314 ha to 814 ha and cropping intensity from 46% to 120%. The gross irrigation requirement are given in Tables VI.1 and VI.2 of Appendix-VI.

It is expected that designed cropping intensity of 120% would be achieved within 5-6 years of completion of sub-project. The design cropping pattern includes high value crops to enhance farmers' income.

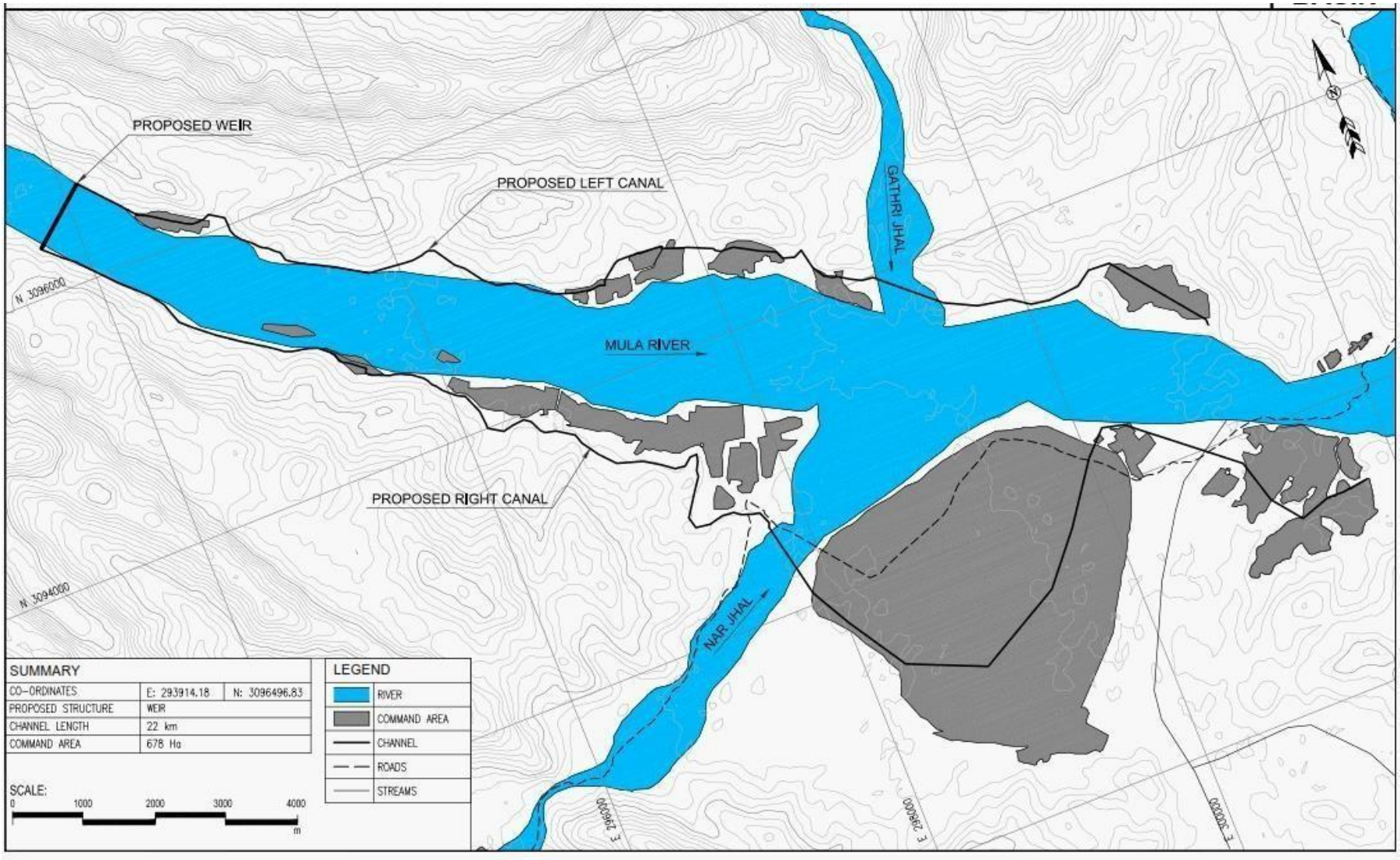

Figure 6-19: Manyalo, Raiko and Rind Ali perennial irrigation sub-project - layout plan

6.12 Socioeconomic Baseline of Zhob River Basin

This Chapter presents a summary of the socio-economic conditions in the BWIRDP area. The complete social assessment is presented separately in individual social assessment reports for each of the basins.

6.12.1 Demographics and Population Distribution

According to 2017 census, total population of district Zhob is 310,544, with 54.21% male and 45.79% is female, as compared to 193,458 in 1998. Male-female sex ratio is 118.41 and population growth rate is 2.52% per year. Urban population of the district is 46,248 (14.89%) and rural population is 264,296 (85.11%). Overall household (HH) size in the dsitrict is 6.76, Urban (6.73) and Rural (6.76).

6.12.2 Ethnic and Language Groups

Balochistan is a fragmented society in which tribe and tribal networks dominate social organization. The main ethnic groups are the Baloch, Brahvi and Pashtun.

The vast majority of the population of Zhob district is Pashtun. The indigenous tribes of Zhob include the Mandokhail, Khosti, Sherani, Kakar, Harifal, Lawon and Babar. Currently a large number of IDPs have been settled within the confines of the District as part of the evacuation from Operation Zarb-E-Azb taking place to the north of Zhob.

6.12.3 Family

The family set-up in the district is different for rural and urban areas. Urban life is limited to Zhob city. The rest of the district is purely rural. A large number of families in the district lead a nomadic or semi-nomadic life. Most people in the district live in a joint family system. In Zhob city nuclear families occur apart from the joint families.

6.12.4 Health Facilities

The highly subsidized public healthcare system is the major provider of curative and preventive care services to the local population. The health infrastructure includes: 1 Hospital, 4 Rural Health Centers (RHCs), 14 Basic Health Units (BHUs), 19 Civil Dispensaries (CDs), 2 Maternal & Child Health Centers (MCHCs), 2 School Health Unit and 1 TB Clinic. There are 138 beds out of which 34 are situated in RHCs. One mobile dispensary is also functioning in the district to cover the far flung areas. Apart from these health facilities there is one non-functional BHU and five under construction BHUs in the district. Moreover there is one (1) private hospital with 10 beds in the district.

6.12.5 Education

From infrastructure to state of indicators at different levels of education, it is evident that gender disparity needs immediate interventions to move towards gender balance. Most children do not continue education beyond primary and this is more pronounced in case of girls. One of the major reasons for low enrollment in secondary levels is non-availability of schools. Against 285 primary schools in the district, there are only 25 middle and 16 high schools. There is also general scarcity of female teachers as on average there is only one primary teacher per 27 pupils. Primary school completion is also very low (29%).

6.12.6 Communication

Zhob is linked by air with major cities of the country. A fokker flight operates from Quetta linking Zhob with Multan, Dera Ismail Khan, Peshawar and Islamabad. Zhob is 320 kilometers from Quetta, 225 kilometers from Dera Ismail Khan. However, the road linking Zhob with Dera Ismail Khan is for the most part a dirt track passing through water streams and only 48

kilometers is metalled. The poor condition of the road acts as a deterrent for an increase in inter-provincial transportation and commercial exploitation of the route. The narrow gauge railway linking Quetta with Zhob became moribund in 1984 and the service is no longer available. While it functioned-the railway was a romantic reminder of yester years with the highest railway-station of the country en route namely Kan Mehtarzai (altitude 2800 meters). The total length of the track was 295 kilometers with I I railway stations on the way.

6.12.7 Post Offices / Courier Services

Postal service in Zhob is based on departmental and extra departmental arrangements. There is a grid station at Zhob facilitating power supply from the national grid

There is a General Post Office (GPO) because Khuzdar is also the divisional headquarter of the postal services.

6.12.8 Role, Position and Status of Women

In District Khuzdar, The role, position and status of women in Khuzdar are not any different from the Baloch women in other parts of Balochistan. They perform very productive roles at home and on family farms, but their role as decision makers in family matters is rather limited. They have little or no role in decisions concerning investment, acquisition of property etc. However, in case marriage affairs elder women may play influential role. Home is considered their proper domains. They enjoy respect at home and outside, but, as stated above, have no status in the sense that in most matters they have no decision making role. There is no concept or tradition of granting right of inheritance to women. Their economic role is that of allies, but they do not have their own income, hence are economically dependent. Their access to health care and education is often denied (female literacy, 15 years and above, in the district is quite low – only 10.3%).

6.12.9 Drinking Water

In District Khuzdar, A household survey conducted in 2010,has shown that 74% population has access to one or more improved water sources, of which, protected dug wells (33%)constitutes major source followed by tube wells or boreholes (20%) and piped water (20%).Other minor improved sources include protected springs (1%). Major unimproved sources are unprotected dug wells (23%) and unprotected springs (2%) and approximately 1% of unimproved water source belonged to other categories as mentioned in the graph. About 35% household population have no water on their premises and have to travel long distances to fetch water.

6.12.10 Minerals

In District Khuzdar, Other than Marble, Lead and Zinc are also among main minerals. Common minerals of economic significance are Galena (PbS) and Sphelerite (Zn, Fe). Some of the important Lead Zinc prospects of District Khuzdar require detailed exploration. Gunga Lead Zinc Barite has deposit of 10 million tones according to preliminary estimates (Geological Survey of Pakistan) wheres Surmai Lead Zinc deposit are estimated at 3 million tons Iron Ore deposits of Hematite are of economic significance at different localities in ultramafic rocks near Monar Talar. These deposits are being mined by private sector and transported down the country in raw form. Strontium and Copper deposits of good quality have been reported too. The Barite mineral in chemical composition of BaSo4 owing to its high specific gravity is used in production of oil well drilling mud, in paints, chemical ceramics, paper industries and manufacture of barium chemicals. Its large deposits occur at Gunga 16 Km to south-east of Khuzdar city with ore in interbedded limestone and shale. The zone of mineralization is about 1,380 meters long. Massive Sulphide Copper deposits are also found in the area.

6.13 Socioeconomic Baseline of Mulab River Basin

All the irrigation schemes of Mula River Basin are located in District Khuzdar, so socioeconomic conditions has been described accordingly.

6.13.1 Demographics and Population Distribution

Total population of district Khuzdar is 802,207 (Census PBS, 2017) as compared to 417,466 in 1998; 52.51% is male population and 47.49% is female population in 2017. Male-female sex ratio is 110.59 and population growth rate is 3.49% per year. Urban population of the district is 277,136 (34.55%) and rural population is 525,071 (65.45%). Distrcit household size is 6.66, urban household size is 7.09 and rural household size is 6.46. Baloch is the main ethnic group, while Brahvi, Balochi and Sindhi are the major languages of the district.The major Baloch tribes in the district are Zehri, Sumalani, Mengal, Kalandrani, Mohammad Hasni, Sajidi, Bizenjo, Nichari, Qambrani, Pandrani, Mirwani, Rekizai, Gurganari, Jattak, Rodeni and Sasoli.

6.13.2 Ethnic and Language Groups

In District Khuzdar, Baloch is the main ethnic group, while Brahvi, Balochi and Sindhi are the major languages of the district.The major Baloch tribes in the district are Zehri, Sumalani, Mengal, Kalandrani, Mohammad Hasni, Sajidi, Bizenjo, Nichari, Qambrani, Pandrani, Mirwani, Rekizai, Gurganari, Jattak, Rodeni and Sasoli.

6.13.3 Family

In urban areasof Khuzdar, the nuclear family system is preferred to a joint family system, where people are residing for professional reasons. Having limited income they prefer to live independently, whereas in rural areas, majority of the people live in joint families. The eldest male member takes care of all the family members. His decision is final in family affairs. In rural areas, nuclear families are very rare; however, the trend for nuclear family is rising in urban areas. The family institution is very important as it provides social security during un-employment and financial crisis. It also plays an important role in social interaction and conflict.

6.13.4 Health Facilities

The highly subsidized public healthcare system is the major provider of curative and preventive care services to the local population. The health facility infrastructure includes: 1 Hospital, 6 Rural Health Centers (RHCs), 34 Basic Health Units (BHUs), 31 Civil Dispensaries (CDs), 1 Maternal & Child Health Center (MCHC) and 1 TB Clinic. There are 190 beds, out of which 100 are situated in RHCs. Apart from these health facilities, there are two leprosy clinics and two private hospitals with 30 beds.

6.13.5 Education

Gender disparity is high at all levels of education. The number of female education institutions is also far lower than those for males. Most children do not continue education beyond primary and this is more pronounced in case of girls. One of the major reasons for low enrollment in secondary levels is lack of schools. As compared to 575 primary schools in the district, there are only 47 middle and 22 high schools.The number of female teachers is very less as on average there is only one primary teacher per 57 pupils. Only 29 % of the students complete their primary education.

6.13.6 Communication

Khuzdar has active transportation linkages with other parts of the country including Quetta, Karachi and Shahdad Kot. As Khuzdar is located halfway on the RCD highway, transport for Quetta and Karachi is available 24 hours a day. Motorcycles are the most common means of transportation for local people. A large number of vehicles are registered at Karachi and Quetta No railway service exists in the district. Khuzdar is linked with Karachi, Sukkur, Turbat and Moen-jo-Daro by air, however, the airport in Khuzdar is not functional.

6.13.7 Post Offices / Courier Services

There is a General Post Office (GPO) because Khuzdar is also the divisional headquarter of the postal services.

6.13.8 Role, Position and Status of Women

In District Khuzdar, The role, position and status of women in Khuzdar are not any different from the Baloch women in other parts of Balochistan. They perform very productive roles at home and on family farms, but their role as decision makers in family matters is rather limited. They have little or no role in decisions concerning investment, acquisition of property etc. However, in case marriage affairs elder women may play influential role. Home is considered their proper domains. They enjoy respect at home and outside, but, as stated above, have no status in the sense that in most matters they have no decision making role. There is no concept or tradition of granting right of inheritance to women. Their economic role is that of allies, but they do not have their own income, hence are economically dependent. Their access to health care and education is often denied (female literacy, 15 years and above, in the district is quite low – only 10.3%).

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In District Khuzdar, Other than Marble, Lead and Zinc are also among main minerals. Common minerals of economic significance are Galena (PbS) and Sphelerite (Zn, Fe). Some of the important Lead Zinc prospects of District Khuzdar require detailed exploration. Gunga Lead Zinc Barite has deposit of 10 million tones according to preliminary estimates (Geological Survey of Pakistan) wheres Surmai Lead Zinc deposit are estimated at 3 million tons Iron Ore deposits of Hematite are of economic significance at different localities in ultramafic rocks near Monar Talar. These deposits are being mined by private sector and transported down the country in raw form. Strontium and Copper deposits of good quality have been reported too. The Barite mineral in chemical composition of BaSo4 owing to its high specific gravity is used in production of oil well drilling mud, in paints, chemical ceramics, paper industries and manufacture of barium chemicals. Its large deposits occur at Gunga 16 Km to south-east of Khuzdar city with ore in interbedded limestone and shale. The zone of mineralization is about 1,380 meters long. Massive Sulphide Copper deposits are also found in the area

6.14 Economic Activities and Livelihood Patterns in the Project area

The main economic activity of the project area is agriculture. Most farmers supplement their income from livestock keeping, cultivation of land, livestock grazing, reaping and harvesting of the produces and other allied subsidiary occupations. Some of the population is engaged as unskilled labour in road infrastructure and general. Others are either employed in Government services or in the private sector. Tenancy is common in the area and the main source of income of landless households is tenancy in Sailaba and Khushkaba farming systems. One-third of the households depend primarily on agricultural activities for income generation as land tenants. Due to the unpredictability of the Sailaba and Khushkaba agriculture, the agricultural incomes are usually slightly above subsistence levels.

It is uncommon to take credits from Zari Taraqiati Bank Ltd or from other banks. However, social mechanisms exist in which interest free loans can be taken from relatives, traders and shopkeepers and repay at the time of harvest. Most the farmers plough their land on credit

from tractor owners of the area, paying only the cost of fuel and oil at the time of ploughing and paying the tractor hire cost at the time of harvest. The economy of the province is largely based upon the production of natural gas, coal and minerals. The provincial natural resources significantly help to meet the energy needs of Pakistan. Due to the tribal lifestyle of many Baloch and Brahvi, livestock is important as trading bazaars are found throughout the project area.

6.15 Traditional Water Rights and Management

In Balochistan, water-rights in spate-irrigated areas, whether perennial or non-perennial, are essential for conflict resolution. However, there is a categorical difference between water rights in spate-irrigation systems and neighbouring canal irrigation systems in arid lands.The perennial spate-irrigation system basically originates from the springs fed by the aquifer, but is subject to devastations caused by the floodwater supporting non-perennial spate-irrigation system. Therefore, perennial spate-irrigation system is an integral part of overall stream-network of the floodwater. The water-rights of the perennial spate-irrigation system are often sharply defined in fixed and even exchangeable proportions of the flow and allowed usage-time compared to the non-perennial spate irrigation system, where water-rights are reactive. Water-rights of perennial spate irrigation system are also disturbed in terms of availability of water at the source or at any point in the conveyance channel due to medium-term changes in the river-morphology, scouring, siltation and change of river course (Ahmad et al. 1998). Water distributions in the floodwater irrigation systems are based on allocation rules rather than alienable property.

Irrigation water rights are based on customary tribal laws and can be differentiated in o three linguistic groups namely Pashtuns, Balochs and Brahvis and they directly derive from land rights. The water can be used freely for domestic and stockwater uses. The domestic use rights apply only to water used on the spot or fetched in buckets and pitchers, but do not allow for the construction of channels or pipes to homes for this purpose. Detailed descriptions of the traditional water management systems in both basins are provided in the social assessment reports.

In the local water resource management of the indigenous water harvesting systems, the public sector is considered as an external player. Indigenous systems are managed completely by the local water users' institutions. Therefore, for any change, there is a need to have clear focus on resource users' institutions itself and see what factors influence change, stagnation or sustainability. Furthermore, it is also useful to define role of public sector in setting more transparent conditions for change, stagnation or collapse.

Transaction costs are the cost of arranging, monitoring and enforcing contracts. In local water resource management these are often social contracts, regulating access and usage of the resource within group of resource users. This is referred to first order transaction costs related to management of the indigenous systems in traditional framework.

The second order transactions costs deal with institutional or technological change. Second order transaction costs are generally high in comparison to first order transaction costs. Institutional change requires learning rather than information collection, and bargaining rather than contract preparation. Moreover, institutional change is not repetitive, but incidental. Its outcome is uncertain and the behaviour of various actors cannot be predicted. Whereas at the level of institutional management interests are often defined by the institutions and a status quo exists, in institutional change interests are open. They may differ and conflict and complicated negotiation is necessary. The costliness of institutional change explains why some changes – although they could improve resource utilization – do not take place at all. There are several examples of institutional stagnation in local water resource management in Pakistan that can be attributed to high second order transactions costs. The failures of groundwater management regimes in most valleys of Balochistan, the inability to reach agreement on water rights in new agency-developed systems, and the lack of adjustment in

water delivery schedules in perennial-spate-irrigation systems are the few examples (Steenbergen, 1997).

7 POTENTIAL IMPACTS AND MITIGATION MEASURES

7.1 General

This chapter identifies the significant potential environmental and socio-economic impacts which may occur during the project life. The appropriate mitigation measures are also discussed in this and the subsequent chapters of this report. A brief qualitative description of each aspect and the affected environment in both Project Area and AOI is presented in the following sections.

7.2 Impact Assessment Methodology

Potential environmental and social impacts were identified by reviewing the independent ESIA, feasibility study reports, stakeholder consultations, and other sources. The significance of potential impacts was assessed using the criteria and methodology given below.

Impact Magnitude

The potential impacts of the project have been categorized as major, moderate, minor or nominal based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria.

The magnitude of potential impacts of the Project has generally been identified according to the categories outlined in Table 48.

Table 48: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration of potential impact	Long term (more than 20 years)	Medium Term Lifespan of the project (6 to 20 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable

Parameter	Major	Moderate	Minor	Minimal
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity of Receptor

The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in Table 49.

Table 49: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown in Table 50.

Table 50: Significance of Impact Criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very High	High	Medium	Low
Major	Critical	Major	Moderate	Minimal
Moderate	Major	Major	Moderate	Minimal
Minor	Moderate	Moderate	Minor	Minimal
Minimal	Minimal	Minimal	Minimal	Minimal

7.3 Summary of Assessed Impacts

The project's potential impacts and their significance have been assessed using the methodology described in Section 6.2 above. A summary of these impacts and their significance is presented in Table 51.

Table 51: Potential Impacts and Their Significance

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Environmental and Social impacts during pre-construction stage:						
Negative Impacts						
Failure of previous similar interventions/projects and schemes.	Pre-construction	High	Minor	Moderate adverse	• The causes of failure of previous interventions in terms of design and / or construction faults will be studied and incorporated into the detailed designs.	Minimal
Improper dam site selection/route selection(alignment)of proposed new canal and land acquisition will lead to social issues related to relocation of assets	Pre-construction	High	Minor	Moderate adverse	• The site selection of dam should be with regards to the area geology and topography as these plays important role for the sustainability of project and to ensure proper land acquisition justified to all stakeholders • Special considerations will be made for the selection of routes for both main canal and right & left canals which ensure proper distribution of water for all, alignment must be avoided from any controversial land, and alignment selection must be justified to all stakeholders	
Storage capacity of dam will be reduced due to sedimentation	Pre-construction	High	Minor	Moderate adverse	• Watershed management and erosion control measures have been included as an integral component of the project to control the reservoir sedimentation	
The Sri Toi Dam Project area lies in zone 3 as per seismic map of Pakistan which clearly shows that the area is in moderate to high risk zone. So due to earthquake the breaching of dam, canal and other irrigation structures is possible	Pre-construction	High	Minor	Major adverse	• Design engineer should ensure that seismic design of dam, spillways, reservoir and other allied and irrigation structures should be carried out as per international engineering standards	
Schemes will only benefit some influential people of the area and not benefit the poor and vulnerable people most in need.	Pre-construction	High	Minor	Moderate adverse	• Location of proposed schemes should be identified based on field survey, need assessment, and consultations with local community to have a proper geographical dispersion of interventions to ensure equitable distribution of benefits. • The project intervenes in both basins in a manner that ensures that there are many individual beneficiaries from project activities.	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Any perceived or real disturbance to traditional local water rights will almost certainly lead to social disturbance in the area. This impact would be of moderate significance					• Proper water distribution through "Warabandi System" engaging Water User Associations and BIPD (Irrigation department)	
Impacts on Ecology, Soil and Land						
Some acres of land may be required on temporary basis for contractor' camp.	Pre-construction	Very High	Major	Major adverse	• Only government land to be used; no private or community land to be used. • In extreme case where private land acquisition is unavoidable, it will be compensated under the guidelines presented in the resettlement policy framework included in the Social Impacts Assessment and Mitigation Plan.	Minimal
Sub-basin / Watershed and Scheme site location. Improper selection with reference to site ecology (i.e. improper project siting) may lead to erosion and loss of useful agricultural land.	Pre-construction	High	Major	Major adverse	• Appropriate site selection and design are being conducted according to national and the ADB guidelines in order to entail no or minimal disturbance to local ecology, soil and land.	Minimal
Improper site selection and design can lead to removal of vegetation and cutting of trees.	Pre-construction	High	Major	Major adverse	• Schemes located in ecologically sensitive areas not approved, in order to avoid impact on flora /fauna.	Minimal
Sub-basin / Watershed and Scheme site location may lead to deforestation in the sub-basins.	Pre-construction	High	Major	Major adverse	• Plantation plan / forest / rangeland management consideration during design phase.	Minimal
Impacts on Surface Water						
Watershed / Scheme Site interventions may affect natural drainage / run-off. This can stress local natural stream flow –which may cause surface water quality degradation and contamination of water resources and affect downstream ecology.	Pre-construction	High	Major	Major adverse	• During design stage, watershed hydrological modelling is being considered of each scheme site to account for effects on natural drainage and surface water quality.	Minimal
Improper design considerations for suspended silt / maintenance of minimum flows may degrade downstream ecology.	Pre-construction	High	Major	Major adverse	• Designs to consider flow regulatory structures / schemes and minimum flow requirements.	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Excessive diversion/use of surface water resources may lead to depletion of natural surface water resources in the area.	Pre-construction	High	Major	Major adverse	• Design to consider proper water utilization rates under schemes as not to deplete water resources.	Minimal
Impacts on Groundwater						
Improper assessment of sub-surface ground water levels prior to design stage for Non- perennial schemes may lead to depletion of ground water resources.	Pre-construction	High	Major	Major adverse	• Extensive ground water table studies are beinge carried out during feasibility stage. • Schemes should be designed according to Ground water recharge/ pumping regulations.	Minimal
Improper capacity lead to inappropriate fertilizer and pesticide use in irrigation may lead to degradation of sub-surface water quality and contamination.	Pre-construction	High	Major	Major adverse	• An integrated pesticide management plan is prepared under the national regulatory guidance and in line with ADB safeguard policies. • Extensive training is designed under the On Farm Water Management Program for the proper use of pesticide.	Minimal
Social impacts during construction stage						
Positive Impacts						
Generation of employment.	Construction	Medium	Moderate	Moderate beneficial	• Temporary employment for local workers and technicians, local unskilled labors. Also, employment of locals during surveys.	Moderate beneficial
Increased economic activity.	Construction	Medium	Moderate	Moderate beneficial	• Establishment of new businesses and commercial enterprises; local employment. • New market for local produces, more sale and revenue generation. • As a result of the influx of a workforce, there shall be a higher demand for locally produced food, goods and services benefiting local farmers, producers, traders including small shops within project area.	Moderate beneficial
Negative Impacts						
Temporary land acquisition by the contractor during construction.	Construction	Medium	Moderate	Moderate adverse	• Only government land to be used; no private or community land to be used. • In extreme case where private land acquisition is unavoidable, it will be compensated under the guidelines presented in the resettlement policy framework included in the Social Impacts Assessment and Mitigation Plan.	Minor adverse

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Safety hazards due to increased traffic especially for children and elderly people.	Construction	Medium	Moderate	Moderate adverse	• Traffic Management Plan addressing general access to be implemented. • Safety and security actions and procedures to protect local community during construction phase.	Minimal
Risk of accidents and unsafe working conditions for workforce.	Construction	Medium	Moderate	Moderate adverse	• Occupational Health and Safety Plan to be implemented. • Emergency Preparedness Plan to be implemented. • Contractor follows ADB core labor standards on Labor and Working Conditions; • Safety training for all workers.	Minimal
Security risks for workers and project staffs, especially in Mula River basin area.	Construction	Medium	Moderate	Major adverse	• Continued consultations with the tribal leaders and local community leaders on security matters. • Security at the work sites and camps. • Identification cards to workers. • Access to the camps must be controlled through gated entrances and entrance and exit logs shall be maintained at each gate. • Preparation and implementation of the contractor's Communication plan to engage local leaders and community.	Minimal
Inadequate construction site security poses a significant risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion.	Construction	Medium	Moderate	Moderate adverse	• Ensure security at the work sites and camps. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Ensure there is proper fencing around construction site perimeter, chain-link at least 2.4 m high and secured with a steel chain and lock. • Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background. • Identification cards to workers	Minimal
Possible cultural conflicts between communities and workers.	Construction	Medium	Moderate	Moderate adverse	• Awareness campaign; Code of conduct for workers. • Grievance mechanism developed and implemented. • Develop and implement strong community participation plan.	Minimal
Risks of HIV/AIDS and STI due to the flow of migrant workers.	Construction	Medium	Moderate	Moderate adverse	• Awareness creation on HIV/AIDS infection and diseases through a well-designed campaign implementation plan targeting all risk-prone groups. • Empowering women through employment in the construction work.	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Increased pressures on local facilities (i.e., mosques, health care facilities) due to in-flux of migrant labors.	Construction	Medium	Moderate	Moderate adverse	• Construction contractors will provide all required facilities for workers, so workers will not put pressure on local facilities.	Minimal
Health and safety risk of the community due to the existence of a construction site(s) and the storage and use of hazardous chemicals.	Construction	Medium	Moderate	Moderate adverse	• The Contractor shall follow ADB Safegaurds EHS guidelines as detailed in bidding documents to be reviewed by the Bank. • If there are any hazardous materials, they shall be safely stored on construction site locations under lock and key.	Minimal
Temporary interruption of irrigation water supply during construction works. During construction, supplies of water may be insufficient to satisfy the requirements of crops growing in the command area of each Canal, thus reduce the income of these farmers which shall have a negative impact on the socio-economics of the impacted area.	Construction	Medium	Moderate	Moderate adverse	• Prepare construction schedule to avoid farming seasons. • For longer construction scheme, the contractor shall be prohibited from interrupting the water supply to any canal or reducing it below the allocated discharge of these canals by proving diversion canals on the section where work is planned on priority basis. • The Contractor shall programme the Works to utilize the low water demand periods in the command area. • The Contractor shall submit a construction schedule to the Engineer for approval on mobilization. If in case, the closure of water supply is unavoidable, the Contractor needs to share his plan with the farmers and get their consensus.	Minimal
Environmental impacts during construction stage						
Negative Impacts						
Emissions of dust and air pollution will be generated from excavation works, operation of construction equipment and vehicles, material transport, and site clearance	Construction	Medium	Moderate	Moderate adverse	• Water the soil surface and any non-asphalted roads, especially in the dry season. • Water the soil before starting excavating. • The storage and handling of spoil, subsoil, topsoil and materials should be carefully managed to minimize the risk of wind-blown material and dust. • Cover hauling vehicles carrying dusty materials moving outside the construction site. • Fit vehicles with appropriate exhaust systems and emission control devices. • Limit the idling time of vehicles not more than 2 minutes.	Minimal
Clearing of natural vegetation and trees during construction activities in project areas. There may also be	Construction	Medium	Moderate	Moderate adverse	• Vegetation clearance shall be limited to the extent required for execution of works.	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
pressure on timber trees (illegal logging) by influx of workers.					• Avoid cutting down of tree species of conservation significance and those that are protected, even those that act as nesting and breeding sites. • Tree planation will be carried out in and other suitable areas near the river training works at a ratio of 5 new trees per each tree cut. • Include environmental management and awareness as part of training for employees during construction.	
Access routes through agriculture land will damage the land quality as well as standing crops.	Construction	Medium	Moderate	Moderate adverse	• Construction Contractors will be prohibited from using agricultural lands for access routes.	Minimal
Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	Construction	Medium	Moderate	Moderate adverse	• Strip the top soil to a depth of 35 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and others. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites.	Minimal
Excavation works will impact on the loss of habitats especially the terrestrial invertebrates that live in the ground.	Construction	Medium	Moderate	Moderate adverse	• Avoid construction during the rainy season • Minimize digging of trenches and vegetation clearance to minimum required level.	Minimal
Operation of piling activities, excavation, operation of heavy equipment and transport vehicles, and blasting operation will cause noise and vibration affecting workers and the nearby population.	Construction	High	Moderate	Major Adverse	• Construction activities near settlements will be limited to day time only (8AM – 6PM). • High noise producing equipment will be provided with mufflers or acoustic enclosures. • Install acoustic enclosures around generators and install temporary noise control barriers where appropriate to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Notify affected communities in advance regarding major noisy operation, e.g. blasting.	Minimal
Impact on surrounding environment and communities from Construction Camps	Construction	Medium	Moderate	Moderate adverse	• During construction phase the contractor site camps should be properly managed. Water usage, fuelwood cutting, deforestation, trees injury should be avoided. Community of the area should not be affected. Proper	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					sanitation and construction machinery should be maintained according to environmental standards. • The Contractor needs to establish main and site camps. The main camp may be a rented building in the Lasbela city and will be for the Contractor project management staff while site camps shall be for the labour and Contractor's machinery operators. The site camps shall be located where the construction works are in progress.	
Increased Traffic on local roads will affect access to the trading centre and, houses close to the road, deteriorate safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration	Construction	Medium	Moderate	Moderate adverse	• Contractor will implement traffic management plan to ensure uninterrupted traffic movement during construction. • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centres, etc. • Inspect structures within the close proximity of construction site for damages.	Minimal
Contamination of soil and water due to the accidental spills and leakage of fuels and chemicals.	Construction	Medium	Moderate	Moderate adverse	• Contractor will prepare and implement Pollution Prevention Plan • Contractor to confine the contaminants immediately after such accidental spillage • Contractor to collect contaminated soils and washouts containing petroleum products treat and dispose them in environment friendly manner • All areas intended for storage of hazardous materials to be quarantined and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation	Minimal
Impact of spoils, solid waste, and waste effluents.	Construction	Medium	Moderate	Moderate adverse	• Siting of fuel and hazardous material storage sites, including refuelling facilities, batching plants and construction yards are to be located outside the flood embankments and at least 500 m away from any residential areas. • Hazardous waste will be disposed of by designated contractors.	Minimal
Impact of borrow and quarry activities.	Construction	Medium	Moderate	Moderate adverse	• Borrow/quarry areas will be developed close to the project area for extraction of earth material and aggregates for river protection works.	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					• No private lands or agriculture lands will be used for borrowing. • Minimize volume of borrow material by using dredged material generated from the project. • The use of explosive should be used as low as possible to reduce noise, vibration, and dust. • Control dust and air pollution by application of watering. • Photographs recorded of each borrow area showing pre-construction baseline for comparison with after rehabilitation	
Disturbance/damage to unidentified archaeological asset or graveyard.	Construction	Medium	Moderate	Moderate adverse	• No archaeological sites are reported with in the construction areas. However, in case any artefact or site of archaeological, cultural, historical, or religious significance are discovered during construction activities, the works will be stopped in that area, and the appropriate department will be informed. • An additional study to develop a cultural heritage management plan will be carried out in the first six months of the project..	Minimal
Disturbance to sites of religious importance	Construction	Medium	Moderate	Moderate adverse	• Location of all schemes are at a safe distance from sites of religious importance	Minimal
Impacts on Ecology, Wildlife and Habitats						
Loss of faunal habitat at locations of construction works, camp, staff quarters and on access/haul routes due to the felling of trees. Fragment and lead to loss of critical habitats for resident and migratory birds. The Zhob River basin is a main route of Migratory birds that pass through this area from Siberia to south in the winter season.	Construction	Very high	Moderate	Major adverse	• Minimize construction in the critical habitats of birds. • Care should be taken to make sure bird nests are not destroyed. If there is no option available, rehabilitate them in other neighbouring trees. Also protect and rehabilitate injured or orphaned birds. • Use of existing access road and limit the width of new access roads.	Minimal
Impact on river habitats (i.e., breeding and nesting sites) from construction activities, including riverine vegetation clearance.	Construction	Medium	Moderate	Moderate adverse	• Control of sediment flow from the construction activities • Silt curtains along river training works to control sediment runoff. • Minimize and restrict clearing of riverine vegetation as much as possible.	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Loss of temporary breeding pools and pans due to refilling of such pools by construction soil or gravel.	Construction	Medium	Moderate	Moderate adverse	• Schedule construction during the dry season to reduce impact since the amphibian populations will be low during non-breeding season • Fence off the trenches with nets to prevent amphibians falling into the trap.	Minimal
Impacts on Downstream and Protected Areas						
Impact on downstream river habitats from construction activities, such as construction of flood protection and river training works.	Construction	High	Minor	Moderate adverse	• Control of sediment flow from the construction activities. • Silt curtains along river training works to control sediment runoff.	Minimal
Social Impacts during operation & maintenance stage						
Positive Impacts						
Access to irrigation water, farming capacity and technology, flood protection, potable water supply, watershed and rangeland management, and environmental protection.	O & M	High	Major	Major adverse	• Benefit thousands of people by 9 Irrigation and flood Protection schemes; improved Watershed and Rangeland Management, and environmental protection of protected and wetland areas.	Extremely beneficial
Access to improved irrigation system and improved water use practices	O & M	High	Major	Major adverse	• Improved irrigation system and improved water use practices will lead to a considerable increase in cultivatable land, thus increase crop production and improve income and livelihoods of farmers. • The implementation of project will result in increased crop production, resulted by increase in cropping intensity from 20% to 100% and improvement in yield /acre. • Productivity of crops is expected to more than double after project implementation.	Extremely beneficial
Damage of command areas by flood waters	O & M	High	Major	Major adverse	• Prevention of floods from entering into the command area by constructing flood protection works, will improve the livelihood of the population and protect crops, • Flood schemes will reduce the likelihood of devastating damage and the economic burden associated with recovery following the flood. • Construction of flood water diversion structure will play a pivotal role in increasing the income of households at farm level. This will help in increasing the area under cultivation along with cultivation of improved varieties.	Extremely beneficial

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					• Flood water diversion schemes in the province will help in improving the family nutrition through availability of better and nutritious food and thus contribute to better health of households.	
Loss of opportunities for women and social uplift	O & M	High	Major	Major adverse	• Project will enhance opportunities for women to participate in profitable agriculture, by tailoring interventions to their specific needs and by promoting gender equity in rural communities. • It is expected that 352,789 women will benefit directly from implementation of Irrigation Schemes, Potable Water, Flood Protection and Watershed and Rangeland Management.	Major beneficial
Water supply and waterborne disease in the Project area.	O & M	High	Major	Major adverse	• Potable water supply sub-projects are expected to directly benefit project area communities. • Lifestyle in surrounding areas will be improved by ensuring sustained supply of potable water. • Sanitation and water borne diseases in the area will be improved. • Sustained water supply will contribute significantly on reduction to households spending on water borne diseases. • Improvement in livestock quantity and composition due to consistent availability of water will improve economic income and food security of people.	Extremely beneficial
Loss of nutrient rich sediments in upstream areas and deprive the benefit from better crop production.	O & M	Medium	Moderate	Moderate adverse	• Diversion schemes are designed to distribute nutrient rich sediments in the command area, which will work positively for cropland and increase crop production, without discharging them to the downstream water flow.	Moderate beneficial
Social Impacts of Watershed and Rangeland Management - Poor Watershed and Rangeland Management.	O & M	High	Major	Major adverse	• Watershed management activities will be undertaken in both Project river basins, including soil and water conservation measures, rainwater harvesting and plantations.	Extremely beneficial
- Biomass productivity for sustenance.	O & M	High	Moderate	Major adverse	• Production of fuel wood for use by low income households.	Moderately beneficial
- Social forestry jobs	O & M	High	Moderate	Major adverse	• Will create local jobs for harvesting timber and non-timber products.	Moderately beneficial

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
- Grazing area and food stock for livestock.	O & M	High	Moderate	Major adverse	• Improvement in livestock (quantity and composition) due to more consistent food stock availability for grazing animals. • Develop livestock potential of the area through management of pasture lands	Moderately beneficial
Negative Impacts						
Social issues will arise due to unavailability or Improper Distribution of Irrigation Water in the Area	O & M	High	Moderate	Major adverse	• BIPD could play a key role to involve the local staff of agriculture department to ensure the best utilization of available water; • Water management rules and regulations must incorporate ways to tackle such issues as water scarcity and surplus flows; • Local water user associations and groups need to be trained and involved to operate the canals, channels, gates, inlets, outlets and other structures; • Compensate downstream Farmers in case of any water rights losses; and • Desilting of irrigation channel after regular intervals	
Breach of dam, canal and irrigation structures is unlikely to occur. However, it will threat system sustainability and fatal accidents	O & M	High	Moderate	Major adverse	• BIPD should ensure the design review during operation phase by panel experts; • BIPD (Irrigation Department) to monitor the system regularly; • The important facilities that need attention and annual maintenance are canal embankments, falls and control structures and bed levels which are affected by siltation or scour. Canal section has been designed to ensure safety by following the standard design principals to design the banks against piping. In addition, all *nullah* crossings have been provided with Cross-drainage structures of at least 40 years return period flood capacity with adequate freeboard. For major *nullahs*, canal syphons have been provided so that *nullah* flows unhindered and therefore does not cause damage to the canals; • Liaise with the communities to identify potential weaknesses in the system that could cause breaches;	
With availability of sweet water in the canal, there will be a tendency to use it for potable purposes as well.	O & M	Medium	Moderate	Moderate adverse	• Train local community on safe drinking water; • Place warning and information signs about dangers of using irrigation water for potable purposes;	

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					• Local Government to assure potable water quality as per WHO/ GOP standards;	
the current natural flow of rain water is such that it generally comes in flash floods from the hill torrents in the Project Area	O & M	Medium	Moderate	Moderate adverse	• Periodic maintenance of drainage structures; and • Ground water monitoring wells should be established in command area to monitor the salinity of ground water by BIPD.	
Disposal of Waste (Connection of Waste Streams) in the Canals will lead to serious health issues	O & M	Medium	Moderate	Moderate adverse	• The BIPD will develop and implement a proactive maintenance plan for the proposed project, with predefined periodicity; • Ensure proper disposal of waste at designated landfill/disposal sites; and • Efficiency of the system will be at its best by adopting proper maintenance activities such as silt removal and bed scratching at periodic intervals.	
Environmental Impacts during operation stage						
Positive Impacts						
Groundwater recharge	O & M	High	Moderate	Major adverse	• Improved recharge of ground water tables in the project area by water storing techniques and plantation. • Improved watershed and rangeland management technologies to improve soil moisture retention, reducing erosion and improving groundwater recharge.	Major beneficial
Impacts due to Watershed and Rangeland Management	O & M	High	Major	Major adverse	• Prevent grazing on degraded land, protect areas with good natural regeneration potential, reseeding/sowing rangelands with palatable species, • Establish grazing management plans based on carrying capacities, and construction of watering ponds for livestock. • Planting of palatable shrubs and trees and reseeding of grass as well as introduction of stall feeding based on fodder production • Rangeland management will introduce rotational grazing and stocking rate limits. • At the irrigation scheme level, watershed management will include drainage improvement, soil and water conservation measures and rehabilitation/protection of irrigable land degraded/endangered by erosion gullies.	Major beneficial

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Negative Impacts						
Enhanced/ induced use of fertilizers and pesticides due to increased cultivation.	O & M	High	Moderate	Major adverse	• An Integrated Pest Management (IPM) plan is being prepared as part of the EMP and will be implemented during project operation stage. • Disseminate information regarding sustainable use of fertilizers and insecticides to keep the use at an optimal level. • A comprehensive education and awareness programme on sustainable fertilizer use is planned under On Farm Water Management component. • Development of a biodiversity database; community-based sustainable use programmes; developing and strengthening the protected areas system; developing a policy for ex-situ conservation of biodiversity; developing an effective policy framework and enabling legislation; and developing institutional capacity to manage biodiversity.	Minimal
High Residual Sodium Carbonate levels in river water can cause crusting of seed beds, temporary saturation of the surface soil, high pH and the increased potential for diseases, weeds, soil erosion, lack of oxygen and inadequate nutrient availability.	O & M	High	Major	Major adverse	• Farmers will be educated on best practices to solve the RSC problem, which will include some of the following: – Injection of sulfuric acid to dissociate the bicarbonate ions (PH around 6.2) giving off carbon dioxide. It allows the calcium and magnesium to stay in solution in relation with the sodium content. – Add gypsum when soils have low free calcium plus leaching. – Add sulfur to soils with high lime content plus leaching	Minimal
Land conversion due to improved irrigation and agricultural potential.	O & M	Medium	Minor	Minor adverse	• Schemes are designed in such a way to include cultivable land only, without affecting land of ecological significance.	Minimal
Forest land conversion, degradation by increased overgrazing, firewood collection, etc.	O & M	Medium	Minor	Minor adverse	• Rangeland and Watershed Management plan will ensure that no forest land is converted to cropland. In addition, the project will include more sustainable watershed agriculture especially livestock farming (increased livestock productivity and production due to increased production of fodder and improved rangeland management).	Minimal
Impacts on Downstream						
Pesticide residue in water bodies	O & M	High	Minor	Moderate adverse	• Monitoring of organochlorine pesticide residue is recommended to establish the baseline during the early	Minimal

Impact from various activities	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					stage of project implementation and follow-up monitoring to compare with the baseline.	

7.4 Environmental and Social Impacts of the Project

Major and important moderate adverse impacts are discussed in more detail below. It is expected that minor and many moderate adverse impacts will be addressed through the implementation of Environmental Code of Practices (ECP) by the contractor.

7.5 Environmental and Social Impacts during Pre-construction Stage

During the public consultations, local people raised concerns regarding the design of the project, site selection and possible consequences. These concerns along with other impacts were addressed in the pre-construction assessment and are discussed in more detail below.

7.5.1 Proper Dam Site Selection, Route selection(Alignment) of Proposed New Canal and its Land Acquisition

- Improper dam site, route selection of main canal & distributaries and land acquisition will lead to social issues related with relocation of assets. This impact would be of moderate significance.

Mitigation

- Most of the significant environmental impacts of the project can be addressed at the design phase, which is mainly the responsibility of the Design Engineers. The site selection of dam should be with regards to the area geology and topography as these plays important role for the sustainability of project. The site selection predominantly determines the environmental implications of the project. Despite having examples of other similar projects, the exact quantum of environmental impacts cannot be predicted at times. Hence, the efficacy of the design will finally be tested only when the results of follow up monitoring become available. The Design Engineers must also add all features for safety of the workers during operation and maintenance.
- Special considerations will be made for the selection of dam site to ensure proper land acquisition justified to all stakeholders. By adopting the aforementioned measures, the impact would be of low significance.
- Most of the significant environmental impacts of the project can be addressed at the design phase, which is mainly the responsibility of the Design Engineers. The location of various distributaries and other irrigation structures, nature of construction technology etc. predominantly determine the environmental implications of the project.
- Special considerations will be made for the selection of routes for both main canal and right & left canals which ensure proper distribution of water for all, alignment must be avoided from any controversial land, and alignment selection must be justified to all stakeholders.
- Only government land to be used; no private or community land to be used.
- BIPD (Irrigation Department) and Land Revenue Department to ensure that the land acquisition act 1894 procedures are followed in a transparent manner. Complete records should be maintained, particularly for asset valuation and compensation payment. The communities' grievances associated with the land acquisition and compensation should be addressed on priority basis, in order to avoid any unrest/mistrust among the communities towards the project. By adopting the aforementioned measures, the impact would be of low significance.
- In extreme case, where private land acquisition is unavoidable, it will be done under the guidelines given in Social Impact Assessment Management Plan (SIAMP) and Proper compensation to the affected households will be provided.
- All temporary used sites will be properly decommissioned after completion of construction works before handing over to the owner.

7.5.2 Impacts on Ecology, Soil and Land

The Zhob and Mula River Basins have a wide variety of biodiversity variations in physical features and the climatic conditions have produced diverse landscapes, ecosystems and habitats that are important to the national and global heritage. The basins also face a wide range of environmental and resource degradation problems. The major problems are depletion of aquifers, loss of vegetation in watersheds and rangelands, destruction of wildlife habitats, and depletion of wild flora and fauna. Improper Sub-basin / Watershed and Scheme site location may lead to:

- Erosion and loss of useful agricultural land
- Removal of vegetation and cutting of trees
- Deforestation in the sub-basins

These impacts have been assessed as Major adverse, as shown in Table 51.

Mitigation

- Appropriate site selection and designing according to the national and ADB guidelines in order to entail no or minimal disturbance to local ecology, soil, and land.
- Schemes located in ecologically sensitive areas were not included, in order to avoid impact on flora /fauna.
- Plantation / forest conservation/ rangeland management are considered during the design phase.

7.5.3 Impacts on Surface Water

Balochistan is divided into 18 river basins. The main water sources for irrigation are surface water from irrigation system, flood flows and perennial base flows in rivers, subsurface flow through river gravels, springs and groundwater through tube wells. Watershed / scheme site interventions and improper design considerations may:

- Stress local natural stream flow and cause surface water quality degradation and contamination of water resources and affect downstream ecology.
- Inadequate maintenance of minimum flows may degrade downstream ecology.
- Excessive diversion of surface water resources may lead to depletion of natural surface water resources in the area.

These impacts have been assessed as Major adverse, as shown in Table 51.

Mitigation

- During design stage, watershed hydrological modelling should be conducted to check the suitability of the scheme location considering the natural drainage and surface water quality.
- Design should also considered flow regulatory structures / schemes and minimum flow requirements.
- Provision should be made for proper water utilization rates under schemes so that water resources are not depleted.

7.5.4 Impacts on Ground Water

Balochistan is an arid country, where in most of the districts, a lot of water for agriculture crop production and drinking purposes is withdraw from ground water sources. Due to degradation of Rangeland and erosion the Zhob and Mula River basins have lost considerable ability to re-charge groundwater. Improper assessment of sub-surface ground water levels prior to design for Non- perennial schemes may lead to depletion of ground water resources. Improper design considerations for irrigation schemes may lead to degradation of sub-surface ground water quality and contamination. These impacts have been assessed as Major adverse, as shown in Table 51.

Mitigation

- Ground water table studies should be carried during feasibility stage.
- Schemes should be designed according to ground water recharge/ pumping regulations.
- Regulatory measures for pesticide contamination/ sewage disposal to be followed.

7.5.5 Water Right Issues in the Area

The Water being the most precious commodity in the area, its usage rights has been established traditionally. Any perceived or real disturbance to these water rights will almost certainly lead to social disturbance in the area. This impact would be of moderate significance

Mitigation

- Proper water distribution through “Warabandi System” engaging Water User Associations and BIPD (Irrigation department).
- An important aspect to be taken into account at the design level is the traditional water rights. This will need to be minutely considered while carrying out the detail designs. Coupled with this, continual two-way communication with the local population will be necessary, to ensure that their perceptions about the project remain realistic, rational, and positive.
- Conduct social surveys to involve local public at the maximum in design phase, and probe ways and means to tackle these issues so as to maximally benefit them from the proposed project. By adopting the measures, the impact would be of low significance.

7.5.6 Design Works Construction of Dam, New Canal and Other Irrigation Structures as per Proper Engineering Standards

Absence of any design provision (e.g. seismic consideration) may lead to design failure thus resulting in system collapse. The impact significance has therefore been categorized as 'High'.

Mitigation

The project should be designed as per applicable national / international engineering standards. Morevoer, the project should also be reviewed by the design consultant at the detail design stage. By adopting the aforementioned measure, the impact would be of low significance.

7.5.7 Dam Reservoir Sedimentation

Storage capacity of dam will be reduced due to sedimentation. This impact would be of moderate significance.

Mitigation

Watershed management and erosion control measures have been included as an integral component of the project to control the reservoir sedimentation. These interventions include; structural measures like earthen micro-catchments (eyebrow terraces), digging of pit, addition of compost, termite treatment, plantation of trees, seeding of native grasses, small check dams and water storage ponds. By adopting the aforementioned measures, the impact would be of low significance.

7.5.8 Risk due to Natural Hazards i.e. earthquakes etc

The Sri Toi Dam Project area lies in zone 3 as per seismic map of Pakistan which clearly shows that the area is in moderate to high risk zone. So due to earthquake the breaching of dam, canal and other irrigation structures is possible. This impact would be of high significance. The other natural hazard which can affect the area is flooding which would be of moderate significance.

Mitigation

Design engineer should ensure that seismic design of dam, spillways, reservoir and other allied and irrigation structures should be carried out as per international engineering standards. By adopting the above measure, the impact would be of low significance.
Flood protection bunds has been included as an integral component of the project to control the damages occurred by floods. By adopting the above measure, the impact would be of low significance.

7.6 Social Impacts during Construction Stage

7.6.1 Generation of employment in the project area

The project will employ unskilled and skilled construction workers. Contractors are encouraged to employ local workers and technicians to the extent possible. Employing local people will also diffuse the conflicts between migrant workers and local community and also prevent possible spread of HIV/AIDS infection due to the migrant workers. All these new opportunities for work for local residents will boost employment and improve the social and economic position of the population. This impact has been assessed as Moderate beneficial, as shown in Table 51. Populations in project areas will be notified of these opportunities during the early stage of project implementation.

7.6.2 Increased economic activity in the project area

The influx of workforce will stimulate the local economy. There will be a higher demand for locally produced food, goods and services benefiting local farmers and small businesses, such as hotels, shops, fruit sellers, tea cabins, and poultry stalls. This impact has been assessed as Moderate Beneficial, as shown in Table 51.

7.6.3 Temporary Land acquisition by the contractor

No private land is required on permanent basis for project interventions. Only government land will be used for the project. In extreme case where private land acquisition is unavoidable, it will be done under the guidelines given in SIAMP and proper compensation to the affected households will be provided. This impact has been assessed as Moderate adverse, as shown in Table 51.

7.6.4 Safety hazards for children and elderly people due to increased traffic

The construction activities can potentially impact the residents of nearby villages, particularly the movement and safety of school children. The increased use of trucks and other vehicles on local roads may increase risk of traffic accidents on pedestrians, particularly elderly people and children. This impact has been assessed as Moderate adverse, as shown in Table 51.

Mitigation

- Contractor will develop a traffic management plan in compliance with ECP on traffic management
- The Traffic Management Plan will be implemented with aim at ensuring access to residential areas, and preventing unsafe situations, especially near schools, housing areas, construction areas, camps and office.
- Ensure that all construction vehicles observe speed limits on the construction sites and on public roads
- Provide adequate signage, barriers, and flag persons for traffic control.
- Fit audible warning devices in vehicles to alert during reversing

7.6.5 Increased risk of accidents for workers

Most of the construction activities will be carried on land and in River, the Contractors and project management will pay close attention to the increased risk of accidents, unsafe working

conditions and health risks. Construction workers will be in risk if there is no proper safety protocols in place Construction activities also pose safety hazards for the site staff. This impact has been assessed as Moderate adverse, as shown in Table 51.

Mitigation

- Occupational health and safety procedures will be enforced at site. Each contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan.
- In-stream construction workers will be adequately trained and provided with proper personal protection equipment (PPE) before putting them in to work. Frequent supervision will be carried out by supervision consultants to ensure they are wearing proper PPE at all times.
- Contractor OHS plan describe the tasks and methods to be used by workers associated with water borne construction and diving operation, and how to perform them safely and state how potential hazards are identified and handled. Contractor will ensure that the construction workers associated with these works are adequately informed about the OHS plan. Emergency response mechanism will be put in place to rescue workers from drowning and providing immediate treatment to the injured workers
- Contractor will train the workers of water borne construction to deal with safety.
- Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge how to deal with emergencies.
- Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic.
- Vehicle speeds near / within the communities will be kept low, to avoid safety hazards.
- The communication strategy complements awareness raising and information dissemination.

With the implementation of above mitigation measures, the residual impact on workers' health and safety has been assessed as minimal.

7.6.6 Security Risks for Workers

Due to tribal feuds, terrorism, insurgents and other issues, there may be a security risk for construction staffs and workers, especially in southern Balochistan (Mula River basin area). Also, if not properly managed, conflicts arising as a result of community disturbance and/or in-migration may escalate into violence, led by criminal elements. The impact has been assessed as Moderate adverse, as shown in Table 51.

Mitigation

- Continued consultations with the tribal leaders and local community leaders on security matters.
- Provide security at the work sites and camps.
- Ensure identification cards to all staffs and workers.
- Preparation and implementation of the contractor's Communication plan. This plan shall focus on early and continued consultation by the contractor with influential figures within the project area,
- The Communication plan shall also include plan for ongoing consultation in local languages within project affected communities. As for the landlord consultations, the aim of these meetings will be to raise awareness amongst the local community of upcoming activities, and for community members to feedback any concerns or suggestions.
- All contractors' staff shall be required to carry identification cards issued by the Contractor which clearly state the staff member's identification details and affiliation with the contractor and the project. Cards shall also be issued to all sub-contracted staff and the Consultant's staff active in the project area. The issue of identity cards shall be strictly controlled by the contractor, and following termination/completion of staff contract the identity card shall be destroyed.

- Access to the camps must be controlled through gated entrances and entrance and exit logs shall be maintained at each gate. Access shall be restricted to project staff holding valid identity cards only.
- Assessing the situation and if required, the contractor will engage his own security companies, the contractor shall be responsible to ensure such companies or personnel do not have a history of past abuse and that personnel are trained in the use of force and in the applicable laws so that no contravention of national legislation takes place.
- The contractor shall provide training to security personnel using the guiding principle that force shall not be used except in defense and in proportion with the nature and extent of the threat.
- Finally, the contractor's emergency response plan shall be required to include details of emergency evacuation of the camp site in the event of an emergency and be supplemented by annual drills.

With the implementation of above mitigation measures, the residual impact has on workers security has been assessed as minimal.

7.6.7 Security risks, theft, and vandalism for construction workers and materials

Inadequate construction site security poses a significant risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion. The impact has been assessed as Moderate adverse, as shown in Table 51.

Mitigation measures are:

- Provide security at the work sites and camps. Employ night watchman for periods of significant on-site storage or when the area necessitates.
- Ensure there is proper fencing around construction site perimeter, chain-link at least 2.4 m high and secured with a steel chain and lock.
- Employ appropriate security personnel at job sites. Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background.
- Maintain register to keep track of number of persons present in the camp at any given time.
- Ensure job sites are properly lighted at night.

With the implementation of above mitigation measures, the residual impact has on security risks, theft, and vandalism for construction workers and materials has been assessed as minimal.

7.6.8 Possible cultural conflicts between communities and migrant workforce

There could be potential conflicts between the local community and the migrant workforce. Workers coming from other parts of Pakistan may have norms and values in social behavior and religion that differ from those of the resident population. The influx and accommodation of a large work force will result in increased concerns for the health and safety of local population. The impact has been assessed as Moderate Adverse, as shown in Table 51.

Mitigation

- This situation will be addressed by an awareness campaign implemented in the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which easily could lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behavior of workers on site, in camps, and in local communities.
- The contractor shall employ a Community Liaison Officer who shall be responsible for the preparation and implementation of a Communication Strategy. This strategy shall detail stakeholders, their information, disclosure, and consultation and participation requirements

and shall aim to ensure relevant stakeholders are pre-warned of any activities on site which may result in their disturbance. The Communication Strategy will define a process for receiving, recording and responding to complaints and also monitoring of the success of any responsive action taken.

- In addition, complaints register shall be set up at the Contractor's and Engineer's offices to record any complaints received during the implementation of the works.

With the implementation of above mitigation measures, the residual impact has been assessed as minimal.

7.6.9 Risks of HIV/AIDS, STI and TB due to Outside Workers

There is a risk of the likelihood of spread of HIV/AIDS, STD/STI and TB infection and diseases through interaction between migrant workers and community women during project construction. This impact has been assessed as Moderate adverse as shown in Table 51.

Mitigation

- Awareness creation on HIV/AIDS infection and diseases through a well-designed campaign implementation plan targeting all risk-prone groups.
- The awareness campaign will be aimed at the risk of interaction between the resident population and the construction work force, including the spreading of sexually transmitted diseases such as HIV/AIDS
- Diagnose and treat STD/STI and TB through in-house medical facility constituted by the Contractor for workers' safety to be provided by the Contractor.
- Empowering women through employment in the construction work.
- Contractors will be encouraged to employ workers from the nearby communities so that they can be close proximity of their families and reduce the risk of mixing with other genders.

7.6.10 Interruption of Irrigation water due to Construction Works

Temporary interruption of irrigation water supply during construction works may affect water availability for crops in the command area of Canal/distributary/channel, thus reduce the income of these farmers which shall have a negative impact on the socio-economics of the impacted area. This impact has been assessed as Moderate adverse in Table 51.

Mitigation

- The contractor shall be prohibited from interrupting the water supply to Canal/distributary/channel or reducing it below the allocated discharge of these canals by providing diversion canals on the section where work is planned on priority basis.
- The Contractor shall program the works to utilize the low water demand periods in the command area.
- The Contractor shall submit a construction schedule to the Engineer/PSIA Consultant for approval on mobilization. If in case, the closure of water supply is unavoidable, the Contractor needs to share his plan with the farmers and get their consensus.

7.7 Environmental Impacts during Construction Stage

7.7.1 Emissions of Dust and Air Pollution

Air pollution may be caused by emissions from construction related traffic and machinery. Dust will be generated from earth works at access road, excavation and construction works for guide walls, and river bank protection. This impact is characterized as Moderate adverse, as given in Table 51.

Mitigation

- Special care must be taken to inspect carefully whether all construction vehicles are properly maintained and correctly operated (including the use of dust filters or hoods).
- Water the soil surface and any non-asphalted roads, especially in the dry season.

- Water the soil before starting excavating.
- The storage and handling of spoil, subsoil, topsoil and materials should be carefully managed to minimize the risk of wind-blown material and dust.
- Cover hauling vehicles carrying dusty materials moving outside the construction site.
- Burning of any waste on site is prohibited.
- Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition.
- Limit the idling time of vehicles not more than 2 minutes.
- Regular and proper maintenance of vehicles and machinery.

7.7.2 Clearing of Natural Vegetation and Trees in Project Area

Some of the trees may be cut/ uprooted during the construction phase. This impact is characterized as Moderate adverse as given in Table 51.

Mitigation

Following mitigation measures will be adopted to compensate the loss of vegetation and mitigate impacts associated with clearance of vegetation

- Vegetation clearance shall be limited to the extent required for execution of works.
- Avoid cutting down of tree species of conservation significance and those that are protected, even those that act as nesting and breeding sites.
- Care will be taken to make sure bird habitats are not destroyed. If there is no option available, rehabilitate them in other neighboring trees. Also protect and rehabilitate injured or orphaned birds.
- Tree planation will be carried out in the canal alignments and other areas near the river training works at a ratio of 5 new trees per each tree cut.
- Plantation will be developed only with indigenous species.
- Restrict developments of contractor's workspace in critical habitats.
- Maintain buffer zones of plants and trees on river banks
- Include environmental management and awareness as part of training for employees during construction

With the above mitigation measures, the adverse impacts tree cutting has been assessed as minimal.

7.7.3 Impact of Earthworks and Excavation

Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development. Excavation works will impact on the loss of habitats especially the terrestrial invertebrates that live in the ground. These impacts have been listed as Moderate adverse in Table 51.

Mitigation

- Strip the top soil to a depth of 35 cm and store in stock piles of height not exceeding 2m.
- Remove unwanted materials from top soil like grass, roots of trees and others.
- Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites.
- Avoid construction during the rainy season
- Minimize digging of trenches and vegetation clearance to minimum required level.

7.7.4 Noise from Construction Equipment, Piling and Vehicles

Noise and vibration will be generated by piling activities, blasting, earth and excavation works, headworks of pier, guide walls, river bank protection, machinery, concrete mixing, and traffic from trucks and vehicles. This impact is characterized as Major Adverse, as given in Table 51.

Mitigation

- Noise and vibration awareness training for all construction workers including subcontractors as part of general site induction;
- Restrict construction and operation of heavy machines to daylight (8AM to 6PM);
- Ensure that noise level in all nature sanctuary sections of the watermain is kept 55 dBA during construction;
- Inform local communities on the construction schedule in advance, especially blasting operation;
- All vehicles and construction machinery shall have an efficient muffler design in accordance with the manufacturer's specifications. This also includes high noise generating handhelds like power drills, saws, nail guns etc. The mufflers shall be well maintained and regularly tested with the results documented in the maintenance logs.
- Regular and effective equipment maintenance in order to ensure all machinery is in good working order and use does not generate excess noise/vibration.

With the implementation of above mitigation measures, the residual impact on noise and air pollution has been assessed as minimal.

7.7.5 Risk from Increased Traffic

Increased Traffic (I.e. trucks, transport vehicles, construction machinery) on local roads will affect access to the trading center and, houses close to the road, deteriorate safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration. This impact has been characterized as Moderate adverse in Table 51.

Mitigation

- Include in the contractor's traffic management plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges, temporary diversions, necessary barricades, warning signs / lights, road signs, construction schedule etc.
- Provide signs at strategic locations of the roads complying with the schedules of signs contained in the National Traffic Regulations.
- Restrict truck deliveries, where practicable, to day time working hours.
- Restrict the transport of oversize loads.
- Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions.
- Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc.
- Inspect structures within the close proximity of construction site and ensure that all affected persons are evacuated from the property before construction commences.

7.7.6 Potential risk of soil and water pollution

During construction there is a high risk of accidental spills and leakages from fuel and oil tanks, vehicles, machinery and stored chemicals that are used in construction areas, yards, batching plants, worker camps, and storage sites. These spills can pollute soils and contaminate surface and groundwater in the area. This impact is characterized as Moderate adverse, as given in Table 51.

Mitigation

The following mitigation measures will be implemented:

- Contractor will prepare and implement a Pollution Prevention Plan prior to the start of the work.
- Contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the soil and water resources both upstream and downstream.
- Periodic monitoring will be carried out by the Contractor and MEC.

- Contractor to confine the contaminants immediately after such accidental spillage
- Contractor to collect contaminated soils, treat and dispose them in environment friendly manner
- All areas intended for storage of hazardous materials to be quarantined and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation

With the implementation of above mitigation measures, the residual impact on risk of soil and water pollution has been assessed as minimal.

7.7.7 Risk of pollution from spoils, solid waste and waste effluents

Excavation and earthwork will generate substantial quantity of soil, gravels, and spoil. Further construction works also generate large quantities of excess materials from construction sites (concrete, discarded material) and wastes from workers camp and construction yards, including garbage, recyclable waste, food waste, and other debris. In addition, small quantities of hazardous waste will be generated from maintenance activities, including contaminated soil, oil filters and other waste products. These impacts are characterized as Moderate adverse, as given in Table 51.

Mitigation

- Contractor will prepare and implement earth materials, solid waste collection, and disposal plan.
- Daily collection of solid waste from the Camps.
- The contractor will identify suitable sites for disposal of hazardous and non- hazardous waste. The selection will be done in consultation with local authorities.
- Contractor to develop and undertake construction waste management strategy for both hazardous and non-hazardous wastes separately.
- Siting of any fuel and hazardous material storage sites, including refueling facilities, batching plants and construction yards are to be located outside the flood embankments and at least 500 m away from any residential areas.
- Hazardous waste will be disposed of by designated contractors.
- With the implementation of above mitigation measures, the residual impact on solid waste has been assessed as minimal.

7.7.8 Impact from borrow and quarry activities

Construction of diversion weir, flood protection, and river training works will require stone, aggregates and earth fill. Improper siting and extraction of these construction materials will have significant impacts on physical and biological environment on the quarry and borrow areas. This impact is characterized as Moderate adverse as given in Table 51.

Mitigation

The following mitigation measures will be implemented:

- The contractor shall use the government approved quarry sites for procurement of stones and aggregates. Contractor will obtain necessary government permits before procurement of this material.
- Earth fill material will be excavated during low flow season when these areas are dry.
- No private lands or agriculture lands will be used for borrowing.
- The borrow areas will be approved by relevant authorities.
- The contractor will prepare borrow area management and restoration plan for approval.
- Minimize volume of borrow material by reusing material excavated elsewhere in the project
- Borrow/quarry areas will be developed close to the project area for extraction of earth material and aggregates for river protection works.

With the implementation of above mitigation measures, the residual impact on borrow sites has been assessed as minimal.

7.7.9 Impact on faunal habitats and resident and migratory birds

The Demoiselle and Eurasian cranes migrate from Afghanistan to India and cross Zoab River and Loralai area. The Hubara Bustard is also listed as threatened and is found in the project areas. Loss of faunal habitat at locations of construction works, camp, staff quarters and on access/haul routes due to the felling of trees can lead to loss of critical habitats for resident and migratory birds and habitats for species that are of conservation significance. Agricultural lands and ponds act as wintering grounds for many migratory birds, and habitat for many resident birds. However, due to the vast habitat range of the birds and the fact the birds are not confined to a particular location, the project is not expected to have any lasting impact on the birds. If any construction activities disturb their roosting, hunting and feeding grounds, they move to another lesser or undisturbed areas without any difficulty. The presence of avifauna in the project area will increase during the winter months, with the arrival of migratory birds. This impact of the project on overall avifauna is characterized as Major adverse as given in Table 51.

Mitigations

- Minimize construction in the critical habitats of birds.
- The Contractor will introduce and enforce a Code of Conduct and raise awareness about the protection of birds among the work force to reduce impacts such as disturbance and poaching.
- Care should be taken to make sure bird nests are not destroyed. If there is no option available, rehabilitate them in other neighboring trees. Also protect and rehabilitate injured or orphaned birds.
- Bird surveys will be carried out before vegetation removal for protection of nests.
- Contractor will be required to recruit a qualified ecologist to implement the mitigation measures and monitor the impacts on birds
- Use of existing access road and limit the width of new access roads.

With the implementation of above mitigation measures, the residual impact on birds has been assessed as minimal.

7.8 Social Impacts during Operation & Maintenance Stage

7.8.1 Access to irrigation water, farming capacity and technology, flood protection, potable water supply, watershed and rangeland management, and environmental protection

Balochistan is Pakistan's least developed province and an estimated 47 percent of people live below the official poverty line. Agriculture (crops and livestock) is the basis of the Balochistan economy, contributing 60 percent of the GDP and 67 percent of labor. Overall, the project components: (i) Irrigation Schemes, (ii) Potable Water, (iii) Flood Protection and (iv) Watershed and Rangeland Management will have a net positive impact on the farming households and people in the area. A large population will benefit directly and indirectly from the project, including landless farm laborers and temporary and permanent laborers in the construction and manufacturing sectors. The Project will also strengthen local private sector service providers (for land improvement) and input suppliers. This impact is characterized as Major adverse prior to mitigation and its residual significance after implementation is deemed extremely beneficial as given in Table 51.

7.8.2 Access to Improved Irrigation System and Improved Water Use Practices

Currently the area has an inadequate and underdeveloped irrigation system which severely limits crop production and livestock potential. In total, nine (9) irrigation schemes will be implemented, five in Mula River Basin and Four in Zhob River Basin. Implementation of

irrigation schemes will lead to Improvements in the irrigation system and improved water use practices will lead to a considerable increase in cultivatable land, thus increase crop production and improve income and livelihoods of farmers. The implementation of project will result in increased crop production, resulted by increase in cropping intensity from 2% to 100% and improvement in yield /acre. Productivity of crops is expected to double after project implementation. The project impact will be the increased farm income in the project area. The project outcome will be the increased agricultural production. The project outputs will be (i) irrigation infrastructure and watershed protection constructed and/ rehabilitated; (ii) command area expanded and improved; and (iii) institutional capacity strengthened.This impact is characterized as Major adverse prior to mitigation and its residual significance after implementation is considered extremely beneficial as given in Table 51.

7.8.3 Damage of Command Areas by Flood Waters

Severe floods in 2007, 2010 and 2011 led to loss of life and destruction of settlements and irrigation infrastructure, significantly reducing the agricultural production base. The implementation of the flood works will improve the lives of people, protect agricultural areas and the livelihoods of people. These interventions will also reduce the likelihood of flooding to the command area as well as the devastating damage and the economic burden associated with recovery following these floods. Erosion protection to the flood embankments on both sides of the river is also proposed to ensure the longevity of these defenses. Construction of flood water diversion structure would play a pivotal role in increasing the income of households at farm level. This will help in increasing the area under cultivation along with cultivation of improved varieties. Flood water diversion schemes in the province would definitely help in improving the family nutrition through availability of better and nutritious food and thus contribute to better health of households. This impact is characterized as Major adverse prior to mitigation and after implementation is deemed extremely beneficial as given in Table 51.

7.8.4 Loss of Opportunities for Women and Social Uplift

Without the project case, there would be a loss of opportunities for women. The Project will enhance opportunities for women to participate in profitable agriculture, by tailoring interventions to their specific needs and by promoting gender equity in rural communities. Women will benefit directly from implementation of Irrigation Schemes, Potable Water, Flood Protection and Watershed and Rangeland Management. This impact is characterized as Major adverse prior to mitigation and its residual significance after implementation is considered Major beneficial as shown in Table 51.

7.8.5 Loss of Nutrient Rich Sediments for Crop Production

Diversion schemes are designed to distribute nutrient rich sediments in the command area, which will work positively for cropland and increase crop production, without discharging them to the downstream water flow. This impact is given as Moderate adverse prior to mitigation and its residual significance after implementation is considered Moderate beneficial as shown in Table 51.

7.8.6 Social Impacts due to Watershed and Rangeland Management Plan

Rangeland degradation is occurring as a result of over grazing, removal of vegetation for fuel wood and no clear authority of rangeland ownership. Watershed and Rangeland Management will have a positive impact on the surrounding communities. Communities of project area are expected to benefit from the implementation of the Watershed & rangeland Management plan practices. Watershed management activities will be undertaken in both Project river basins, including soil and water conservation measures, rainwater harvesting and plantations. The impacts are characterized as Major adverse before mitigation and after implementation they are deemed extremely beneficial as shown in Table 51. Rangeland Management will further provide the following enhancements for surrounding communities:

- Production of fuel wood for use by low income households

- Will create local jobs for harvesting timber and non-timber products
- Improvement in livestock (quantity and composition) due to more consistent food stock availability for grazing animals.
- Further develop livestock potential of the area through management of pasture lands.

7.8.7 Social Impacts on Downstream Areas due to increased use of Pesticides & Fertilizers

The project will result in an increase in cultivated land, thus there will be an increase in the use of pesticides and fertilizers which may have a negative effect on fisheries in downstream areas, especially in the Miani Hor. This impact is characterized as moderate adverse, as given in Table 51.

Mitigation

- Disseminate information regarding sustainable use of fertilizers and insecticides to keep the use at an optimal level.
- A comprehensive education and awareness programme for farmers; development of a biodiversity database; community-based sustainable use programmes.
- The EMP includes an Integrated Pest Management.

7.9 Environmental Impacts during Operation & Maintenance Stage

This will be the phase where major impacts, both positive and negative, can surface, and the earlier predictions could be validated. This phase will comprise commissioning the new interventions. While the operations phase entails mostly engineering activities, it has an equally important requirement of inter-departmental coordination, for harvesting the full

7.9.1 Unavailability or Improper Distribution of Irrigation Water in the Area

As per the feasibility calculations, sufficient water will be available for the project and if not, social issues will arise. This impact would be of moderate significance

Mitigation

- It is obvious that more consistent and regulated availability of water will be a beneficial outcome. To further improve the situation, BIPD could play a key role to involve the local staff of agriculture department to ensure the best utilization of available water;
- Many area people mentioned the need for potable water supply arrangements for the area. Once the consistent availability of water is assured, the Local Government could make potable water supply arrangements for the nearby villages;
- Agreements between different communities;
- Water management rules and regulations must incorporate ways to tackle such issues as water scarcity and surplus flows;
- Local water user associations and groups need to be trained and involved to operate the canals, channels, gates, inlets, outlets and other structures;
- Compensate downstream Farmers in case of any water rights losses; and
- Discourage Spate agriculture.
- Desilting of irrigation channel after regular intervals

7.9.2 Breaching of Dam, Canal and Structures

Breach of dam, canal and irrigation structures is unlikely to occur. However, it will threat system sustainability and fatal accidents and following factors may also contribute to this process:

- Improper operation of water control facilities;
- Reservoir sedimentation
- Deterioration of free board due to cattle trespass and other factors;
- Tampering of outlets;
- Canal siltation;

- Action of borrowing animals such as rats and porcupines;
- Inadequate supervision;
- Lack of timely and adequate repairs;
- Lack of coverage of hydraulic gradient; and
- Fatal accidents like flooding of settlements. Due to seismic conditions of the area , the probability of breaching of dam can occur if seismic considerations are not incorporated into the design. The nearest existing settlement is present at a distance of 16.5 km from the project area. However, this settlement pattern may change due to development of the command area with future settlements coming in much closer to the canal area.

The impact significance has therefore been rated as 'High'.

Mitigation

To mitigate the above-mentioned impacts following measures shall be adopted:

- BIPD should ensure the design review during operation phase by panel experts;
- BIPD (Irrigation Department) to monitor the system regularly;
- The important facilities that need attention and annual maintenance are canal embankments, falls and control structures and bed levels which are affected by siltation or scour. Canal section has been designed to ensure safety by following the standard design principals to design the banks against piping. In addition, all *nullah* crossings have been provided with Cross-drainage structures of at least 40 years return period flood capacity with adequate freeboard. For major *nullahs*, canal syphons have been provided so that *nullah* flows unhindered and therefore does not cause damage to the canals;
- Include capacity building of the communities in the O&M activities;
- Liaise with the communities to identify potential weaknesses in the system that could cause breaches;
- Ensure that the canal brick lining is regularly monitored to avoid any cracking impact from weathering;
- The construction and rehabilitation of flood protection bunds as part of the project will be regularly checked to undertake any prone damage;
- Repairs on urgent basis; and
- Emergency response plan for Dam and canal breach shall be prepared and followed.
- A training program should be executed by BIPD for locals with special emphasis on public
- evacuation during emergency conditions.

Above measures will step down the significance of impact from high to low

7.9.3 Use of Irrigation Water for Drinking Purposes

Karaiz is the only existing water source in the project area. With availability of sweet water in the canal, there will be a tendency to use it for potable purposes as well. However, this may lead to health-related issues. This impact would be of moderate significance.

Mitigation

To mitigate the above-mentioned impacts following measures shall be adopted:

- Train local community on safe drinking water;
- Coordinate with Local Government to install small filter plants at suitable locations for potable water;
- Place warning and information signs about dangers of using irrigation water for potable purposes;
- Local Government to assure potable water quality as per WHO/ GOP standards;
- Turbidity and free residual chlorine tests shall be regularly performed;
- Arsenic will be tested as per WHO/GOP standards; and
- Keep continuous check on the site by employing security professional to check and shun the water usage (for potable purposes) by local public.

Above measures will step down the significance of impact from moderate to low.

7.9.4 Ground Water Contamination in Command Area

New irrigation infrastructure might hinder and adversely affect the natural drainage pattern. This may result in localized flooding. This may also lead to water use rights issues later on. However, the current natural flow of rain water is such that it generally comes in flash floods from the hill torrents in the Project Area. In case of improper drainage system ground water will contaminate (become brackish). This impact would be of moderate significance

Mitigation

By adopting the following measures, the impact would be finally of low significance:

- Periodic maintenance of drainage structures; and
- Ground water monitoring wells should be established in command area to monitor the salinity of ground water by BIPD.

7.9.5 Disposal of Waste (Connection of Waste Streams) in the Canals

This impact will lead to serious health issues and will be of moderate significance.

Proper monitoring of canals alignment and disconnect all identified waste streams would step down the significance of impact to low.

- Keep regular monitoring through that no waste is dumped within the canals; if it is dumped, fine should be imposed;
- Arrange awareness programs for the local public to educate them about the harms caused by disposal of waste into canals;
- Labelled sign boards to avoid entry of waste disposal;

Mitigation

By adopting the following measures, the impact would be finally of low significance:

- The proposed project is an integrated irrigation program. The proponent will also facilitate it to become an integrated community development program through formal structure made by BIPD and through the community engagement. Timely and correct sharing of information will enable other line departments to implement their own development schemes in the area;
- The BIPD will develop and implement a proactive maintenance plan for the proposed project, with predefined periodicity;
- Monitoring results;
- Ensure proper disposal of waste at designated landfill/disposal sites; and
- Efficiency of the system will be at its best by adopting proper maintenance activities such as silt removal and bed scratching at periodic intervals.

7.9.6 Community Participation for Management and Operation of the Irrigation System

The impact may lead to social and system sustainability issues and would be of moderate significance.

Mitigation

By adopting the following measures, the impact would be finally of low significance:

- Ensure community participation in management and operation of the irrigation system; by implanting O & M manual for Farmers' management of Irrigation System prepared as a separate document for Sri Toi Irrigation Project;
- Training of related communities; and
- Interaction of FAO with the rest of community is recommended throughout the Project implementation. Moreover, any change in the design or structure or operation if incurred, it must be done in consultation with the local public.

7.9.7 Disruption to Public and Wildlife

Expected changing behavior of the wildlife for movement and drinking water due to canal is envisaged. The other impacts which likely to be occur is as follows:

- The dam traps sediments, which are critical for maintaining physical processes and habitats downstream of the dam (include the maintenance of productive deltas, barrier islands, fertile floodplains and coastal wetlands);
- Agriculture expansion will disturb habitat and use of potential pesticides will affect biodiversity;
- Discharge of toxic matters (pesticides, toxic metals etc.) and their condensation in food chain may affect sensitive animals immediately; all living organisms may expire when the stream becomes unable to recover itself; and
- Hunting of migratory birds because of wetland may affect their population.
- It is also envisaged that during the operational phase the construction of canals would give problems to local community especially in terms of crossing the canals to reach the other side.

  The impact may lead to disruption of public movement as well as wildlife conservation issues and would be of moderate significance.

  Mitigation
- Design has already provided cattle drinking troughs at different intervals and pedestrian bridge for canal crossing approximately at 500 m interval. Watershed management activities on the catchment and stream bank will be afforested. Agricultural advisory services will be started to grow organic vegetables and crops. Biological control of pests will be adopted through agriculture department support. As dam will be constructed, with the coordination of
- Forest and wild life and conservation organization, environmental awareness regarding hunting control will be raised. It will be the responsibility of BIPD to ensure the proper maintenance of aforementioned structures. By adopting the aforementioned measures, the impact would be finally of low significance.

7.9.8 Health and Safety

- During the operational stage of project significant human safety issues will arise due to the impounding of the reservoir. These include the need to raise awareness of the dangers of drowning in the reservoir, especially due to the rapid changes in water level that will be experienced.
- The proposed project can also result in an increase in the vector borne diseases (e.g. malaria) due to presence of a large water body.

The impact may lead to health and safety issues and would be of moderate significance.

Mitigation

- A training program will be organized by BIPD at community level for health and safety practices adoption and ensure the community participation. This program should be instigated through the local schools to to warn about the dangers of water borne diseases to children. Proper medication to treat the water borne diseases should also be available in nearby BHUs. By adopting the aforementioned training on health and safety, the impact would be finally of

low significance.

Team members of HSE Department shall be deputed to prohibit swimming in dam, spillway or dykes. Warning signs shall also be posted for public awareness.

7.9.9 Periodic Cleaning and Maintenance of the System

The blessing of any available resource might be wiped out by poor governance. Nonfunctional water use associations, leakage, improper maintenance of structure, broken outlets, and poorly maintained field channels may result in unequal utilization of water. This impact would have a moderate significance.

7.9.10 Ground Water Recharge

Due to the degradation of groundwater table, the principal watersheds have almost lost their capacity for intercepting rainfall and ground water recharge. Also, currently ground water provides a significant percentage of the irrigation water for crops in the areas. After project implementation there will be a reduced burden on ground water since there will be a reduced area under tube-well irrigation. Also improved watershed and rangeland management technologies will improve soil moisture retention, reducing erosion, and improving groundwater recharge. This impact is characterized as Major adverse prior to mitigation and after implementation is deemed major beneficial as given in Table 51.

7.9.11 Impacts due to Watershed and Rangeland Management Plan

Rangeland degradation is occurring as a result of no grazing management plans, removal of vegetation for fuel wood and no clear authority of rangeland ownership. The implementation of the Watershed and Rangeland management will prevent grazing on degraded land and protect areas with good natural regeneration potential. Also, grazing management plans based on carrying capacities, and construction of watering ponds for livestock will be introduced. Planting of palatable shrubs and trees and reseeding of grass as well as introduction of stall feeding based on fodder production. Rotational grazing and stocking rate limits will be introduced. Rotationally controlled grazing will lead to less degradation of land, provide a chance for vegetation to grow and also provide erosion control. At the irrigation scheme level, watershed management will include drainage improvement, soil and water conservation measures and rehabilitation/protection of irrigable land degraded/endangered by erosion gullies. This impact is characterized as Major adverse prior to mitigation and after implementation is considered to be Major beneficial as given in Table 51.C

7.9.12 Enhanced/ Induced use of Fertilizers and Pesticides

The project will result in an increase in cultivated land, thus there will be an increase in the use of pesticides and fertilizers which may have a negative effect on ecosystems and downstream areas. There will also a negative effect on downstream areas. This impact is characterized as Major Adverse, as given in Table 51.

Mitigation

- An Integrated Pest Management (IPM) plan is being prepared as part of the EMP and will be implemented during project operation stage.
- Disseminate information regarding sustainable use of fertilizers and insecticides to keep the use at an optimal level.
- A comprehensive education and awareness programme on sustainable fertilizer use.
- Development of a biodiversity database; community-based sustainable use programmes; developing and strengthening the protected areas system; developing a policy for ex-situ conservation of biodiversity; developing an effective policy framework and enabling legislation; and developing institutional capacity to manage biodiversity.

7.9.13 Diversion will Alter the Natural Flow Regime

Diversion may alter the natural flow rates and hydro period, degrade bank line and riparian habitats, and alter aquatic community structure and diversity in downstream areas. This impact is characterized as Major Adverse, as given in Table 51.

Mitigation

- The entire scheme of analysis is developed on the baseline geospatial datasets and incorporating the basins water management evaluation approach (WEAP) and analyzed for Zhob and Mula river basins.
- Zhob and Mula river basins hydrological studies at sub-basin levels were conducted and a comprehensive assessment undertaken for the quantification of runoff and availability of surface and ground water is assessed. In addition, demand assessments and water

consumptive usage is also assessed in terms of population, livestock and population. Environmental flow assessments will help to maintain the hydrological regimes and provide protection of river flows and ecosystem characteristics.

7.9.14 Pesticide Residue in Water Bodies

Due to high use of pesticides for agricultural activities there may be a high pesticide residue in water bodies that may negatively affect fish and other aquatic wildlife. This impact is characterized as Moderate adverse, as given in Table 51.

Mitigation

- Based on secondary information, organochlorine pesticide residue in water is low but high in sediments in Miani Hor.
- Monitoring of organochlorine pesticide residue is recommended to establish the baseline during the early stage of project implementation and follow-up monitoring to compare with the baseline.

7.10 Climate Change Impacts and Risks

Climate change is expected to have a negative impact on both surface and groundwater resources in Balochistan. According to climate change predictions of Pakistan Meteorological Department, temperatures in high Balochistan are expected to increase to 0.12-0.6 °C by 2050 and 0.27-1.35 °C by the end of century. On the other hand, for lower Balochistan, the numbers are 0.04-2 °C by 2050 and 0.09-4.5 °C by the end of century. Climate change is also expected to increase extreme precipitation events in high Balochistan and decrease in lower Balochistan. As agriculture is directly dependent on the availability of water, this sector will be one of the first to suffer from climate change. It is predicted that any further decline in water availability would prove catastrophic for local people's food security and incomes. Local agricultural practices provide little scope for adaptation. The scarce and the mangrove forests provide a variety of ecosystem goods and services. These forests will continue to experience huge pressures, including demand for fuelwood, and degradation unless immediate measures for their resilience are taken. It should be noted that forests play a large role in sequestering carbon, therefore mitigating climate change. The consumption of groundwater is likely to become unsustainable in the semi-arid regions of Balochistan. Already, aquifer drawdown in some areas of Balochistan is such that future reliance cannot be placed on this resource.

The Project schemes reviewed and analyzed with respect to their potential for emission of GHGs and consequent impact on global warming/climate change. The emission of GHGs from the Project is likely to be almost negligible as there shall be little change from the baseline GHG emissions to the operational stage of the project. There will be emission of GHGs from construction machinery and vehicles to be used during construction period. However, the proposed interventions of BWRDP will not contribute to global climate change since construction activity will last only 4 years and thus will produce a negligible amount of GHGs. Future climate change is expected to increase the variability in rainfall, increase temperatures and most likely reduce water availability. Hence, improved water management is thus critical for the future economic and social development of Balochistan.

8 Cumulative Impact Assessment

8.1 Objective

The Government of Balochistan is planning the IWRMD Project which will transform the existing water management from a narrow irrigation project focus, to an integrated multi-sectoral river basin planning and development approach. It will achieve this through institutional restructuring and strengthening, investments in hydro-meteorological data and water information systems, and priority infrastructure investments in irrigation, potable water supply, flood protection, watershed and rangeland management, and environmental protection of Juniper forest in the north, Hamal Lake in southeast, and Miani mangrove forest in the south. If the impacts arising from the construction and operation of the proposed intervention are considered individually for each scheme, they are mostly construction related and temporary in nature, but these impacts may be significant and long term when evaluated in the context of the combined effects of all the existing water resources project, proposed intervention under the project, and planned and future water resources management project.

The objective of the current cumulative impact assessment (CIA) is to evaluate these combined effects of all interventions.

The main focus of the cumulative impacts of the water resources project will lead to the impacts on the availability of water in downstream stretches in terms of the release of environmental flows for the survival of aquatic habitats. The environmental flows of River Basins of Balochistan on the downstream ecosystem are already well documented and recommendations for these impacts are also available considering the current water usage. These are explained in Section 7.2.

The most significant valued environmental components (VECs) related to this project are identified and they are: surface water, aquatic habitat and fish, and biodiversity and forests, and are considered for the current CIA study. Significance of these VECs is described in Section 7.3.2.

8.2 Background

ADB TA 4560: Supporting Implementation of IWRM Policy in Balochistan: The purpose of the study was to assess minimum environmental flows for downstream ecosystems of river basins. The specific objectives of the study included estimation of water balance at the basin level and minimum environmental flows for downstream ecosystems. The estimation of minimum environmental flows for the river basins was based on the following:

- Total surface water generated within the river basin was multiplied by a selected coefficient of minimum flow to estimate the minimum environmental flows;
- Minimum environmental flow is to be considered sufficient or acceptable, if its estimated value is less than the flow of surface water to the downstream basin, otherwise the current flow would be the available minimum environmental flow;
- Demand of ecosystem or habitat covering plants, fish species and birds was assumed to be ≤ 10% of the total generated water within the basin in an average year;
- Surface water available for development was considered equal to the difference between the flow of surface water to the downstream basin and minimum environmental flow; and
- Potential water available for recharge was estimated by adding surface water available for development and current recharge level (or direct recharge by groundwater).

Minimum environmental flows for river basins in Balochistan were estimated from the total internally generated water within the basins at 50% probability. The minimum environmental flows of 1.08 billion m^3 are estimated for the 18 river basins. CIA in Context of BWRM Project

8.2.1 Study Boundaries

The spatial boundaries of cumulative impact assessment (CIA) have been based on the jurisdiction of GoB. The spatial boundary is the Zhob and Mula River basins and the projects considered for the assessment are BIWRMD, Delay Action Dam, 100 Dams, and other Water and Power Development Authority (WAPDA) Dam in the selected river basins in Balochistan in next 10 years. Locations of these river basins are shown in Figure 8-1.

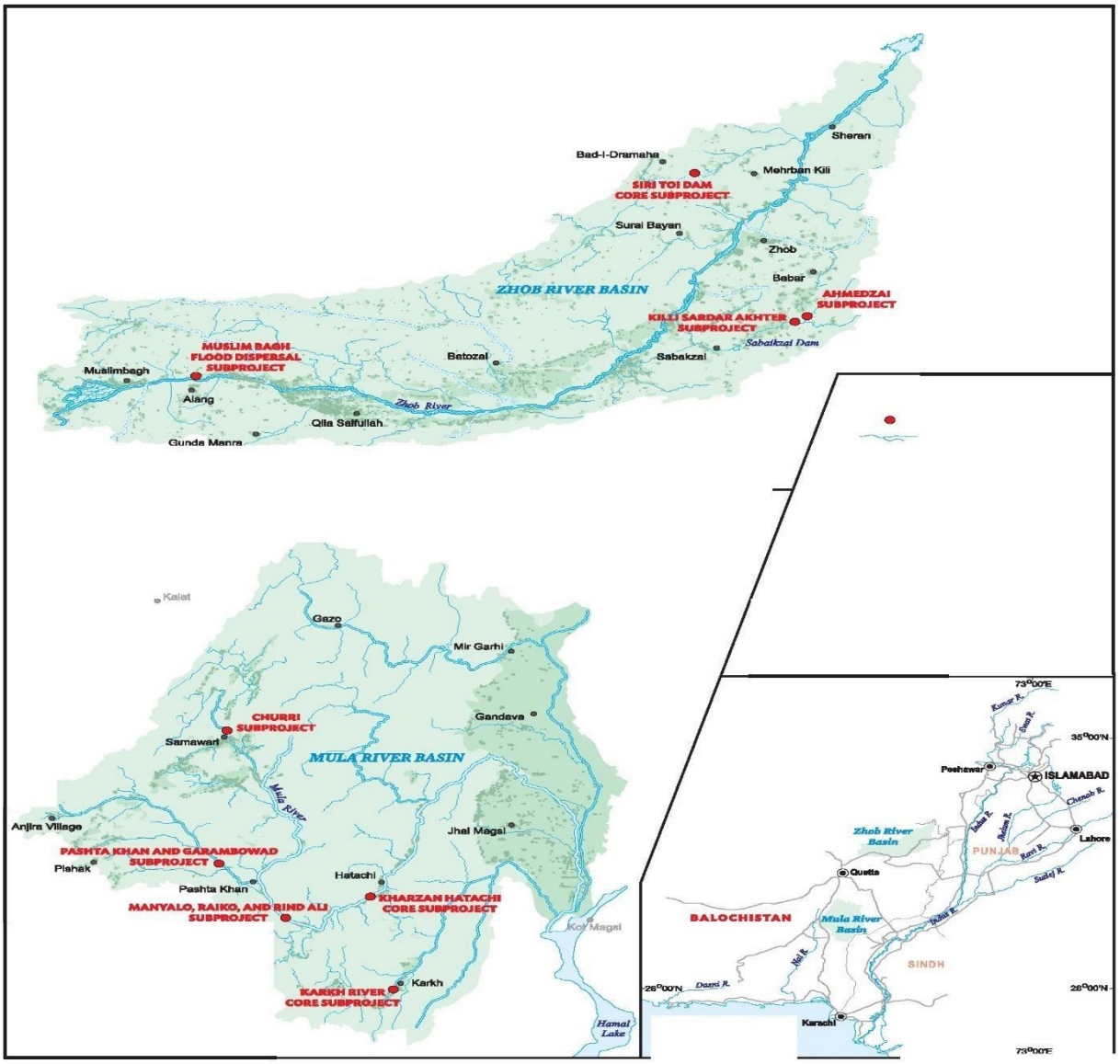


Figure 8-1: CIA boundary

8.2.2 Identification of Valued Environmental Components for the CIA

Based on consultations with various stakeholders, three valued environmental components are identified for the CIA study. These VECs and their significance are described below:

- **Surface Water**: Construction of upstream water resource infrastructures as major influence in water availability for irrigation and drinking water while affecting negatively in downstream water flow. Downstream water release will be reduced during low flow season due to the improved water supply for irrigation, possible land conversion for agriculture due to increased water availability, and reduced water available for maintaining environmental flow.
- **Biodiversity and Forests**: The main drivers of biodiversity loss are converting

natural areas to farming and irrigation, polluting or over-exploiting resources including water and soils and harvesting wild plants and animals at unsustainable levels. Project will divert water for irrigation by reducing flows and/or increased surges in low flow season, increase pressure on timber trees/forests (illegal logging) by influx of workers, may convert forest land due to increased agricultural potential, release less water in downstream resulting in reduction or degradation of aquatic and forest habitats, may degrade rangeland by overgrazing, collect firewood, etc.

8.3 Surface Water Constraints and Availability

Downstream Water Releases

8.3.1.1 Proposed Project Scheme

Hydrological alteration of river flow regimes can cause significant environmental degradation. Feasibility study of the Project undertook water balance assessment to determine what components of the natural flow (amounts, timing) will be released in downstream. An ADB TA conducted in 2005 to estimate the environmental flow requirement of 18 river basins of Balochistan.[1] This assessment determined environmental flow requirements or environmental water allocations of a river, wetland or coastal zone necessary to maintain the biophysical, ecological processes and health of aquatic ecosystems, and associated ecological goods and services. The water balances are based on estimates of the water demand for "nature" and do not directly consider flow regime characteristics and hence specific environmental flow requirements. Nonetheless, the water balances indicate that on average, the volumes of water for consumptive demands are relatively small and there is additional water that can be sustainably diverted in these basins to improve livelihoods of local inhabitants.

8.3.1.2 Delay Action Dam

(a) Background

Groundwater recharge is a process of gravity driven infiltration measure of the precipitation through surfaces (original ground) and river beds, whereas, the artificial recharge(s) measures are mainly through the recharge devices in the form of infiltration well and ponds River runoff does not generally contributes as sub-surface groundwater recharge due to its short duration (torrential), in addition severe surface erosion caused by floods devastates the groundwater conservation conditions in the drainage areas. Consequently Delay Action Dams (DADs), artificial recharge facilities, have been constructed in Balochistan to accelerate recharge of groundwater aquifer. Due to the rapid depletion of groundwater resources, the Government of Balochistan has constructed about 292 DADs with a gross storage capacity of 276 million m^3 (223,556 acre-ft) for recharging groundwater aquifers.

(b) Objectives of DADs

The major objectives to construct the DADs are the following:

- Recharge of groundwater;
- Flood control and damage minimization;
- Control of sediment loads;
- Socio economic uplift of the population.

(c) Design and Salient features of DADs

The basic embankment configuration comprises of homogeneous and zoned earth fill sections depending on the availability of fill material with varying configuration as follows:

- Maximum height varying from 9.14m to 15.2m (30 ft. to 50 ft.);
- Top width is usually kept as 6m (20 ft);

[1] ADB TA 4560-PAK (2008); Supporting Implementation of IWRM Policy in Balochistan, Asian Development Bank, the Philippines.

- Upstream slopes vary from 2 to 3:1 and downstream slopes vary from 2 to 4:1;
- 0.46 to 1 m (1.5 to 3 ft) hand packed stone pitching provided on the upstream slopes to protect against wave action;
- 0.23m to 0.304m (0.75 to 1.0 ft) thick shingle/gravel layer provided on the top and downstream slope of the embankment for protection against erosion from wind or rain cuts.

Depending upon the site-specific topographic and geological conditions and discharge requirements, stepped and sloping gabion apron spillways are provided mostly without any stilling basin structures for energy dissipation. The spillway is usually sized (designed) to pass the 30-50 years return period inflow flood. Table 52 presents the list of the delay action dams.

Table 52: Summary of completed Delay Action/ Storage Dams in Balochistan

Basin	No. of Dams	Total Storage (million m^3)
Dasht	18	28
Gaj	3	6
Gawadar	4	76
Hamun-E-Lora	1	0
Hamun-E-Mashkhel	9	21
Hingol	5	4
Hub	7	8
Kachi Plain	11	3
Kadnai	--	0
Kaha	8	4
Kand		0
Kunder	4	0
Mula	5	5
Nari	44	22
Pishin Lora	127	43
Porali	13	16
Rakhshan	4	8
Zhob	29	30
Total	**292**	276

Source: Irrigation and Power Department, Government of Balochistan

8.3.1.3 The 100 Dams Project

Government of Balochistan planned 100 Dams project in 2008 to mitigate the sharply depleting groundwater table as well as to protect medium and high-level floods. Federal Government approved it for financing in 2010, and physical works began in 2011. This project has been building multipurpose dams across the province for full utilization of the huge potential of floodwater (about 63% of the water budget).

The construction of these 100 Dams is planned in three phases, with 20 dams to be completed as Package I, 26 dams in Package II while remaining 54 dams to be completed in Package III. To date, 18 Dams of Package I and 6 dams of Package II have been completed. Remaining dams of Package II are scheduled to be completed by June 2017.

Out of the completed 24 dams, only six are located in Zhob and Mula River basins and they are:

- *Zhobi Basin*: Dabar Dam, Zhom Kumbri Dam in Bolan: This dam has catchment area of 22.02 Sq. Km with storage capacity of 0.617 million m^3.
- *Mula Basin*: Sasool Dam storage capacity of 1.826 million m^3, Taigh Dam storage capacity of 0.703 million m^3, Kashi Dam storage capacity of 2.93 million m^3, Hashtri Dam storage capacity of 1.07 million m^3, Lohi Dam storage capacity of 0.74 million $m^3$and Arambo Dam storage capacity of 2.06 million m^3in Khuzdar.

In the remaining Packages, following are the dams planned for construction, across the two river basins. Although termed as dams, none of these structures is to serve as a water reservoir rather water is to flow out once its velocity has been achieved.

8.3.1.4 Dam Investment by Water and Power Development Authority

The Federal Water and Power Development Authority plans to construct medium sized (with storage capacity of less than 1 MAF) water storage dams across Balochistan. Currently, there are four operational water storage dams constructed by WAPDA in the province, out of which one is located in the Project study area and they are:

- Sabakzai Dam in Zhob[2] -The main objectives of the dam are to provide 21.5 km metalled access road upto Sabakzai, extension of 11 kV line upto dam site, irrigation supply of about 0.934 cumec of water for more than 2,782 ha of land round the year with an average cropping intensity of 123%. The dam is build on Sawar Rud a tributary of Zhob River. The live storage capacity of the dam is 18.13 Mm^3 (14,700 acre-ft) and stored water is meeting the drinking water requirements of about 15,000 people, helping to mitigate the flood and annual losses to property.

8.3.2 Cumulative Effects

8.3.2.1 Downstream water releases

Based on the analysis above, the following conclusions can be made based on a conservative estimate:

- *Impacts of Project Schemes*: It is estimated that scheme diversion under the proposed Project in Zhob River basin is 33.11 million m^3 and in Mula River basin it is 15.2 million m^3, respectively.
- *Impacts of Delay Action Dams*: In Zhob River Basin, 29 dams were constructed with total storage capacity of 30 million m^3 and in Mula River Basin, 5 dams were constructed with total storage capacity of 5 million m^3. Therefore, total use of the water by the DADs in two river basins is 35 million m^3.
- *Impacts of 100 Dams*: Given the timeframe it took for the initial 24 dams to implement, not all of the dams mentioned above are likely to complete in the next 5 to 10 years. The funding is to come from Federal Government, in the form of packages, and its flow is dependent on physical progress achieved. With current security situation in Southern Balochistan, it is highly unlikely that the dams in at least Mula River basin will be completed in the timeframe being considered by this CEIA. As such, even if they do complete, there are minimal negative impacts of these multipurpose dams, as they will help reduce flash flooding, improve groundwater tables, as well as provide drinking water for animals, and in some cases human settlements. Since these are not diversion structures, nor are they reservoirs, downstream water flows, for agriculture and/or domestic purposes, are likely to remain unaffected.
- *Impact of WAPDA Dam*: This dam is constructed on different tributary of Zhob River and has n impact on downstream water. Recommendations under the Project

8.3.3 Recommendations under the Project

The following recommendations are made to protect surface water:

- Install hydro meteorological stations at designated locations to monitor water flow of the rivers and distributaries. This is crucial to make any future investment in water resources. The hydrological data is needed to monitor future water availability and flow in the rivers and evaluate the performance of the schemes.
- Preserve aquatic biodiversity by river management focusing on restoring both the timing and duration of flood pulses, as well as on maintaining critical minimum flows in the dry season.

[2] NESPAK, Project Summary, www.nespak.com.pk/projects/pdf/4-1-0.pdf, visited on January 8, 2016

- The project will work closely with the local communities as well as Forest and Wildlife, and Revenue Departments to ensure that natural habitats including rangelands and forests remain unaltered as a result of this project. The areas of ecological important will be delineated as per land records using GIS and remote sensing support, with active community involvement. Since the project aims to work with farmer communities in the shape of farmer organizations as well as water user associations, a binding clause on protection and non-conversion of natural habitats will be included into the terms of partnerships signed with the local/farmers' organizations.
- During operation stage of the project care will be taken to stop converting ecologically important land for irrigation.

8.4 Biodiversity and Forest

8.4.1 Conversion of Rangeland and Forest

Rangeland degradation in the Project area is occurring as a result of no grazing management plans, removal of vegetation for fuel wood and no clear authority of rangeland ownership. The major indicators of rangelands degradation are shift in species composition, loss of range biodiversity, reduction in biomass production, less plant cover, low small ruminant productivity, and soil erosion.[3] Perennial grasses and palatable shrub species are confined to only in some protected Forest Areas. The degradation of rangeland is site specific and depends on the existing vegetation, grazing pressure, grazing accessibility, human population, availability of stock water, and tribal conflicts.[4] Major rangeland management issues include: open range areas, no clear land ownership, weak community participation, recurrence of drought, and lack of integrated range management approaches. Perennial grass like *Chrysopogon aucheri* a highly palatable species is gradually replacing by low palatable species of *Cymbopogon jwarancusa* and shrubs like Artemisia species or Haloxylon species. Even at many rangelands these shrub species have been replaced by unpalatable shrub species like *Peganum harmala* and *Othonophsis intermedia* with clear evidence of soil erosion. Pastoral communities have some realization about the rangeland degradation by assessing their livestock production or health, forage availability and traveling in search of forage. However, the impact of rangeland degradation on other services like carbon sequestration, conservation of plant and wildlife biodiversity, water harvesting and spreading, infiltration, and many other environmental services are either not monitored, documented or disseminated the information among the various sectors of the society.

8.4.2 Cumulative Effects

Livestock serve as a backbone of the rural economy of Balochistan (80% of all Pakistan's sheep and 40% of goats + sheep occur here). There is potential for careful application of indigenous and scientific knowledge to improve models of livestock and rangeland management, thereby yielding a number of improved goods and services, which in turn will help to relieve pressure on other natural resources. The rangelands, forestland, and watersheds of both river basins are already under severe stress from local population, livestock grazing/browsing, and fuelwood extraction. With the influx of construction activity, the pressure will increase considerably (as labor camps will be set up which typically use wood and shrubs for fuelwood). The project will need to work with the local communities as well as Forest and Wildlife, and Revenue Departments to ensure that natural habitats including rangelands and forests remain unaltered as a result of this project. The rangelands will need to be delineated as per land records using GIS and remote sensing support, with active community involvement.

[3] Ahmad, S.S. and H. Ehsan. 2012. Analyzing the herbaceous flora of Lohi Bher wildlife park under variable environmental stress. Pak. J. Bot., 44(1): 11-14.
[4] Ahmad, S. And M. Islam. 2011. Rangeland productivity and improvement potential in highlands of Balochistan, Pakistan. Biomass - Detection, Production and Usage, Darko Matovic (Ed.), ISBN: 978-953-307-492-4, In Tech, pp. 289-304.

Most people inhabiting watershed areas are surviving just at the subsistence level due to the limited resources, and are gradually getting further impoverished due to overgrazing, removal of vegetation, fires and cultivation on steep slopes. They cannot improve their lot because they are uneducated, do not possess many skills and do not have enough money to invest. They are nevertheless sticking to their meagre holdings primarily due to sentimental (cultural) reasons and thus refuse to out-migrate. Human and livestock (cattle and sheep) populations are on the increase. As they are cultivating steep slopes using medieval technology, without any modern inputs, they continue to get minimal returns. But in the process they are destroying the existing land base, are carving out new agricultural land by removing trees, and accelerating soil disturbance and sedimentation. This results in reduced life of costly reservoirs, being choked with silt, sand and debris, and rises in river bed levels which aggravates flash flood damages, causing havoc to infrastructures, and destroying crops and fertile agricultural land. Forests have a bigger role in the rehabilitation and development of rangelands, water management, wildlife management, promotion of ecotourism, and soil conservation. Recommendations under the Project

The following initiatives will be taken by BID in the project area as a continuous process:

- Rangeland improvement can be achieved through proper grazing control, developed as a system by involving the people who live there. Scientific management of rangelands can go a long way in enhancing their productivity. Partial or complete closures in certain areas through rotational or deferred grazing reinforced with reseeding can be emphasized. Benefits of regulated grazing can be demonstrated effectively by developing model pastures either on state land or on the lands of some volunteers to achieve a make-believe effect. The concept of group grazing can also be introduced. The protection of forested land, which is an erstwhile resource of fodder, fuel and grazing, must go hand in hand with the protection and improvement of pastures. Some unproductive lands designated as forests can best be managed as pastures.
- At present, agricultural yields in watershed areas are very low because of the use of outdated and inefficient techniques and inadequate knowledge. Improvement measures for rangeland management under the Project will reduce soil exposure, improve surface storage, increase infiltration and reduce damage. The methods to achieve desired objectives include use of fertilizers and green manuring, preservation of stubble and crop residues, proper crop rotation, ploughing along the contours, bench terracing, and subsoiling.
- Since, the project aims to work with farmer communities in the shape of farmer organizations as well as water user associations, a binding clause on protection and non-conversion of natural habitats can be added into the terms of partnerships signed with these local organizations.
- Propose monitoring of land conversion and management plans in the EMP to improve rangelands in the Project area.

9 Environmental Management Plan

9.1 Objectives of EMP

The EMP is a strategic approach towards the effective implementation of the mitigation measures and environmental protection of the Project Area and its surroundings. This EMP ensures that the undue or reasonably adverse impacts of a project are prevented and the positive benefits of the project are enhanced. According to this plan, all the activities related to various phases of the project are controlled and monitored.

This EMP encompasses all the phases of the project and may be used as a quick reference by the personnel(s) of client and contractors for effective implementation of the proposed mitigation measures and tracking the overall environmental performance of the project.

This EMP addresses all the significant impacts that are identified during the impacts identification process of the EIA. It should be amended in consultation with the concerned regulatory authority, in this case BEPA, if any issue has been overlooked or if any need would arise as the project continues.

Structure Of EMP

The contents of this chapter are given below:

- Regulatory Requirements
- Purpose & Need of the EMP
- Objectives of the EMP
- Scope of the EMP
- Institutional Arrangement for Implementation of EMP
  - Institutional Arrangements for Implementation of EMP during Construction Phase
    a) Role and Responsibilities of the Functionaries involved in EMP Implementation
    b) Reporting Mechanism
    c) Non-Compliance of the EMP
  - Institutional Arrangements for Implementation of EMP during Operation Phase
    a. Role and Responsibilities of the Functionaries involved in EMP Implementation
    b. Reporting Mechanism
- Environmental Mitigation Plan
- Environmental Monitoring Plan
- Implementation of EMP
    a. NOC and other Approvals
    b. Stakeholder Coordination
    c. Trainings
    d. Communication & Documentation
  - Grievance Redressal Mechanism (GRM)
  - Environmental Management Cost
  - Change Management

Regulatory Requirements

This EMP refers to the applicable legal framework given earlier as **Chapter 2** for the proposed project for the protection of the environment.

Purpose & Need of the EMP

Primarily, the purpose of this EMP is to serve as a quick reference for the consultants, contractor as well as the proponents to implement the proposed mitigation measures effectively and to monitor the overall environmental performance of the project. Furthermore, to house the procedure, which the proponent follows to implement and maintain this EMP. The need of the EMP is mentioned as follows:

- Ensure that attention is paid to the actual environmental effects arising from construction, and operation of the proposed project;
- Ensure that anticipated impacts are maintained within the levels predicted;
- Ensure that unanticipated impacts are managed or mitigated before they become a problem; and
- Ensure that environmental management brings about real environmental benefits and achieves environmental sustainability, rather than the Environmental Approval Process being a mere paper chase to secure a development approval[11].

Objectives of the EMP

The main objectives of the EMP during different phases of the project is to implement mitigation measures and to evaluate the effectiveness of mitigation measures as proposed in the EIA and recommend improvement if any need would arise.

Scope of the EMP

The scope of the EMP includes the following phases of the project:

- Planning and Design Phase;
- Implementation and Construction Phase; and
- Operation Phase.

All the activities performed during these phases will be controlled and monitored according to this EMP.

Institutional Arrangement for Implementation of EMP

The following is a broad guideline has been proposed for institutional setup under this project as a reference for BIPD. It is based on the recommendations for PIU of ADB's Sri Toi Irrigation Project. The final organizational structure, working and monitoring of Institutional setup would be proposed by the BIPD and would be finalized in consultation with ADB's Resident Mission in Pakistan.

8.7.1 Institutional Arrangements for Implementation of EMP during Construction Phase

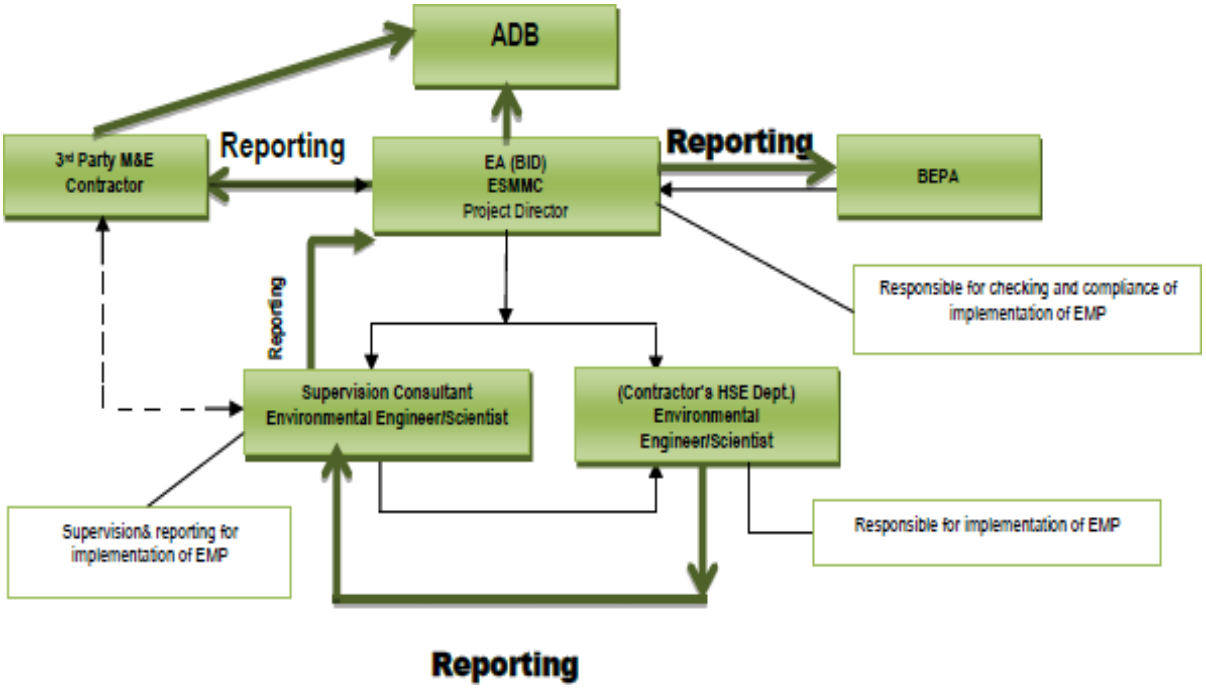
The Chief Engineer (BIPD) will formulate an Environmental & Social Management and Monitoring Cell (ESMMC) which will comprise senior professionals, and should preferably have representative of various stakeholders including local administration. The Cell should also include at least one technical expert from R&D institutions (either from academia or international NGOs e.g. IUCN / WWF), and a representative from BRSP.

The key players involved during construction stage of the proposed project are the ESMMC, 3rd Party M&E Contractor, Balochistan Environmental Protection Agency, the Contractor and the Supervisory Consultants (SCs). The roles, remits and responsibilities of these organizations are outlined below.

The following staff will be involved in the implementation of EMP:

- ESMMC Representative;
- 3rd Party M&E Contractor;
- SC's Environmental Engineer/Scientist; and
- Contractor's Environmental Engineer/Scientist.

The Construction Contractor will make a bond through contract documents to implement the EMP. The whole EMP will be included as a clause of the contract documents. The organizational setup for implementation of EMP is given below:



Roles and Responsibilities

a) BEPA

BEPA is the regulatory authority for issuance of NOC for this proposed project. As part of its mandate, protection of environment is its responsibility. Therefore, this agency will undertake an audit (as and when required) of project activities with respect to the protocols as defined in EMP.

b) 3rd Party M&E Contractor (if required)

3rd Party M&E shall be responsible for:

- To make sure that all the contractual obligations related to the environmental and social compliance are met;
- To monitor the progress regarding implementation of environmental safeguard as provided in EMP;
- Oversee the Compliance of all the monitoring programs as given in EMP;
- Check randomly whether monitoring of the environmental aspects of the project during construction phase is being properly carried out;
- Document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports, and make follow-up on these actions to ensure progress toward the desired outcomes;
- Make sure that the Contractor is implementing the additional measures suggested by the M&E Contractor; and
- Reporting the status of EMP compliance to BIPD and ADB

c) Chief Engineer/ Project Director, BIPD / ESMMC:

Project Director will have responsibility for assuring implementation of EMP. This includes the following:

- Ensuring that the required environmental training is provided to the concerned staff;
- The Project Director will be responsible for carrying out random site visits to the construction sites to review the environmental performance of the Construction Contractors;
- Review monitoring reports for the progress of environment related activities;
- Make sure that the Construction Contractor is implementing the additional measures suggested by the Supervision Consultant in environmental monitoring reports;
- To assist Contractor for obtaining necessary approvals from the concerned departments.
- Maintaining interface with the other lined departments / stakeholders; and
- Reporting to the BEPA on status of EMP implementation.
- Reporting to ADB on status of EMP implementation.

d) Supervision Consultant: Resident Engineer

Resident Engineer's (RE) roles and responsibilities will be:

- To oversee the performance of Construction Contractor to make sure that the Construction Contractor is carrying out the work in accordance with the tender design and follow the specifications;
- Ensuring that the day-to-day construction activities are carried out in an environmentally and socially sound and sustainable manner;

- Strong coordination with the Construction Contractor and ESMMC.

e) Supervision Consultant: Environmental Engineer/Scientist

SC's Environmental Engineer/Scientist will perform following roles and responsibilities:

- Directly reporting to the RE;
- Preparing Environmental training materials and implementing programs;
- Ensure the implementation of the mitigation measures suggested in EMP;
- To supervise and monitor environmental activities being performed at site;
- To organize periodic environmental training programs and workshops for the consultant's and contractor's staff;
- Periodic reporting as mentioned in EMP; and
- Suggest any additional mitigation measures if required.

f) Construction Contractor: Environmental Engineer/Scientist

Contractor will be bond to appoint a Site Environmental Engineer/Scientist with relevant educational experience and background. Contractor's Environmental Engineer/Scientist will carry out following activities:

- Implementation of the mitigation measures at construction site;
- Contractor will be bond through contract to take actions against all the special and general provisions of the contract document;
- Contractor will make sure the compliance of EMP recommendations and will also be responsible for effective liaison with local heads of villages;
- Provision of proper Personal Protective Equipment (PPEs) to the workers and train them for their proper use;
- To conduct the environmental and health & safety trainings to the workers/labor; and
- Coordinate with Environmental Engineer of SC.

Reporting Mechanism

Progress reporting related to environmental activities will be responsibility of Supervision Consultant, Environmental Engineer/Scientist. He will also be responsible for submitting monthly EMP compliance report for the project to the PD. A bi-annual report of environmental activities shall be submitted to ADB by BIPD / Supervision Consultant.

PD will in turn add his remarks / comments / feedback and submit the Report to ADB and BEPA in accordance with the frequency defined by them. In case the frequency is not defined and/or communicated, bi-annual monitoring reports based on the monthly monitoring report will be submitted to ADB for disclosure on ADB website.

Non-Compliance of the EMP

The implementation of the proposed EMP involves inputs from various functionaries. Construction Contractor will be primarily responsible for ensuring implementation and reporting of the mitigation measures proposed in the EMP, which will be part of the contract documents. In addition, the Contractor will also need to prepare Site Specific Environmental Management Plan (SSEMP) and get it approved from Consultant / BIPD before start of any construction phase. The SSEMP will provide the risk rating for each construction activity and will provide mitigation measures to reduce activities with higher degree of risk. Various plans, and layout maps (construction camp layout plan) will also form part of SSEMP. The provision of the environmental mitigation cost will be made in the total cost of project, for which Construction Contractor will be paid on the basis of monthly compliance reports. However, if the Construction Contractor fails to comply with the implementation of EMP and submission of the monthly compliance reports, deductions will be made from the payments to the Construction Contractor claimed under the heads of environmental components.

Institutional Arrangement for Implementation of EMP during Operation Phase

The key players involved during operation phase of the proposed project are BIPD, BEPA, Water User Associations (WUA) and Farmer Organizations (FOs) or Jirga. The roles, remits and responsibilities of these organizations are outlined below. The following staff will be involved in the implementation of EMP. Organizational setup for implementation of EMP is also given below.

- WUA and FOs, or Jirga; and
    - BIPD, Environmental Engineer/Scientist.

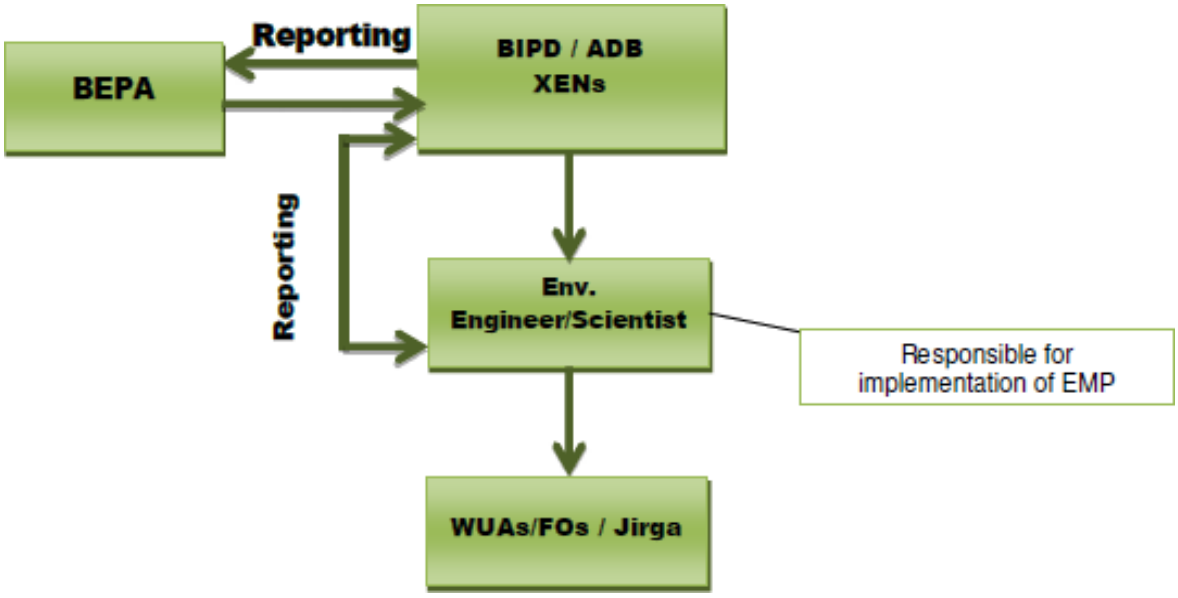


Table 53: Mitigation Plan

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
A. ENVIRONMENTAL AND SOCIAL IMPACTS DURING PRE-CONSTRUCTION STAGE				
Negative Impacts				
1.	Failure of previous similar interventions/projects and schemes.	• The causes of failure of previous interventions in terms of design and / or construction faults will be studied and incorporated into the detailed designs.	Design Consultant	PMU
2.	Improper dam site selection/route selection(alignment)of proposed new canal and land acquisition will lead to social issues related to relocation of assets	• The site selection of dam should be with regards to the area geology and topography as these plays important role for the sustainability of project and to ensure proper land acquisition justified to all stakeholders • Special considerations will be made for the selection of routes for both main canal and right & left canals which ensure proper distribution of water for all, alignment must be avoided from any controversial land, and alignment selection must be justified to all stakeholders	Design Consultant	PMU
3.	Storage capacity of dam will be reduced due to sedimentation	• Watershed management and erosion control measures have been included as an integral component of the project to control the reservoir sedimentation	Design Consultant	PMU
4.	The Sri Toi Dam Project area lies in zone 3 as per seismic map of Pakistan which clearly shows that the area is in moderate to high risk zone. So due to earthquake the breaching of dam, canal and other irrigation structures is possible	• Design engineer should ensure that seismic design of dam, spillways, reservoir and other allied and irrigation structures should be carried out as per international engineering standards	Design Consultant	PMU
5.	Schemes will only benefit some influential people of the area and not benefit the poor and vulnerable people most in need.	• Location of proposed schemes should be identified based on field survey, need assessment, and consultations with local community to have a proper geographical dispersion of interventions to ensure equitable distribution of benefits. • The project intervenes in both basins in a manner that ensures that there are many individual beneficiaries from project activities.	Design Consultant	PMU
6.	Any perceived or real disturbance to traditional local water rights will almost certainly lead to social disturbance in the area. This impact would be of moderate significance	• Proper water distribution through “Warabandi System” engaging Water User Associations and BIPD (Irrigation department)	Design Consultant	PMU
Impacts on Ecology, Soil and Land				
7.	Some acres of land may be required on temporary basis for contractor’ camp.	• Only government land to be used; no private or community land to be used. • In extreme case where private land acquisition is unavoidable, it will be compensated under the guidelines presented in the resettlement policy framework included in the Social Impacts Assessment and Mitigation Plan.	Design Consultant	PMU

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
8.	Sub-basin / Watershed and Scheme site location. Improper selection with reference to site ecology (i.e. improper project siting) may lead to erosion and loss of useful agricultural land.	• Appropriate site selection and design are being conducted according to national and the ADB guidelines in order to entail no or minimal disturbance to local ecology, soil and land.	Design Consultant	PMU
9.	Improper site selection and design can lead to removal of vegetation and cutting of trees.	• Schemes located in ecologically sensitive areas not approved, in order to avoid impact on flora /fauna.	Design Consultant	PMU
10.	Sub-basin / Watershed and Scheme site location may lead to deforestation in the sub-basins.	• Plantation plan / forest / rangeland management consideration during design phase.	Design Consultant	PMU
Impacts on Surface Water				
11.	Watershed / Scheme Site interventions may affect natural drainage / run-off. This can stress local natural stream flow –which may cause surface water quality degradation and contamination of water resources and affect downstream ecology.	• During design stage, watershed hydrological modelling is being considered of each scheme site to account for effects on natural drainage and surface water quality.	Design Consultant	PMU
12.	Improper design considerations for suspended silt / maintenance of minimum flows may degrade downstream ecology.	• Designs to consider flow regulatory structures / schemes and minimum flow requirements.	Design Consultant	PMU
13.	Excessive diversion/use of surface water resources may lead to depletion of natural surface water resources in the area.	• Design to consider proper water utilization rates under schemes as not to deplete water resources.	Design Consultant	PMU
Impacts on Groundwater				
14.	Improper assessment of sub-surface ground water levels prior to design stage for Non- perennial schemes may lead to depletion of ground water resources.	• Extensive ground water table studies are beinge carried out during feasibility stage. • Schemes should be designed according to Ground water recharge/ pumping regulations.	Design Consultant	PMU
15.	Improper capacity lead to inappropriate fertilizer and pesticide use in irrigation may lead to	• An integrated pesticide management plan is prepared under the national regulatory guidance and in line with ADB safeguard policies.	Design Consultant	PMU

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	degradation of sub-surface water quality and contamination.	• Extensive training is designed under the On Farm Water Management Program for the proper use of pesticide.		
Social impacts during construction stage				
Positive Impacts				
16.	Generation of employment.	• Temporary employment for local workers and technicians, local unskilled labors. Also, employment of locals during surveys.		
17.	Increased economic activity.	• Establishment of new businesses and commercial enterprises; local employment. • New market for local produces, more sale and revenue generation. • As a result of the influx of a workforce, there shall be a higher demand for locally produced food, goods and services benefiting local farmers, producers, traders including small shops within project area.		
Negative Impacts				
1.	Temporary land acquisition by the contractor during construction.	• Only government land to be used; no private or community land to be used. • In extreme case where private land acquisition is unavoidable, it will be compensated under the guidelines presented in the resettlement policy framework included in the Social Impacts Assessment and Mitigation Plan.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
2.	Safety hazards due to increased traffic especially for children and elderly people.	• Traffic Management Plan addressing general access to be implemented. • Safety and security actions and procedures to protect local community during construction phase.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
3.	Risk of accidents and unsafe working conditions for workforce.	• Occupational Health and Safety Plan to be implemented. • Emergency Preparedness Plan to be implemented. • Contractor follows ADB core labor standards on Labor and Working Conditions; • Safety training for all workers.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
4.	Security risks for workers and project staffs, especially in Mula River basin area.	• Continued consultations with the tribal leaders and local community leaders on security matters. • Security at the work sites and camps. • Identification cards to workers. • Access to the camps must be controlled through gated entrances and entrance and exit logs shall be maintained at each gate.	Construction Contractor Monitoring by Supervision Consultant	ESMMC

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Preparation and implementation of the contractor's Communication plan to engage local leaders and community.		
5.	Inadequate construction site security poses a significant risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion.	• Ensure security at the work sites and camps. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Ensure there is proper fencing around construction site perimeter, chain-link at least 2.4 m high and secured with a steel chain and lock. • Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background. • Identification cards to workers	Construction Contractor Monitoring by Supervision Consultant	ESMMC
6.	Possible cultural conflicts between communities and workers.	• Awareness campaign; Code of conduct for workers. • Grievance mechanism developed and implemented. • Develop and implement strong community participation plan.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
7.	Risks of HIV/AIDS and STI due to the flow of migrant workers.	• Awareness creation on HIV/AIDS infection and diseases through a well-designed campaign implementation plan targeting all risk-prone groups. • Empowering women through employment in the construction work.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
8.	Increased pressures on local facilities (i.e., mosques, health care facilities) due to in-flux of migrant labors.	• Construction contractors will provide all required facilities for workers, so workers will not put pressure on local facilities.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
9.	Health and safety risk of the community due to the existence of a construction site(s) and the storage and use of hazardous chemicals.	• The Contractor shall follow ADB Safegaurds EHS guidelines as detailed in bidding documents to be reviewed by the Bank. • If there are any hazardous materials, they shall be safely stored on construction site locations under lock and key.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
10.	Temporary interruption of irrigation water supply during construction works. During construction, supplies of water may be	• Prepare construction schedule to avoid farming seasons. • For longer construction scheme, the contractor shall be prohibited from interrupting the water supply to any canal or reducing it below the allocated discharge of these canals by proving diversion canals on the section where work is planned on priority basis.	Construction Contractor Monitoring by Supervision	ESMMC

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	insufficient to satisfy the requirements of crops growing in the command area of each Canal, thus reduce the income of these farmers which shall have a negative impact on the socio-economics of the impacted area.	• The Contractor shall programme the Works to utilize the low water demand periods in the command area. • The Contractor shall submit a construction schedule to the Engineer for approval on mobilization. If in case, the closure of water supply is unavoidable, the Contractor needs to share his plan with the farmers and get their consensus.	Consultant	
Environmental impacts during construction stage				
Negative Impacts				
11.	Emissions of dust and air pollution will be generated from excavation works, operation of construction equipment and vehicles, material transport, and site clearance	• Water the soil surface and any non-asphalted roads, especially in the dry season. • Water the soil before starting excavating. • The storage and handling of spoil, subsoil, topsoil and materials should be carefully managed to minimize the risk of wind-blown material and dust. • Cover hauling vehicles carrying dusty materials moving outside the construction site. • Fit vehicles with appropriate exhaust systems and emission control devices. • Limit the idling time of vehicles not more than 2 minutes.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
12.	Clearing of natural vegetation and trees during construction activities in project areas. There may also be pressure on timber trees (illegal logging) by influx of workers.	• Vegetation clearance shall be limited to the extent required for execution of works. • Avoid cutting down of tree species of conservation significance and those that are protected, even those that act as nesting and breeding sites. • Tree planation will be carried out in and other suitable areas near the river training works at a ratio of 5 new trees per each tree cut. • Include environmental management and awareness as part of training for employees during construction.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
13.	Access routes through agriculture land will damage the land quality as well as standing crops.	• Construction Contractors will be prohibited from using agricultural lands for access routes.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
14.	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	• Strip the top soil to a depth of 35 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and others. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
15.	Excavation works will impact on the loss of habitats especially the	• Avoid construction during the rainy season • Minimize digging of trenches and vegetation clearance to minimum required level.	Construction Contractor	ESMMC

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	terrestrial invertebrates that live in the ground.		Monitoring by Supervision Consultant	
16.	Operation of piling activities, excavation, operation of heavy equipment and transport vehicles, and blasting operation will cause noise and vibration affecting workers and the nearby population.	• Construction activities near settlements will be limited to day time only (8AM – 6PM). • High noise producing equipment will be provided with mufflers or acoustic enclosures. • Install acoustic enclosures around generators and install temporary noise control barriers where appropriate to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Notify affected communities in advance regarding major noisy operation, e.g. blasting.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
17.	Impact on surrounding environment and communities from Construction Camps	• During construction phase the contractor site camps should be properly managed. Water usage, fuelwood cutting, deforestation, trees injury should be avoided. Community of the area should not be affected. Proper sanitation and construction machinery should be maintained according to environmental standards. • The Contractor needs to establish main and site camps. The main camp may be a rented building in the Lasbela city and will be for the Contractor project management staff while site camps shall be for the labour and Contractor's machinery operators. The site camps shall be located where the construction works are in progress.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
18.	Increased Traffic on local roads will affect access to the trading centre and, houses close to the road, deteriorate safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration	• Contractor will implement traffic management plan to ensure uninterrupted traffic movement during construction. • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centres, etc. • Inspect structures within the close proximity of construction site for damages.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
19.	Contamination of soil and water due to the accidental spills and leakage of fuels and chemicals.	• Contractor will prepare and implement Pollution Prevention Plan • Contractor to confine the contaminants immediately after such accidental spillage • Contractor to collect contaminated soils and washouts containing petroleum products treat and dispose them in environment friendly manner • All areas intended for storage of hazardous materials to be quarantined and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation	Construction Contractor Monitoring by Supervision Consultant	ESMMC
20.	Impact of spoils, solid waste, and waste effluents.	• Siting of fuel and hazardous material storage sites, including refuelling facilities, batching plants and construction yards are to be located outside the flood embankments and at least 500 m away from any residential areas. • Hazardous waste will be disposed of by designated contractors.	Construction Contractor Monitoring by Supervision Consultant	ESMMC

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
21.	Impact of borrow and quarry activities.	• Borrow/quarry areas will be developed close to the project area for extraction of earth material and aggregates for river protection works. • No private lands or agriculture lands will be used for borrowing. • Minimize volume of borrow material by using dredged material generated from the project. • The use of explosive should be used as low as possible to reduce noise, vibration, and dust. • Control dust and air pollution by application of watering. • Photographs recorded of each borrow area showing pre-construction baseline for comparison with after rehabilitation	Construction Contractor Monitoring by Supervision Consultant	ESMMC
22.	Disturbance/damage to unidentified archaeological asset or graveyard.	• No archaeological sites are reported with in the construction areas. However, in case any artefact or site of archaeological, cultural, historical, or religious significance are discovered during construction activities, the works will be stopped in that area, and the appropriate department will be informed. • An additional study to develop a cultural heritage management plan will be carried out in the first six months of the project..	Construction Contractor Monitoring by Supervision Consultant	ESMMC
23.	Disturbance to sites of religious importance	• Location of all schemes are at a safe distance from sites of religious importance		
Impacts on Ecology, Wildlife and Habitats				
24.	Loss of faunal habitat at locations of construction works, camp, staff quarters and on access/haul routes due to the felling of trees. Fragment and lead to loss of critical habitats for resident and migratory birds. The Zhob River basin is a main route of Migratory birds that pass through this area from Siberia to south in the winter season.	• Minimize construction in the critical habitats of birds. • Care should be taken to make sure bird nests are not destroyed. If there is no option available, rehabilitate them in other neighbouring trees. Also protect and rehabilitate injured or orphaned birds. • Use of existing access road and limit the width of new access roads.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
25.	Impact on river habitats (i.e., breeding and nesting sites) from construction activities, including riverine vegetation clearance.	• Control of sediment flow from the construction activities • Silt curtains along river training works to control sediment runoff. • Minimize and restrict clearing of riverine vegetation as much as possible.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
26.	Loss of temporary breeding pools and pans due to refilling of such pools by construction soil or gravel.	• Schedule construction during the dry season to reduce impact since the amphibian populations will be low during non-breeding season • Fence off the trenches with nets to prevent amphibians falling into the trap.	Construction Contractor Monitoring by	ESMMC

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
			Supervision Consultant	
Impacts on Downstream and Protected Areas				
27.	Impact on downstream river habitats from construction activities, such as construction of flood protection and river training works.	• Control of sediment flow from the construction activities. • Silt curtains along river training works to control sediment runoff.	Construction Contractor Monitoring by Supervision Consultant	ESMMC
Social Impacts during operation & maintenance stage				
Positive Impacts				
28.	Access to irrigation water, farming capacity and technology, flood protection, potable water supply, watershed and rangeland management, and environmental protection.	• Benefit thousands of people by 9 Irrigation and flood Protection schemes; improved Watershed and Rangeland Management, and environmental protection of protected and wetland areas.		
29.	Access to improved irrigation system and improved water use practices	• Improved irrigation system and improved water use practices will lead to a considerable increase in cultivatable land, thus increase crop production and improve income and livelihoods of farmers. • The implementation of project will result in increased crop production, resulted by increase in cropping intensity from 20% to 100% and improvement in yield /acre. • Productivity of crops is expected to more than double after project implementation.		
30.	Damage of command areas by flood waters	• Prevention of floods from entering into the command area by constructing flood protection works, will improve the livelihood of the population and protect crops, • Flood schemes will reduce the likelihood of devastating damage and the economic burden associated with recovery following the flood. • Construction of flood water diversion structure will play a pivotal role in increasing the income of households at farm level. This will help in increasing the area under cultivation along with cultivation of improved varieties. • Flood water diversion schemes in the province will help in improving the family nutrition through availability of better and nutritious food and thus contribute to better health of households.		
31.	Loss of opportunities for women and social uplift	• Project will enhance opportunities for women to participate in profitable agriculture, by tailoring interventions to their specific needs and by promoting gender equity in rural communities.		

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		• It is expected that 352,789 women will benefit directly from implementation of Irrigation Schemes, Potable Water, Flood Protection and Watershed and Rangeland Management.		
32.	Water supply and waterborne disease in the Project area.	• Potable water supply sub-projects are expected to directly benefit project area communities. • Lifestyle in surrounding areas will be improved by ensuring sustained supply of potable water. • Sanitation and water borne diseases in the area will be improved. • Sustained water supply will contribute significantly on reduction to households spending on water borne diseases. • Improvement in livestock quantity and composition due to consistent availability of water will improve economic income and food security of people.		
33.	Loss of nutrient rich sediments in upstream areas and deprive the benefit from better crop production.	• Diversion schemes are designed to distribute nutrient rich sediments in the command area, which will work positively for cropland and increase crop production, without discharging them to the downstream water flow.		
34.	**Social Impacts of Watershed and Rangeland Management** - Poor Watershed and Rangeland Management.	• Watershed management activities will be undertaken in both Project river basins, including soil and water conservation measures, rainwater harvesting and plantations.		
35.	- Biomass productivity for sustenance.	• Production of fuel wood for use by low income households.		
36.	- Social forestry jobs	• Will create local jobs for harvesting timber and non-timber products.		
37.	-Grazing area and food stock for livestock.	• Improvement in livestock (quantity and composition) due to more consistent food stock availability for grazing animals. • Develop livestock potential of the area through management of pasture lands		
Negative Impacts				
38.	Social issues will arise due to unavailability or Improper Distribution of Irrigation Water in the Area	• BIPD could play a key role to involve the local staff of agriculture department to ensure the best utilization of available water; • Water management rules and regulations must incorporate ways to tackle such issues as water scarcity and surplus flows; • Local water user associations and groups need to be trained and involved to operate the canals, channels, gates, inlets, outlets and other structures; • Compensate downstream Farmers in case of any water rights losses; and • Desilting of irrigation channel after regular intervals	Irrigation Department Water user association and farmer organizations	BIPD
39.	Breach of dam, canal and irrigation structures is unlikely to occur. However, it will threat system sustainability and fatal accidents	• BIPD should ensure the design review during operation phase by panel experts; • BIPD (Irrigation Department) to monitor the system regularly; • The important facilities that need attention and annual maintenance are canal embankments, falls and control structures and bed levels which are affected by siltation or scour. Canal	Irrigation Department	BIPD

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		section has been designed to ensure safety by following the standard design principals to design the banks against piping. In addition, all *nullah* crossings have been provided with Cross-drainage structures of at least 40 years return period flood capacity with adequate freeboard. For major *nullahs*, canal syphons have been provided so that *nullah* flows unhindered and therefore does not cause damage to the canals; • Liaise with the communities to identify potential weaknesses in the system that could cause breaches;		
40.	With availability of sweet water in the canal, there will be a tendency to use it for potable purposes as well.	• Train local community on safe drinking water; • Place warning and information signs about dangers of using irrigation water for potable purposes; • Local Government to assure potable water quality as per WHO/ GOP standards;	Local Government	BIPD
41.	the current natural flow of rain water is such that it generally comes in flash floods from the hill torrents in the Project Area	• Periodic maintenance of drainage structures; and • Ground water monitoring wells should be established in command area to monitor the salinity of ground water by BIPD.	Irrigation Department	BIPD
42.	Disposal of Waste (Connection of Waste Streams) in the Canals will lead to serious health issues	• The BIPD will develop and implement a proactive maintenance plan for the proposed project, with predefined periodicity; • Ensure proper disposal of waste at designated landfill/disposal sites; and • Efficiency of the system will be at its best by adopting proper maintenance activities such as silt removal and bed scratching at periodic intervals.	Irrigation Department	BIPD
Environmental Impacts during operation stage				
Positive Impacts				
43.	Groundwater recharge	• Improved recharge of ground water tables in the project area by water storing techniques and plantation. • Improved watershed and rangeland management technologies to improve soil moisture retention, reducing erosion and improving groundwater recharge.	Irrigation Department	BIPD
44.	Impacts due to Watershed and Rangeland Management	• Prevent grazing on degraded land, protect areas with good natural regeneration potential, reseeding/sowing rangelands with palatable species, • Establish grazing management plans based on carrying capacities, and construction of watering ponds for livestock. • Planting of palatable shrubs and trees and reseeding of grass as well as introduction of stall feeding based on fodder production • Rangeland management will introduce rotational grazing and stocking rate limits.	Agriculture Department	BIPD

Sr. No	Environmental Impacts	Mitigation/Compensation/ Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		• At the irrigation scheme level, watershed management will include drainage improvement, soil and water conservation measures and rehabilitation/protection of irrigable land degraded/endangered by erosion gullies.		
Negative Impacts				
45.	Enhanced/ induced use of fertilizers and pesticides due to increased cultivation.	• An Integrated Pest Management (IPM) plan is being prepared as part of the EMP and will be implemented during project operation stage. • Disseminate information regarding sustainable use of fertilizers and insecticides to keep the use at an optimal level. • A comprehensive education and awareness programme on sustainable fertilizer use is planned under On Farm Water Management component. • Development of a biodiversity database; community-based sustainable use programmes; developing and strengthening the protected areas system; developing a policy for ex-situ conservation of biodiversity; developing an effective policy framework and enabling legislation; and developing institutional capacity to manage biodiversity.	Agriculture Department	BIPD
46.	High Residual Sodium Carbonate levels in river water can cause crusting of seed beds, temporary saturation of the surface soil, high pH and the increased potential for diseases, weeds, soil erosion, lack of oxygen and inadequate nutrient availability.	• Farmers will be educated on best practices to solve the RSC problem, which will include some of the following: – Injection of sulfuric acid to dissociate the bicarbonate ions (PH around 6.2) giving off carbon dioxide. It allows the calcium and magnesium to stay in solution in relation with the sodium content. – Add gypsum when soils have low free calcium plus leaching. – Add sulfur to soils with high lime content plus leaching		BIPD
47.	Land conversion due to improved irrigation and agricultural potential.	• Schemes are designed in such a way to include cultivable land only, without affecting land of ecological significance.	Agriculture Department	BIPD
48.	Forest land conversion, degradation by increased overgrazing, firewood collection, etc.	• Rangeland and Watershed Management plan will ensure that no forest land is converted to cropland. In addition, the project will include more sustainable watershed agriculture especially livestock farming (increased livestock productivity and production due to increased production of fodder and improved rangeland management).	Forest Department	BIPD
Impacts on Downstream				
49.	Pesticide residue in water bodies	• Monitoring of organochlorine pesticide residue is recommended to establish the baseline during the early stage of project implementation and follow-up monitoring to compare with the baseline. •	Agriculture Department	BIPD

9.2 Monitoring Plan

During feasibility study the baseline monitoring was limited. It is proposed that during the early stage of implementation additional extensive monitoring is conducted to set-up an appropriate baseline condition. Proposed monitoring plan to be carried out during pre-implementation, implementation and operation stages of the project to establish the baseline condition and ensure contractors compliance with the mitigation measures and evaluation of the Project impact on post-completion is given in Table 54 along with the monitoring indicators and frequency. The PSIAC will be responsible for supervision of implementation of the plan. The total cost of monitoring has been estimated at USD 0.65 million.

Table 54: Environmental Monitoring Plan

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implementation	Supervision
Surface water flow and quality	11 locations (9 at the scheme level and two in the downstream discharge points	Sampling and analysis of river water quality and waste water discharges for the parameters given in NEQS 2000 and Organochlorine Pesticides	Monthly during monsoon	Contractor	PSIAC, PMU
			Quarterly	Contractor	PSIAC, PMU
			Annually	External Monitor (PMU through a nationally recognized laboratory)	PSIAC, PMU
		Spot measurements of pH, conductivity, turbidity; visual inspection of presence of petroleum products	Monthly	PSIAC	PSIAC, PMU
Sediment quality	2 samples from downstream locations	Laboratory measurements of organochlorine pesticide residue	Quarterly	External Monitor (PMU through a nationally recognized laboratory)	PSIAC, PMU
			Annually		MEC, PMU
Groundwater quality	From different depth and different sources of Groundwater	Sampling and analysis of groundwater quality for drinking water	Quarterly	Contractor	PSIAC, PMU
			Annually	External Monitor (PMU through a nationally recognized laboratory)	PSIAC, PMU
Air Quality (dust, smoke)	Along the access and haul road	Visual inspection to ensure good standard equipment is in use and dust suppression measures (sprinkling) are in place	Daily	Contractor	PSIAC, PMU
	Along the access and haul road	Visual inspection to ensure dust suppression work plan is being implemented	Daily	Contractor	PSIAC, PMU
Air Quality (PM_{10}, NO_2, SO2, CO_2, CO)	Along the access and haul road	Air quality monitoring for 24 hours for the parameters specified in NEQS 2000	Quarterly	Contractor	PSIAC, PMU
			Annually	External Monitor (PMU through a nationally recognized laboratory)	PSIAC, PMU

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implementation	Supervision
Emissions from plant and equipment	Close to construction area	Visual inspection	Monthly	Contractor	PSIAC, PMU
Noise and vibration	Close to noise generating equipment and road	24 hour noise monitoring	Quarterly	Contractor	PSIAC, PMU
		24 hour noise monitoring	Annually	External Monitor (through a nationally recognized laboratory)	PSIAC, PMU
		Spot measurements	Monthly	PSIAC	PSIAC, PMU
Waste Management	Storage and camp area	Visual inspection that solid waste is disposed of at designated sites	Monthly	Contractor	PSIAC, PMU
Spills from hydrocarbon and chemical storage	Storage area	Visual inspection for leaks and spills	Monthly	Contractor	PSIAC, PMU
Operation of borrow sites	Borrow and quarry areas	Visual inspection of quarry sites	Monthly	Contractor	PSIAC, PMU
Traffic safety		Visual inspection to ensure Traffic Management Plan is implemented	Monthly	Contractor	PSIAC, PMU
Local roads		Visual inspection to ensure local roads are not damaged	Monthly	Contractor	PSIAC, PMU
Drinking water and sanitation		Ensuring construction workers are provided with safe water and sanitation facilities on site	Weekly	Contractor	PSIAC, PMU
Safety of workers		Usage of personal protective equipment	Monthly	Contractor	PSIAC, PMU
Erosion		Visual inspection in all areas where run-off leaves bare and at important drainage features (ditches, gullies, etc.) after major rainfall events	Weekly	Contractor	PSIAC, PMU
Reinstatement of work sites		Visual Inspection	After completion of all works	Contractor	PSIAC, PMU
Plantation		Visual inspection to ensure plantations are growing well	Monthly	Contractor	PSIAC, PMU, External Monitor

9.3 Capacity Building and Training

The environmental and social trainings will help to ensure that the requirements of the EMP are clearly understood and followed by all project personnel. The primary responsibility of providing these trainings to all project personnel will be that of the contractor and PSIAC. The trainings will be provided to different professional groups separately such as managers, skilled personnel, unskilled labors, and camp staff. Capacity building will be aimed at strengthening the PMU, PIU, and operational staff in the field of environmental management and social development. Members of the ESSU responsible for supervision of environmental and social

mitigation measures would be trained in environmental management, environmental quality control, ecology, environmental awareness, participatory approach and social development. The training plan shall include a program for the delivery of intermittent training, to cover the subjects included in Table 55. Training should be carried out initially at induction of staff and repeated throughout the project.

Table 55: Training Subjects for Inclusion in Contractors Training Plan

Training Subject	Target Audience
Environmental Code of Practices	All staff
Handling, use & disposal of hazardous material	Construction workers with authorised access to hazardous material storage areas and required to use hazardous material during their works
Waste Management	All staff (construction and camp staff)
Efficient& safe driving practices, including road & vehicle restrictions	Drivers & mobile plant operators
Actions to be taken in the event of major or minor pollution event on land	All construction staff
Use of flexible booms and surface skimmers in event of pollution event in water	All construction staff working on diversion weir, headwork structure and canals
Pollution prevention: Best practice	All staff
Health & Safety: Safe way to work & hazard awareness	All construction staff and O&M Staff
Health & Safety: Safe use of plant & equipment	Operators of plant & equipment
Health & Safety: Working at height	Staff colony and regulator construction staff
Health & Safety: Working near/on water	All construction staff working on diversion weir, headwork structure and canals
Health & Safety: Working near/on water	All construction staff working on barges
Health & Safety: Use of PPE	All construction staff
Occupational Health and Safety	To all persons entering the construction site
Emergency procedures and evacuation	All staff
Spill clean-up training	Contractor's spill management staff
Fire fighting	All staff
Site inductions, including requirements under the Environmental Management Plan & details of environmentally sensitive areas of the site	All staff
Culturally sensitive awareness rising on HIV/AIDS and the spread of sexually transmitted diseases. Awareness raising on risks, prevention and available treatment of vector-borne diseases	All staff
Cultural sensitivities of the local population	On induction of all non-local staff

9.4 Audits and Annual Review of EMP

Internal environmental audits will be held with an objective to review the effectiveness of environmental management of the project. PSIAC environmental and social staffs under the supervision of ESSU will carry out annual review of the appropriateness and adequacy of EMP in the light of its own monitoring and supervision as well as on the basis of the third party monitoring and audits discussed earlier. PSIAC will revise the EMP in case substantial gaps and shortcomings are identified in these plans.

External third party environmental audits will be held with an objective to review the effectiveness of environmental and social management of the project. It is proposed that MEC carry out these audits on yearly basis. These audits would be used to re-examine the continued appropriateness of the EMP and to provide advice on any updates required.

9.5 Grievances

This section describes mechanism to receive and facilitate the resolution of affected persons' concerns and grievances. It explains how the procedures are accessible to aggrieved party (AP) including women. A grievance mechanism will be available to allow an AP appealing any disagreeable decision, practice or activity arising from land or other assets compensation. APs will be fully informed of their rights and of the procedures for addressing complaints whether verbally or in writing during consultation, survey, and time of compensation. It is preferred that APs/local community should submit their complaints/ concerns and issues formally and accordingly the project staff will enter the complaint on Community Complaint Register (CCR) comprising of a minimum information such as the name and address of complainer, description of complaint, action taken, status of resolution of complaints and other necessary information/ record and reasons; in case the issue is not resolved. Proper consideration will be given to avoid the grievances rather than going through a redress process.

A Grievance Redress Committee (GRC) will be established at both project and field level. GRC at project level will include the Project director, representative of PIU/ BIPD, Social Safeguards staff of BIPD, representatives of APs/ or local community and representatives of concerned FO (if any).

- The GRC at project level will include the following members: i). PD (Balochistan Irrigation and Power Department)
  ii). Representative (Project Implementation Unit)
  iii). Representative of AP / FO

This GRC will work both at the project and field level. The District level BIPD staff will inform the aggrieved party about GRC and mechanism by registering their concerns at concerned office. The complaints will be registered by maintaining community complaints register (CCR), where the name & address of complainer, date, description of complaint and action taken will be entered.

- The GRC at field (District) level will include:

i). Executive Engineer / Sub-Engineer

ii). Social Mobilizer

iii). Patwari (land record keeper) iv). Representative of AP/ FO

Table 37: Community Complaints/ Grievance Redress Process

Land Compensation Issues	Other Items Compensation Issues
First, complaint resolution will be attempted at site (field level) through the involvement of the PIUs/ informal committee/ and or concerned FO (if any).	First, complaints resolution will be attempted at site (field level) through the involvement of the PIUs/ informal committee/ and or concerned FO (if any).
If unsettled, a grievance can then be lodged to the DO (Revenue)/ LAC who has 14 days to decide on the case.	If no solution is reached, a grievance can be lodged to GRC. The GRC will provide the decision within 3 weeks of registering the complaint.
If no solution is reached, a grievance can be lodged to GRC. The GRC will provide the decision within 3 weeks of registering the complaint.	If the grievance redress system does not satisfy the DPs, they can pursue further by submitting their case to the appropriate court of law.
In case, the grievance redressal system does not satisfy the DFs/ DPs, then they can pursue further by submitting their case to the	

appropriate court of law as per the process set out in Section 18 to 22 of the LAA 1894.	

9.6 Cost of EMP

The budget presented in Table 56and Table 57 will include estimates for the cost of mitigation measures, staff employed for implementation of the EMP, tree plantation, and technical assistance of dam.

Table 56: Cost for Contractor

Sr. #	Description	Unit Cost/Month*
1	Laboratory Analysis Cost	125,000
2	Contractor Environmental Engineer (each contractor)	80,000

**** based on unit parameter testing and sampling cost for air, water and noise.***

Table 57: Cost for Proponent

Sr. #	Description	Unit Cost*
A	**During Construction Period**	
1	Laboratory Analysis Cost	100,000/Quarter
2	Supervision Consultant/Environmental Officer	150,000/Month
3	Third Party Monitoring	500,000/Quarter
4	Training on EMP	100,000/day
B	**During Operation & Maintenance Period (for initial three years)**	
1	Laboratory Analysis Cost	50,000/Six Months
2	Training & Community Engagement Cost	50,000/Month
3	Third Party Monitoring	300,000/ Six Months

**** based on unit parameter testing and sampling cost for air, water and noise.***

9 Stakeholder Consultation and Disclosure

9.1 Introduction

The basic purpose of conducting the stakeholder consultation was to involve the important stakeholders and local people into the process of project implementation and to incorporate the appropriate environmental and social concerns into the process. Moreover, Pakistan Environmental Protection Act (PEPA) specifies that the stakeholder consultation process shall be an integral part of environmental assessment, and thus makes it mandatory. This section presents the essence of the stakeholder consultation process carried out for the proposed project.

Frequent meetings and consultations were held with the community and other stakeholders' vis-à-vis BIPD, forest, agriculture, wildlife, Local Government Representatives, Local Welfare Societies (NGOs), academia, NGOs and community influential. During the meetings, the project objectives were explained to the participants. Their concerns and suggestions were documented and taken care of to enhance the project acceptability on social grounds. Their major concerns related to the environmental impacts and mitigation measures. During field visits, a series of public consultations and scoping sessions were carried out at various locations in the project area.

9.2 Objectives

Basic objective of this activity is to have on board the project Affected People, related Governmental institutions and interested non-governmental organizations (NGOs) through:

- Introduction of the project;
- Creating awareness about the project including its impacts;
- Rapport building with APs;
- Involving them in the process of determining the right direction for area development;
- Assessment of the impacts of sub-project, which may occur and their mitigations; and

9.3 Introduction of PEPA- 1997 and ADB environmental and resettlement policy.

9.4 Project Disclosure

Relevant guidelines of ADB prescribe that the affected population and institutions should be fully informed by disclosing the information relevant to the project impacts, the proposed policy of mitigation and compensation options. Consultation with Affected Persons (APs) is, therefore, the starting point for all these activities to allay misgivings and apprehensions about the project and elicit their acceptability, ensure their participation in planning and implementation and provide them with opportunity to participate in key decisions of the project that are likely to affect them.

9.5 Stakeholders Identification

The approach adopted by the consultants consists of the following steps:

Step 1 – List the various resources (natural and otherwise) within the site or in close proximity of proposed project area e.g. sweet water resources, agricultural lands, other types of lands, infrastructure, urban facilities, transportation facilities, forest etc.

Step 2 – List the functions and uses for each of the resources.

Step 3 – Identify the groups and actors that have a stake in each of the functions and uses of the various resources by asking the following questions.

- Who uses / provides the resource(s)?
- Who benefits from the use of the resource(s)? Who wishes to benefit but is unable to do so?
- Who impacts on the resource(s), whether positively or negatively?
- Who has rights and responsibilities over the use / provision of the resource(s)?
- Who would be affected by a change in the status, regime or outputs of proposed project area and its management?
- Who makes decisions that affect the use and status of the resource(s), and who does not?

These questions were answered using field observations, discussions with key persons, literature reviews and personal experience.

In doing Step 3, it emerged that a number of the same stakeholders (groups) is relevant for a number of the functions and uses. This allowed the consultants to begin to see the interconnected groups and stakeholders that have an important stake in the site or area.

The list of relevant stakeholders is provided in the following Table 58.

Table 58: Identification of Stakeholders

Resource	Stakeholders
Forest	Environmental Protection Agency
	Nature conservation NGOs, Academia
	Forest Department
	Wildlife Department
Waterways	Irrigation Department
	Agriculture and Agriculture Extension Department
Infrastructure / Fixtures	District Administration / DCO
	Local Administration / TMA / Assistant Commissioner
	Community at large
Land	Agriculture & Agriculture Extension Department

	Irrigation Department
	Livestock Department
Crops and Vegetation	Provincial Forest Department
	Agriculture Department
	Irrigation Department,
	Livestock Department
	Local Communities
Access Roads	Local Communities
Live Stock	Local Communities,
	Livestock Department
Overall Issues & Benefits	Elders of the Local Communities DC and Assistant DC Zhob

Stakeholder Analysis

Organization and Composition

Typically, stakeholder consultation requires resources to manage. Therefore, most literature on the topic suggests classifying and categorizing them, so that more focus could be paid to the more important entities.

For this project, the stakeholders can be classified into two broad categories; i.e. Internal stakeholders who have some form of legal contract (in any form or at any level) with the proposed project (the project proponents), and External stakeholders who are made up of other individuals, groups or parties that have an interest in the project but are not contractually obligated in any way or form.

The approach adopted by the Consultants for identification and classification of the project stakeholders is based on a tailored form of Winch Matrix. This approach is being used for its simplicity, and its relevance for the situation at hand. The consultants first developed a blank format of a matrix containing 08 cells. For the internal stakeholders, the cells are based on the type of envisaged relationship (supply / demand), and the potential of influence (Direct / Indirect stake). For the external stakeholders, the cells are based on stakeholder origin (public / private) and again on their potential of influence. Once the matrix structure is created, each cell is filled with potential stakeholders' names.

Table 59: Maps and classifies the envisioned Sri Toi sub project stakeholders

	Internal Stakeholders		**External Stakeholders**	
	Demand	**Supply**	**Public**	**Private**
Direct stake / Primary Stakeholder	Local Community, BIPD	BEPA Agriculture Department, Forest Department	Land & revenue Department, Town/UC administration	Communities living or doing business in the area
Indirect stake / Secondary stakeholder		Service Providers for this project (technical	Wildlife Department, Livestock Department	BRSP

		vendors, labor force, consultants) ADB and other project financiers		

Public Consultation in Field

This activity was initiated by the consultants during May 2017 and earlier alongside the socio-economic survey.

During field survey, the Consultants discussed the basic requirements, views and perceptions with the local residents of these settlements about this project. Following opinions were shared by the people of respective areas.

- Generally, the community at Kili Hazrat Sahib has a very positive opinion regarding the proposed project as they perceive that the project will provide canals and supply water for irrigation purpose. This will improve their quality of life, initiate economic activities and income. It will provide grazing and water for live stocks etc;
- An impression exists that some people (Mr. Kareem Mandokhel, Mr. Shahbaz.), are opposing the proposed project and block access to project sites. A meeting with these people revealed that they understand the benefits of the project and were interested in the project but also wanted proper land distribution / delegation from the tribal holdings to individual holdings.

9.5.1 Meeting at Circuit House Zhob (May 12, 2017):

The team left Quetta around 9:30 am and arrived in Circuit House Zhob at 1:30 pm. The team was received and welcomed by the district officers and community members. After exchange of pleasantries, the meeting started, wherein the team leader first introduced the team members. This was followed by the introduction of district officers and community members. Team leader informed the line department officers (Forest and Wildlife Department) and community members that they are here to conduct the Initial Environmental Impact Assessment for construction of Sri Toi Dam. In this regard, they want to schedule meetings with the government line department and community members.

Community members and officers of government line department highly appreciated this project and showed their full support for the scheme. They were of the view that construction of dam will help in bringing more area under cultivation, which will increase the agriculture crop and livestock production in this entire area, which would in turn create income generation /livelihood opportunities for a large number of people. They informed that at present community members are practicing agriculture crop production on a very small scale through rain fed mode.

For this purpose, water harvesting and spreading structures are used by community members. In some instances, where perennial flows are available, farmers have been also diverted water for crop production. Besides the rain fed and diversion of perennial flows, some of the community members have also sunk tube wells to pull out ground water for crop production. In some areas Karezes are also functional that provides water for crop production and drinking purposes. In addition to these sources of water, some community members in the project areas are pulling out ground water from dug well with the help of diesel operated engines and solar pumps. At present, community members are cultivation crops both in Rabi as well as in Kharif seasons. In Rabi season crops cultivated by the farmers include: wheat, onion, garlic, cucumber, maize, tomatoes vegetable and fodder crops, while in Kharif season

the crops sown are: cucumber, brinjal, okra, vegetables fodder crops. Community members have also raised trees of Pistachio, Grapes, Almond and Pomegranate.

Agriculture produce is mostly marketed in Zhob town. Community members informed that the land in the proposed project area belongs to a single tribe, namely Ahmed Khel, which is a sub-tribe of Mandokhel tribe. They further added that 90% of the community members have shown their agreement to the construction of Sri Toi dam. They assured that there no issues related to the distribution of land and water exists in the area. However, due to the communal nature of the land ownership, the area needs to undergo settlement, which will determine the ownership pattern at the household/individual level.

Community members informed that almost all of the residents of the area are educated and have got good social awareness. They have got the capacities to resolve issues. Residents of the area are very happy that a dam is being constructed here, which would change their lives through conversion of barren land into a productive site. Community member have already taken necessary steps for resolving the issue of land settlement through constituting a committee for this purpose, which comprise two top leaders of the sub-tribe.

Community members informed that the entire command area along with dam construction and storage sites belongs to a single tribe Ahmed Khel. Therefore, they do not envisage any issue/challenge and dispute over dam construction, water distribution and land settlement. Community members informed that dam construction would open new vistas of livelihood opportunities in the area that will also contribute towards increasing the productivity in the entire Sri Toi.

They also added that local labour is available for undertaking all sorts of activities. Besides labour, all types of machinery for dam construction and land preparation/levelling can also be made available here because Zhob is home of many big construction companies. Similarly, synergies can be developed with the projects of NGO, such as BRSP, and government line departments, which will greatly help in furthering the project goal and objectives.

Consultation with Institutional Stakeholders

Besides consulting with the people living in or around the sites that are potentially affected by the project, the consultants also met the major institutional stakeholders, including the Government line departments and the NGOs working in the area.

Brief account of the discussion during these meetings is given below:

Syed Pervez Bukhari – Chief Engineer – Balochistan Irrigation and Power Department

Chief Engineer of the irrigation and Power Department, Government of Balochistan presented the project background information. The consultants probed the justification of the project and conditions on the ground. The Chief Engineer was very positive that the project would have a positive impact on the community of the sub-project areas.

Mr. Nadir Gul Barech – CEO – Balochistan Rural Support Programme

The consultations with BRSP were considered a good gesture and appreciated. They informed the consultants of successful work done by BRSP. The consultants briefed the BRSP team of the project interventions. BRSP expressed views on the positive impact the project may have on the local people and BRSP's role on agriculture extension in the project area. BRSP advocated synergistic approach as implementing partner for the sustainability of proposed interventions and wellbeing for the villagers.

Aggrieved Community Representative Mr. Malik Shehbaz of Ahmed Khel –

Mandokhel Tribe at Dam Site

The team visited the dam site on May 13, 2017, which was a very beautiful and most suitable for the purpose of dam construction. The site was located close to the village namely Gul Khan, while the second village close to the dam site was Landai Kalayi. The site belonged to Ahmed

Khel a sub-tribe of Mandokhel tribe. Many community members also accompanied the team during the visit and had good discussion with them at dam site.

Malik Shahbaz representing the aggrieved community having stakes on the proposed dam land met the project team. He expressed his concerns regarding the distribution of land and would oppose the construction of dam if the land distribution was not done. The team noted his concerns and assured him that all the stakeholders will be taken on board and the matters will be resolved before the construction of Dam.

Mr. Malik Baz Muhammad – Tribal Leader of Ahmed Khel – Arabzai Tribe

On the way, back to Zhob town, the team made a brief stay in the guest house of Malik Baz Muhammad, who is the head of Ahmed Khel tribe. He and other influential of the Ahmed Khel tribe present at the occasion highly appreciated the construction of dam in their area. He assured full on behalf of his tribe for construction of dam and all the activities contained/planned in the project. He added that they are vigorously pursuing the land settlement issue and are very hopeful that this would be resolved in the next two/three months. He informed that all his tribesmen support this move of dam construction and are very happy. He added that by taking into account this fact he can say that the settlement issues would also be resolved very smoothly. He also requested for an increase in the command area so that more households could benefit from agriculture crop production. Influential and tribesmen present at the occasion informed that the entire tribe has delegated its power to Malik Baz Muhammad for land settlement and resolving other such issues that may arise in this context.

The consultations were considered a good gesture and appreciated, especially by the landowners and locals of the project. It improves their financial well-being to a great extent because 80 % people job associated with Agriculture work. They emphasized that local villagers should be given priority when employing people for various project-related works and activities according to their skills because non-Local work force coming in the project area that will not be aware of the local customs and norms, may result in conflicts with the local community, keeping in mind the sensitive law and order situation and culture of the area.

Pictorial profile of stakeholder consultation is given as **Annexure 3**.

9.6 Continual Engagement with Stakeholders October-November 2019

Notwithstanding the efforts so far put in for public participation, this activity will have to be pursued through the forthcoming implementation phases of the project. In particular, the focus will be on the improvement and modification of the proposed intervention designs.

The related institutional arrangements should also be in place for continuous consultation throughout the process of planning and implementation.

9.6.1 Points Discussed

Following points were discussed during the public consultations:

- Project components, its activities and impacts.
- Needs, priorities and reactions of the population regarding the proposed project.
- Entitlement for the affected of the project
- Role of the affected in implementation of the project
- Inputs and concerns from the relevant government departments.

9.6.2 Consultation Findings

9.6.2.1 Primary Stakeholder Consultation's Outcomes

1. Skilled and unskilled labor should be preferred from the project area especially among the affected/benefiters.
2. Project activities may produce dust or gaseous emissions and noise/vibration during construction phase, so possible mitigation measures should be taken.
3. Vocational training/ educations needs to be provided to local women/local people, so that they could be able to support their families by supplementing their household income.
4. Due consideration should be given to community consultation in the preparation of project and it should include comments / observations of the community. There should be a continuous community consultation program throughout the project implementation period.
5. The rural women actively participate in outdoor socio-economic activities such as herding livestock, agricultural activities, picking fuel wood etc. Their privacy should not suffer due to the project activities.
6. Safety of general public residing at the top of the hill where excavation is to be carried will particularly be at stake. The local people, particularly the children and women, may get injuries or even fatalities. So to enhance safety of local people the contractor will use protective devices, including wire mesh containment, displaying warning signs along the work site, blowing sirens, etc.
7. It is anticipated that a large quantity of excavated material will need to be disposed of (will be used in side lining of canal). If this waste material is not properly disposed of, it will contaminate the soil and water resources, especially during the rainy season. Excavated material should be managed properly, and if dumping required than dumped it in proper place.
8. Local norms should be honored by construction staff.
9. Contractor should establish construction camps on waste land and should not disturb productive agriculture land.
10. There should be water allocation for drinking purpose for the local communities.
11. Side ponds near the communities should be provided for the washing and livestock so that the canal embankments should be protected.

9.6.2.2 Secondary Stakeholder Consultation's Outcomes

1. Water being the most precious commodity in the area, its usage rights have been established traditionally. Any perceived or real disturbance to these water rights will almost certainly lead to social disturbance in the area.
2. For Land Acquisition, addressing community grievances on priority basis and timely compensation to affectees is needed.
3. Social issues arise due to improper dissemination of project progress.
4. Employment opportunities to some locals for design phase surveys.
5. The construction related issues - such as waste disposal and hazards for the nearby communities should be adequately addressed during the project construction.
6. Avoid dumping construction material along the highway and median.

7. Adopt measures to minimize dust, smoke, and noise pollution, and to control spillages from construction machinery.
8. Provide proper diversions for traffic during construction to avoid traffic congestion, related hazards, and dust emissions.
9. Carry out construction activities at appropriate timings to avoid traffic jams / hazards.
10. Proper traffic management plan should be provided during construction activities.
11. Job opportunities should be provided to the locals during construction activities.
12. Safety of local residents along the canal side should be ensured particularly due to land sliding and stones rolling.
13. An anticipated positive impact on socio-economic conditions during construction phase is the creation of limited-time employment opportunity for the local population. Since the project interventions will require substantial input from manual labor, even people with relatively lower levels of education or skills could get short term employment.
14. A substantial land will be irrigated under the proposed schemes
15. Household income will increase substantially with irrigation improvement measures owing to availability of water for irrigation, crop yields, increase in the number of animals, and
availability of other occupational opportunities.

All the above points would be reflected in Social Framework Agreement (SFA) between the local community and the BIPD and when the project is commissioned for construction.

9.7 SOCIAL FRAMEWORK AGREEMENT (SFA)

It is the commitment by the project proponent and the local community to work together for the successful completion of the project. It establishes bindings for both parties to minimize possible conflicts. SFA shall be considered as a “follow up” of the public consultation and public hearing and indicates that ID and the communities are mutually facilitating the construction process of BWRDP Irrigation schemes and Dam.

9.7.1 Parties to Agreement

SFA will be signed through mutual open consent between the local village leaders and the project proponent. At least two leaders/elders will be chosen from each of the villages situated adjacent to the area where construction activity will be based. These leaders/elders will constitute a villagers committee, which will choose a Chairman among themselves. SFA shall be signed by ID Resident Engineer (RE) representing the project proponent and by the Chairman of villagers’ committee representing the local community before two month start of the construction work.

9.7.2 Agreement Contents

SFA shall be prepared in the form of a legal agreement in Urdu language on a stamp paper to be provided by RE at the project cost. Three copies of the agreement shall be signed by both parties. All the mitigation measures described in EMP which are relevant to SFA shall be included in the agreement. The obligations of the irrigation Department and those of the community shall be listed clearly. Signed copies of SFA shall be kept by both parties and the Project Director BWRDP.

10 Conclusions and Recommendations

This section presents the major conclusions and key recommendations of the EIA study.

10.1 Findings

This study was carried out at the Feasibility stage of the project. Predominantly primary and secondary data and site reconnaissance were used to assess the environmental impacts. The potential environmental impacts were assessed in a comprehensive manner. The report has provided a picture of all potential environmental impacts associated with the sub-projects, and recommended suitable mitigation measures.

There are some further considerations for the Feasibility stage such as submission of EIA report to BEPA for grant of No Objection Certificate for the proposed Balochistan Water Resources Development Project under Balochistan Environmental Protection Act 2012.

Land Acquisition will be involved and forms the subject of a separate study report under this project. Reader is directed to LARP prepared separately under this proposed project.

Construction of BWRDP is going to bring positive changes in the area in terms of availability of water, cultivation of crops, establishment of new settlements and improvement in the standard of life of the inhabitants of the area.

Availability of irrigation and agriculture would support livestock growth and in due course of time would enable farmers to diversify in areas of dairy production.

The project will generate employment opportunities for local laborers during all three phases of project. The Project will positively contribute in improving the carrying capacity of biological environment and overall improvement of the ecosystem.

Household income will increase substantially with irrigation improvement measures owing to availability of water for irrigation, crop yields, increase in the number of animals, and availability of other occupational opportunities.

10.2 Changes in the flora and fauna of the area:

The construction of BWRDP and the resultant agriculture crop cultivation over a wide command area will bring very drastic changes in the flora and fauna of the area. Water storage in the dam body will attract water birds especially those migrating from Siberia to warm area during winter. Depending upon the size of the water body, it serves the purpose of a wetland. Similarly, the natural vegetation present in the command area and the faunal population dependent upon the flora, will also be removed for bringing the area under cultivation. Therefore, the agriculture and fodder crops introduced in the area will not only change the vegetation structure but will also attract new fauna. Bringing command area under cultivation is thus going to completely change the vegetation and related faunal species, which may have beneficial impacts upon the overall ecosystem.

10.3 Change in the water table:

Water for crop production and drinking purposes is extracted from the ground. -Tube wells, diesel operated engines and Karez system are used by the community members for this purpose. Due to relatively good rainfall in the area and better porosity in the soils, a large portion of the run off infiltrates and percolates in the ground.

It is because of this very reason that the water table in this part of the province has not been depleted to the extent as in the arid and hyper-arid areas. The availability of irrigation water to crops will help in maintaining and rise of water table. In future it is expected that water storage in the dam will not only help in raising the water table in the project area but the adjacent areas will also get benefitted in terms of water availability. Recharge of water table in the proposed command and adjacent area would greatly reduce the risk during years of below average rainfalls and droughts through pumping ground water for crop cultivation.

The adverse environmental impacts from the project will mostly take place during the construction stage. Some adverse impacts are also anticipated during the operation phase. The impacts are likely to be similar at most locations and impacts have been reviewed in the relevant section of this EIA report. Moreover, iimplementation of the proposed mitigation measures will ensure the impact significance remains low during the construction and opereation phases.

Adverse environmental impacts during the construction phase are related with the establishment of campsite which are temporary and can be minimized with better management. Construction worker camps will not necessarily be based on the scale of the works needed. If for some unforeseen reason a larger workforce is needed, the construction camp will not be located in settlement areas or near sensitive water resources and will be provided with lavatories. Local employment will be preferred (especially for unskilled jobs) to avoid cultural conflicts.

10.4 Increase in the population:

Implementation of project and cultivation of large area of land with agriculture and horticultural crops will attract a large number of individuals to the area for performing different functions in the area. Following the golden rule of division of Labor, the area will prove an empty niche for individuals related to a number of trades/skills ranging from tenancy to masons and motor mechanics, who will come and engage in their related trades to earn livelihoods. Demography of the area will change drastically resulting in a large population which will start exerting pressure on the available resources. Taking into account the increase in population, who will need all the basic necessities of life, it is important that the town planning should also be given due attention with the passage of time to avoid pollution and other such environmental problems/issues. In case the growing population pressure in the area is not attended properly, it will give rise to many issues ranging from the need for basic necessities of life to conflicts on resources. Population increase is thus very important factor that needs to be taken care of from the very beginning otherwise it may nullify the benefits of projects.

10.5 Recommendations

10.5.1 Physical

Careful planning and management is recommended to avoid air pollution and generation of solid waste during construction phase especially during storage & transport of overburden soil.

The arid climatic conditions at the proposed project area and frequent drought cycles in Balochistan, requires that the farmers cultivate low delta crops especially in the horticulture sector such as grapes, almonds, pomegranate and olives.

Based on the adaptation measures suggested in the Climate Change Study (done by PPTA consultants), the following adaptation measures were included in the design of sub-projects:

- Provision of control gates/breast wall arrangements in the intake structures to have better control on diverted flows during excessive rainfall/flood events expected due to Climate Change.
- Increase in the capacities of surface irrigation network to provide additional flows to the farmers in the command area so that they can increase the cropping intensity and leading to enhanced income at the farm level. This adaptation measure was adopted in all the subprojects.
- Design of spillways for possible maximum floods to manage the risks of extreme flood events.
- Adoption of land use practices which can also survive under both the wet and dry conditions like forest plants, shrubs and forages. Shortage of fuelwood is common in most of the areas and province imports fuelwood from other provinces. This is also a gender support adaptation, as women are solely responsible for the collection of fuelwood. This is the most important adaptation, as farmers are most vulnerable to the extreme events instead of structures, so that adaptations in land use would ultimately reduce the risks of flood and droughts on the livelihood of farming community.

Soil and water are the most precious assets a farmer has at the farm level. Both of these are considered as the key element in all the production systems related to farming/agriculture.

Water rights are equally distributed among the agriculturists according to the land holdings. The FOs in the sub-project areas have not been actively and need to be strengthened. The Agriculture Extension Department in Balochistan can play a vital role in enhancing the cropping intensity of the proposed sub-project area with timely knowledge of best agricultural practices.

10.5.2 **Biological**

The project area also falls in the route of migratory birds but there is no designated protected area in the district. Among wildlife, Cranes are highly important, as these are hunted and trapped in large numbers in the district. Since, there exists no protected area in the district; therefore, the protection of resident wildlife and safe resting grounds for migratory birds are not available at present.

The proposed project does not interfere with any ecological parameters, however, can be seen as a positive contributor in improving the carrying capacity and overall improvement of the ecosystem.

Project area geography is typical of a mountain eco-system represents a typical pastoral dependence and rain fed agriculture. The habitat of the project area and its surroundings are broadly categorized as Hills, Foothills, plains and stream beds. Sri Toi specifically represents dry arid alpine terrain, with marginal vegetation cover, mainly comprising of shrubs, no tree species was recorded during the field visit.

The type of rangeland present in the district is classified as Suleiman Mountain Ranges. It has species like: Stipa pennata, Pennisetum orientalis, Chrysopogon aucheri, and Cymbopogon sp. etc. The productivity is good with average productive capacity of 250 kg /hectare. The rangelands in the district belong to communities living around them. Due to communal ownership, usually these are accessible to all members of the community and also to nomads passing through the area on their traditional routes of migration to new areas.

Wildlife habitat type is Steppic Forest in Intermediate Latitude. There are no historical bench marks to determine the status of wildlife in the area. However, according to the community the

number of wildlife species has declined; which could aptly be attributed to casual attitude for hunting and habitat degradation.

Baseline faunal survey recorded the occurrence of a total Seven mammal species, of which confirmed the occurrence of 3 species fox, wolf and Hyena through direct evidenceslike (pug marks, pelts, faces, territory marking signs and interviews with local residents. The Balochistan Black Bear, Suleiman Markhor and Afghan Urial, which was reported to occur in the past, are now apparently extinct. Cape hare was found very common in the entire area during survey. A total 07 Cape hare were counted during the survey. For the determination of population status of carnivores, nights walks were arranged. In the plains the survey team used vehicle and search lights. After seeing the eyes of carnivores in high powerful lights, noted the eye colors and consulted the literatures. In foothills, used search light in same way. One Indian gray wolf, 2 red fox, 3 Asiatic jackals and one Indian Crested Porcupine were sighted. While indirect observations were made on the droppings, foot prints of several carnivore species such as stripped hyena, Jungle cat, afghan hedgehog, Caracal and Indian gray wolf. Skin of Panther observed in a house, using for prayers.

Direct sight techniques like ground nests searching and stand watch techniques were used for this survey. 16 species of birds observed in the area. Chakoor and Seesee partridges were found very common throughout the area. The birds were mostly observed near water points. 2 small flocks of Chakoor and see partridges were observed in the area. Hunters to trap eagles were observed on three different locations with hunting materials.

The survey team observed lizards in six different locations. At one location hunted Afghan Tortoise shell was observed. Many snake species are reported from the area. Due to hibernation period, no snake species observed in the present survey while 2 lizard species observed in the survey, Clif rcer (Coluber rhodoracus) and Agama (Agama spp.) are available in everywhere.

There are no notified protected areas present in the project vicinity. Approximately more than 200 km south of the project area is Tor Ghar Community Game Reserve in District Qila Saifullah game reserve.

10.5.3 **Social**

During the execution of this study, consultations with relevant government officials, academia, NGOs and local community have been conducted to gain their perceptions of the project and ascertain the nature and scope of local participation in project planning and implementation.

10.5.4 **Agriculture**

Farm forestry should be promoted in project area which can bring three-fold benefits for the farmers. Trees would not only fetch good revenues for the farmers but would also add to soil fertility on the farm level. Further some of the trees would also help in providing fodder to the livestock, while fruit of few trees such as mulberry and fig would supplement family nutrition.

Agro-silvo-pastoral system an integrated approach in which where majority of farmers have small land holdings for crop production along with livestock and trees on the same piece of land; maximizes the productivity of land. Project area has a good potential to support models of Agro-silvo-pastoral systems.

Farmers of the area have low knowledge on modern agriculture practices hence they need capacity building. For capacity building of farmers, informal methods have proved more effective than the formal class room lectures. Similarly, the practical demonstration of

practices, tools, varieties etc. have shown better efficiency in terms of learning and application of these techniques. For the capacity building of farmers of the proposed command area, the modality of Famer Field School (FFS) should be used.

10.5.5 Farmer's Field School an important technique for capacity building of farmers:

Farmers of the area though have got some knowledge on the various agriculture practices, still for introduction of new varieties, tools and technologies they need some kind of capacity building/exposure. For this purpose, it would be much better that for capacity building of farmers of the proposed command area, the modality of Famer Field School (FFS) should be used. FFS can help in dissemination of information on new technologies, varieties etc. FFS once organized can be used by the different agencies, NGO, companies dealing with the agriculture crop production for capacity building, promotion of products etc.

10.5.6 Proper demarcation and preparation of land:

At present the proposed project area is lying in the form of a barren piece of land. The area belongs to Ahmed Khel sub-tribe of Mandokhel tribe and has not been put to settlement so far. The first step in bringing the area under cultivation is to conduct the settlement of the entire area. The settlement should follow the preparation and levelling of land for agricultural crop production. For land levelling proper techniques should be employed to allow for proper flow and drainage of water. Preparation and levelling of land should be followed by lay out for canals and distributaries, this will contribute to an efficient irrigation system, which is a pre-requisite for good agricultural crop production.

10.6 Conclusions

After the detailed impact assessment activity, it is concluded that Project will bring mostly positive changes in physical, biological and socioeconomic environments. Some activities under this project have been identified to cause low to high environmental negative impacts and their mitigation measures have been prescribed. Proper and timely execution of these measures will reverse most of the negative impacts in the long term. Overall, the project causes higher positive impacts under the physical, ecological and socio-economic criterions and should be approved for implementation."