ENVIRONMENTAL IMPACT ASSESSMENT REPORT

SAND EXTRACTION WITH DREDGER MACHINE

FROM BLOCK NO. RIVER TAWI 1, NEAR RIVER TAWI, TEHSIL DISTRICT SIALKOT

Consultant

Proponent

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Executive Summary

Title and Location of the Project:

The project under consideration of this Environmental Impact Assessment (EIA) Report is Sand Extraction with Dredger Machine from Block No. River Tawi 1, near River Tawi, Tehsil District Sialkot.

Proponent of the Project:

Mr. Hafeez-ur-Rehman Mirza is the proponent of this project.

Report Preparation:

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Description of the Project

Nature of the Project: Sand Extraction from Block No. River Tawi 1, near river Tawi,

Tehsil District Sialkot

Total cost of the project: 15 Million (excluding lease cost)

Environmental Budget: Environmental budget of the project is 0.2 million.

Magnitude of the Project:

4-5 persons will perform their duties during operation of the Project.

Depth: The sand mining will be in 1 meter depth layer by layer the overall mining depth will be 5 meters

Storage area: stockpile area will be limited to 0.5 hacters and will be located on even surface.



Who

Loading and unloading and transportation detail: the sand placed in stockpile and will be

loaded to transport trucks with front end loaders for sale to the local market

Water consumption:

1-2 gallon water will be used

Duration of lease: area is on lease for two years.

(Lease agreement is attached in annexure)

Total Area: 457.73 Acres

Category of the Project

This project falls in the Schedule 1 (List of projects requiring IEE), Category D (Commercial

extraction of Sand, Gravel, limestone, clay, Sulphur and other minerals not included in

Schedule II with total cost less than Rs. 100 million) but EPA said to make detailed

Environmental Impact Assessment (EIA) Report of this project due to its potential impacts.

Objective of the Project:

• To fulfill the market demand of sand.

• To get the best quality of sand for construction purpose.

• Positive impacts on local communities in terms of employment and local economic

development.

Benefits of the project

• Being based on the use of submersible pump dredge is more efficient and it

drastically reduces the fuel consumption

The particular design of dredger allows to get only good quality of material avoiding

waste of energy and granting to the end user to work with high quality of sand for

construction purpose.

To Reduce Damages From Future Flood Disasters

Increase Flow Carrying Capacity



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Comparison of Dredger Machine and Excavator

Dredger	Excavator
Sand excavation strategy in-stream using modern technology has not serious impacts on river banks. Sand extraction of river bed recommended from more than 50 m away of river bank, and the part of river where straight, it will be restored as meander to bring the river natural shape and it will increase the river beauty, reduce the water velocity in main channel also reduce the velocity left and right bank in channel. So the lower velocity of water in channel will not affect the River bank. Riparian buffer zone widths more than 30 m are very useful for bank stabilization and aquatic food web. Dredger can target the desired or planned area anywhere in the river and provides better selective and design capabilities	Excavator only has a limited access along the river shore line causing higher risks of cave in shore land and river widening which may not be desirable. Excavator damage the river bank.
Extraction with dredger will lower river bed will increase flow carrying capacity during high flood period, it will also reduce the flood risk in that area.	Excavator cause erosion at the river banks, resulting in eroding river banks and at the time of high rainfall causing flood to the area.
Turbidity can cause serious damage to the ecosystem. This problem will be solved by Drag flow by the production of a bell to limit water turbidity.	Increase the turbidity of water
Due to the particular design it will allow getting only good quality of material avoiding waste of energy and provide the good quality of sand for construction purpose.	
Being based on submersible pump it is more efficient and it drastically reduces the fuel consumption compared to the other old technologies.	





Most of the developed countries are using this	Old Conventional method
1	
technology.	

The Proponent will follow the following mitigation measures

Parts of the river reach that experience deposition will be identified first. The Lease holder and Environmental NOC holder may be allowed to extract the sand deposit in these locations.

Equipment must be regularly serviced and inspected to make sure there are no leaks of oil, diesel, fuel, detergents or hydraulic fluids. Servicing and maintenance of vehicles as far as possible must occur outside of the boundaries of permit area. If maintenance does occur on site due to breakdown, all steps must be undertaken to avoid hydrocarbon spills/leakages. Diesel will be stored on site, secondary containment will be provided. Spilled hydrocarbon must be treated as a hazardous waste and needs to be disposed of in appropriate hazardous waste containers and removed from site as soon as possible. No washing of equipment or machinery may occur on the permit site or in the watercourse. Spill kit will be used in case of any spill. The hydrology of the landscape will be maintained by ensuring that extraction takes place away from the riparian zone and the stockpile area drainage is monitored. The extraction of sand must not exceed the replenishment rate of sand during the rainy season. HEC-RAS model is used for computation of cross-section hydraulic parameters and river discharge capacity. Sediment transport computation and deposition study of project area performed at river cross-section # 1085 by using Acker-White and Engelund-Hansen equations. The Environment Officer and Project Manager must establish working and no-go areas, which need to be strictly adhered to. Keep surrounding vegetation, especially larger trees and shrubs, to create a screen that reduces flood impacts. Protected trees must be marked, their location recorded and must be avoided as best as possible. Bank erosion can be controlled with re-plantation. No trapping, snaring, hunting, fishing or killing of any animal may occur on the permit site.

Vehicle access must be strictly contained onsite. Vehicles may only use designated roads and access points as determined by the Environment officer and project Manager before operations commence.

During transporting sand on public roads, these will be kept clear of spills, leaks, mud and sand. There is not any worth mentioning waste will generate at project site. If any solid waste





will generate on site it will be disposed of in clearly marked bins and solid waste will be handover to the contractor.

Mixed/generals waste and hazardous waste must be separated and disposed of in clearly marked bins. No waste may be buried or burned. Empty fuel storage drums will be handover to the authorized contractor. No disposal of sewage will occur on or near the site. Septic tanks will be available. Rehabilitation will ensure good vegetative cover which will reduce dust creation. Dust fallout monitoring will be introduced if dust becomes an on-going problem. Water will be sprinkled to minimize the dust. Hearing protection will be provided to workers operating machinery.

Site access, including stockpile areas and loading areas will be fenced to prevent unauthorized access. Correct signage must be available at the main access road and entrance of haul road to areas – includes authorization, access authorization, warning activity, safety and warning signs (protective equipment, fire & medical equipment) and contact numbers. No open fires shall be allowed on site under any circumstances.

Turbidity can cause serious damage to the ecosystem; this problem will be solved by Drag flow by the production of a bell to limit water turbidity.

Due to the particular design it will allow getting only good quality of material avoiding waste of energy and provide the good quality of sand for construction purpose. Use advance technology for sand removing in the river bed and minimized the environment impacts on river banks. Sand mining in river bed will be one meter depth layer by layer the overall mining depth will be 05 meters. Maintain the river flow carrying capacity in active channel without any serious activities.

Being based on submersible pump it is more efficient and it drastically reduces the fuel consumption compared to the other old technologies.

The project potential impacts will be mitigated by adopting all suggested technical/ engineering best practices and measures.

The Acker-White and Engelund-Hansen method was used for calculation of sediment transport and sediment rating curve the result obtained from Acker-White equation considered more reliable for sand volume extraction and replenishment. There are 25 cross-section was prepared for this study using HEC-GeoRAS and Global Mapper 19. The sediment rating curve was developed at cross-section no 1085. Hydraulic characteristic of river cross-section such; hydraulic depth (H_d), cross-section area (A), top width (B), and



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Wetted Perimeter was estimated with HEC-RAS 5.0.3 using steady and value of manning's (n) is adopted 0.033 on the bases of field investigation and river morphology. The basic characteristics of river cross-section, computed velocity and computed river flow discharge. The detail is given in chapter 3.

The sand extraction from river must be away 1000 m to 1500 m away from civil structure 500 m to 1000 m away from water intake points, fish breeding areas, irrigation areas riverine settlement. To avoid the sand extraction at riffle and straight channel cross-section due to high velocity it causes rapid bed and bank erosion.

The velocity at straight river reach is very high, sand extraction or extract sand with proper technique create meander which slow the velocity that area), because after riffle a straight portion of started and end at again rifle the velocity of these area.

The width of a buffer depends greatly on what resource you are trying to protect. Scientific studies have shown that efficient buffer widths vary for bank stabilization and stream shading, for wildlife habitat based on catchment characteristic and geometry. Furthermore, the necessary width for an individual site may be less or more than the average recommendations, depending on soil type, slope, land use and other factors. An ordinary planting adjustment to consider is the inconstancy in the width of land accessible for planting inside the riparian zone. The width of a riparian buffer is a key factor in the general outline of the planting (Agriculture and Agri-Food Canada, 2018). Cross-section of a stream and the adjacent riparian area.

Detailed mitigation measures are given in Chapter 3 & 5.

Proposed Monitoring: The EMP is prepared to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives of:(i) providing a pro-active, feasible and practical working tool to enable them ensure and monitoring of environmental performance on site; (ii)guiding and controlling the implementation of findings and recommendations of the environmental assessment (iii)detailing specifications deemed necessary to estimating the environmental impact(iv)ensuring that safety recommendations are complied with detailed Environmental Management Plan (EMP) is presented in Chapter 6.



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1 <u>CHAPTER 1: INTRODUCTION</u>

1.1 Purpose of Report

Environmental Impact Assessment is the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. The purpose of conducting an EIA was to:

- 1. To ensure that environmental considerations are explicitly addressed and incorporated into the development decision making process;
- 2. To avoid and minimize the adverse significant biophysical, social and other relevant effects of the proposed project;
- 3. To promote development that is sustainable and optimizes resource use and management opportunities.

1.2 <u>Identification of the Project and the Proponent</u>

1.2.1 Project

The project is Sand Extraction with Dredger Machine from the Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot

1.2.2 Proponent

Mr. Hafeez ur Rehman Mirza is the proponent of this project.

1.3 Details of Consultant

The services of EnviroSafe Consults (147-Block A, Faisal Town, Near FAST University Lahore,) have been engaged to carry out An Environmental Impact Assessment (EIA) for Sand Extraction with Dredger Machine.



1.3.1 EIA Team

A core team of qualified professionals having relevant experience of conducting environmental and social assessments contributes to preparation of an Environmental Impact Assessment (EIA) shown in Table 1.1

Table 1-1 EIA Study Team

Team Members			
Name	Designation	Qualification	Responsibilities
Mr. Hassan Zahid	Lead Environmental Professional	PhD Researcher Environmental Management	Major responsibilities involve visit of the project area reviewed procedures, guidelines, legal and policy framework and applicable standards, collection of baseline data identification and evaluation of potential significant impacts of the project, developed mitigation measure and EMP preparation of EIA Report, Involve meeting with the client and other stakeholders Over all supervision and technical guidance to team and preparation of EIA report.
Mr. Abid Ali	Lead Environmental Professional	M. Phil. Environmental Sciences	The responsibilities included collecting the baseline data through literature review, social surveys, environmental monitoring and field observations, identification of impacts based on the collected data, recommendations for the mitigation of potential adverse impacts, preparation of a comprehensive environmental management and monitoring plan with detailed responsibilities of each activity, Identification of Impacts on flora fauna, tree counting, Prepare tree plantation plan and addressing mitigation of impacts and compilation of report.





Mr. Awais Hassan	Lead Environmental Professional	M. Phil. Environmental Sciences	The responsibilities include meeting with the client, site visit, and collection of baseline data, identification of impacts, addressing mitigation of adverse impacts, preparation of environmental management plan and preparation of EIA report as per EPA guidelines
Miss. Ayesha Hameed	Environmental Professional	MS. Environmental Sciences	The responsibilities include assistance in collection of baseline data, identification of impacts, addressing mitigation of adverse impacts, preparation of environmental management plan and help in report writing.
Miss Sumaira Saleem	Environmental Professional	M. Phil. Environmental Sciences	The responsibilities include assistance in field level data collection.
Miss Rabia Arshad	Environmental Professional	M. Phil. Environmental Sciences	Major responsibilities are providing assistance in arranging meetings with the stakeholders and client, Conduct public consultation meetings, data collection.





1.4 Screening For Environmental Assessment

The preparation and submission of an Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) report for any development project is a statutory obligation under Punjab Environmental Protection Act, 1997 (PEPA, 1997) amended in 2012 in terms of Section 12 of the Act which states as under:

No proponent of a project shall commence construction or operation unless he has filed with the Provincial Agency, an Initial Environmental Examination or where the project is likely to cause an adverse environmental effect, an Environmental Impact Assessment, and has obtained from the Provincial Agency approval in respect thereof.

The current Project falls under Schedule 1 (List of projects requiring IEE), Category D (Commercial extraction of Sand, Gravel, limestone, clay, Sulphur and other minerals not included in Schedule II with total cost less than Rs. 100 million) As the project is sand extraction/mining from river, EPA said to submit detailed Environmental Impact Assessment (EIA) Report of this project due to its potential impacts.

The Environmental Impact Assessment has been prepared in order to obtain Environmental Approval /NOC from Environmental Protection Agency EPA-Punjab. In accordance with the Punjab Environmental Protection Act,

1.5 Brief description of Nature, Size and Location of Project

1.5.1 **Nature**

As per screening Environmental Impact assessment required for this project.

1.5.2 **Size**

The total area is 457.73 Acres. The total cost of the project is 15 Million. (Excluding lease cost)

1.5.3 Location

The project under consideration is Sand Extraction with Dredger Machine from Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot



1.6 Scoping

The scoping identifies the key issues and impacts that should be further investigated. The Scoping defines the spatial and temporal boundaries, important issues and concerned raised during consultation and significant impact factors to be determined.

1.6.1 **Spatial and Temporal boundaries**

The Location of project is Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot Total mining area is 457.73 Acres.

(Google Map is attached in the Annexure of the Report)

1.6.2 Public Consultation

The consultation, scoping meetings were carried out in the project area to disseminate information about the project and its expected impact on the primary and secondary stakeholders. A number of relevant stakeholders were consulted regarding the proposed project activities during different Discussions and meetings. The participants and Designation is given below-:

Table 1-2 Scoping session

Sr. No.	Name of respondent	Organization	Designation	Views
Envi	ronmental experts fron	Proponent should strictly follow Environmental Management plan Consider all guidelines of Punjab EPA during preparation of Environmental Impact Assessment. Proponent should plant trees in rehabilitation phase		
Sr. No.	Name of respondent	Organization	Designation	Views
	EPA Officials			Consider all guidelines of Punjab EPA during preparation of Environmental Impact Assessment Report.





Public consultation should be conducted. Baseline study should be conducted. Primary and updated data should be used. As the project is sand extraction/mining from river, proponent has to submit Environmental Impact Assessment Report.

1.6.3 Significant Issues Considered

It was unanimously agreed by almost all the consultation participants that the project has not any adverse impact. Also the project is necessary to provide high quality sand to clients/customers.

1.7 Scope of EIA Study

The purpose of this EIA study is identification of key environmental impacts which will likely arise during construction and operational phase along with the assessment of the significant negative impacts and mitigation measures to be adopted for their minimization.

The ultimate goal of this EIA report, among others, is to produce an Environmental Management Plan (EMP) for the proposed project. Compliance of EMP together with the provisions for mitigation measures for the significant negative impacts will ensure the implementation of this project in an environmentally sustainable manner both at construction as well as operation stages of the Project.

The EIA report ensures compliance to all national and local regulations enforced in Pakistan such as requirements of section 12 of Punjab Environmental Protection (Amendment) Act, 2012.

This EIA report also discusses the legal and administrative framework within which the EIA is prepared. A detailed project description is included in the EIA report together with a description of the baseline environmental conditions and the actual environmental situation at the proposed site for the project.





The technical section of the report and the environmental baseline situation form the basis for the detailed impact assessment during replacement and operation phases of the project. Based on the findings of this report, an environmental management system has been devised, outlining necessary mitigation and compensation measures together with monitoring practices.

1.8 Approach & Methodology

The key steps followed while conducting EIA are briefly described below.

1.8.1 Review of Project Documents

Previous feasibility report has been reviewed for getting insight into the project area and related issues. Some offices and organizations were also visited for acquisition of published reports and data.

1.8.2 Reconnaissance Survey of the Project Area

The reconnaissance survey under this study was conducted by an interdisciplinary team to conceptualize the project and understand the potential environmental and social impacts associated with the proposed project. During the field reconnaissance, the main information regarding the topography, soils, land use, surface water, groundwater, flora, fauna, social setting, villages/ towns, in the surroundings of proposed project was examined.

1.8.3 <u>Data Collection</u>

Both primary and secondary data were collected to accomplish the objectives of the study. The primary data was collected by conducting field surveys through individual interviews of local population, focus group discussions and consultations with local community, while secondary data was collected from the published Government documents, i.e. Economic Survey of Pakistan, District Population Census, Weather data, Government Acts, Laws and Regulations.

1.8.4 Data Processing and Analysis

After collecting all above data from different sources including interviews from communities, consultations, physical observations, and data compiled from other documents was analyzed. Accordingly, the results were presented through tables, graphical/pictorial illustrations.



1.9 Environmental Baseline Survey of The Project

Prior to the start of the baseline environmental survey, a checklist was developed. The major items, which were considered for physical, ecological and social environment, are discussed in the subsequent paragraphs.

1.9.1 Physical Environment

For collecting information on the physical environment, the following main parameters were considered:

- Land Resources (that includes land use, soil composition, topography, geology, contamination of soil and soil erosion, etc.)
- Water Resources (that includes sub-surface and surface water and ground water etc.)
- Climate (including temperature, rainfall, humidity, wind direction, etc.), Ambient Air and Noise Quality
- Existing solid waste and waste water management and effluents disposal practices and storm water drainage
- Other infrastructure (public and private) To record the baseline conditions of the ambient air quality, noise levels, ground water, stack emissions from industries and sewage water,

Environmental monitoring at different sites in the project area was carried out form EPA certified Third party Environmental Laboratory.

1.9.2 Ecological Environment

Under the ecological environment, the following main parameters were covered:

- Flora (including vegetation cover of Project Area, trees, shrubs and grasses, and their loss due to implementation of the project, etc.)
- Fauna (including wildlife, avifauna, domestic animals, etc.)
- Reserved Forests and Wildlife Sanctuaries in Project Area or its vicinity
- Migratory birds (if any)
- Endangered Species (both flora and fauna)



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1.9.3 Social and Cultural Environment

To assess the social and cultural baseline settings of the Study Area, social survey was carried out to accomplish the following specific objectives:

- To identify the potential disruption of private infrastructure (if any)
- To identify poor and vulnerable groups and strategies to ensure that such groups should get benefit from the Project.
- To ensure adequate public/stakeholder consultations and their participation.
- To identify the effects on available common resources of the community due to the implementation of the Project.

1.9.4 <u>Identification and Assessment of Impacts</u>

Potential impacts arising as a result of the project activities during the construction and operating period on the physical, biological, socio-economic, archaeological and cultural environments of the project area have been identified. This identification and assessment of impacts has been carried out on the basis of primary field data, secondary data and expert opinion. A detailed account of these impacts has been provided in this EIA report.

1.9.5 <u>Mitigation and Monitoring</u>

1.9.5.1 Mitigation

Mitigation measures to help prevent or minimize all potential adverse environmental impacts of the project have been identified based upon a range of options including management options, monitoring practices, physical controls, or compensation. The proposed mitigation measures are based on the sensitivity and behavior of environmental receptors within the project area, past experience, case studies, legislative controls, environmental guidelines, and expert advice.

1.9.5.2 Monitoring

Monitoring measures have been recommended for residual impacts (impacts remaining after applying the recommended mitigation measures) or for impacts that cannot be accurately predicted at the EIA stage. In such cases advice on requisite monitoring measures was sought from experts involved in the EIA and case studies of similar monitoring exercises carried out in protected areas elsewhere.



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1.9.6 <u>Development of the Environmental Management Plan</u>

An Environmental Management Plan (EMP) for the proposed project activities has been prepared. The EMP provides a framework for implementing and managing the mitigation and monitoring measures recommended in the EIA report. The EMP includes the following:

- A mitigation and monitoring plan;
- Definition of roles and responsibilities of the proponent, contractors and monitoring teams;
- Requirements for communication, documentation and training during the project;
- Restrictions on design, timing and conduct of the project; and
- Change Management Plan to cover unforeseen events/environmental conditions during the project.

1.9.7 Screening Environmental Impacts & Mitigation Measures

After thorough review of the field notes, collected data, extent of proposed project activities and detailed discussions with the stakeholders and design team, the potential impacts of the Project were assessed and measures were proposed to mitigate the negative impacts and to enhance the positive impacts. The potential impacts and mitigation measures were assessed covering the following parameters:

- Environmental problems due to Project location (i.e. location of different components of the Project).
- Environmental problems related with design.
- Environmental problems associated with the construction stage.
- Environmental problems resulting from project operations.

1.9.8 Preparing Environmental Management & Monitoring Plan

An Environmental Management and Monitoring Program (EMMP) depicting the mitigation measures and monitoring plan has also been developed. Institutional capacity of agencies responsible for implementation and operation & maintenance was also reviewed and enhancement was proposed for effective implementation of the EMMP.

1.10 Structure of Report

This EIA study was conducted according to the newly issued standard guidelines and principles available from Punjab-EPA. This EIA report is structured in (9) chapters;



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Chapter 1 is the introductory chapter describing purpose of report, identification of project and proponent, details of consultant and location of project.

Chapter 2 describes the type of project, its objectives, considered alternatives, site layout, land use, road access, vegetation, cost, process flow chart and rehabilitation plan.

Chapter 3: Feasibility Study

Chapter 4 presents the Legislative and Regulatory framework.

Chapter 5 details the baseline data of the project site,

Chapter 6 identifies and assesses the predicted impacts of the proposed project, the methodology for impact assessment and their mitigation measures.

Chapter 7 presents the Environmental Management and Monitoring Plan (EMMP)

Chapter 8 Public consultation

And lastly, **Chapter 9** gives conclusions and recommendations of the EIA study.

The project lies under the categories of the projects requiring detailed EIA as per Pakistan Environmental Protection Agency (Punjab-EPA) (2000) regulations.



Who

2 CHAPTER 2: DESCRIPTION OF THE PROJECT

2.1 Type and category of the Project

According to environmental laws of the country developmental projects have to undergo the process of Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) in order to predict and mitigate the impacts of the development at an early stage. Based on nature, size, cost and associated impacts, the project under consideration has been categorized for Study according to the regulation 3 of Statutory Notification issued on June 13, 2000 s(S.R.O.339 (1) /2001). The Project is a Sand Extraction falls under Schedule 1 (List of projects requiring IEE), Category D (Commercial extraction of Sand, Gravel, limestone, clay, Sulphur and other minerals not included in Schedule II with total cost less than Rs. 100 million) of the IEE / EIA Regulations 2000 made under section 12 of Punjab Environment Protection Act 1997 (Amended 2012) under which the study is mandatory for getting Environmental Approval. As the project is sand extraction/mining from river, EPA said to submit detailed Environmental Impact Assessment (EIA) Report of this project due to its potential impacts. The Director General, EPA Punjab is the authority to issue the requisite Environmental Approval after proper review of the project.

2.2 Objective of the Project:

- To fulfill the market demand of sand.
- To get the best quality of sand for construction purpose.
- Positive impacts on local communities in terms of employment and local economic development.

2.3 Analysis of Alternatives

2.3.1 General

The main objective of this section is to consider various alternatives to make the project more environmental friendly and sustainable with respect to the location and layout of the whole project. For the selection of appropriate layout, under existing site conditions, following environmental and social precautions were considered:

Minimum environmental adverse impacts



- Minimum resettlement and land acquisition
- Cost effective solution

The important factors taken into consideration for selection of site for the project include:

- i) Location
- ii) Technology Option

2.3.2 Location

The sand will be extracted with Dredger Machine from Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot. The project site is acquired on lease for two years from mines and mineral department. The Dredger Machine will be used to extract mixture of water and sand from river.

In comparison with conventional sand removal method, dredger may actually have an edge over excavator and provides a better sustained and safer sand removal. Excavator only has a limited access to the river bed only along the river shore line causing higher risks of cave in shore land and river widening which may not be desirable.

Dredger in comparison can target the desired or planned area anywhere in the river and provides better selective and design capabilities,

2.3.3 Technology Option

Sand extraction by Dredger Machine from River, because being based on the use of submersible pump dredger is more efficient and it drastically reduces the fuel consumption. The particular design of dredger allows to get only good quality of material avoiding waste of energy and granting to the end user to work with high quality of sand for construction purpose. Technology used in the most developed countries.

2.3.4 Environmental Alternatives

Extraction with dredger will lower river bed will increase flow carrying capacity during high flood period, it will also reduce the flood risk in that area.

Turbidity can cause serious damage to the ecosystem to prevent serious damage to the ecosystem. This problem will be solved by Drag flow by the production of a bell to limit water turbidity. So, this site is the best option for sand extraction.



2.4 Location and the site layout of the Project

Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot

2.5 Land use on the site

The land is acquired on lease. Lease agreement is attached in annexure. The project site located at from Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot. The Dredger Machine will be used to extract mixture of water and sand from river bed.

2.6 <u>Vegetation features of the site</u>

Some wild grasses grown with few low bushes and thorny shrubs which have no medicinal value or considered endangered.

2.7 Cost and the magnitude of the operation

Total cost of the project is 15 million. (excluded lease cost)

Breakup of health and safety and environmental budget

Health and Safety Budget of the project is 0.1 million	Ten Thousand rupees for Safety Signs	
	Forty Thousand Rupees for Fire Fighting Equipment	
	Forty Thousand Rupees for Personal Protective Equipment (PPEs), First Aid Boxes	
	Ten Thousand Rupees for bins for solid waste	
Environmental budget of the project is 0.2 million.	Two lac Rupees for plantation.	

2.8 Magnitude of the Project

4-5 persons will perform their duties during operation of the Project.



Schedule of implementation

Project will be executed as soon as the no objection certificate from the environmental

protection agency, Punjab will be issued, as the proponent has applied for other mandatory

approvals from concerned departments The Project will be implemented in 1 week after the

issuance of the EPA NOC.

2.10 Description of the Project:

Nature of the Project: Sand Extraction from Block No. River Tawi 1, near river Tawi,

Tehsil District Sialkot

Depth: The sand mining will be in 1 meter depth layer by layer the overall mining depth will

be 5 meters

Storage area: stockpile area will be limited to 0.5 hacters and will be located on even

surface.

Loading and unloading and transportation detail: the sand placed in the form of stockpile

and will be loaded to transport trucks with front end loaders for sale to the local market

Water consumption:

1-2 gallon water will be used

Duration of lease: area is on lease for two years.

(Lease agreement is attached in annexure)

Total Area: 457.73 Acres

Benefits of the project

• Being based on the use of submersible pump, dredger is more efficient and it

drastically reduces the fuel consumption

• The particular design of dredger allows to get only good quality of material avoiding

waste of energy and granting to the end user to work with high quality of sand for

construction purpose.

• To Reduce Damages From Future Flood Disasters

• Increase Flow Carrying Capacity



The

Comparison of Dredger Machine and Excavator

Dredger	Excavator
Sand excavation strategy in-stream using modern technology has not serious impacts on river banks. Sand extraction of river bed recommended from more than 50 m away of river bank, and the part of river where straight, it will be restored as meander to bring the river natural shape and it will increase the river beauty, reduce the water velocity in main channel also reduce the velocity left and right bank in channel. So the lower velocity of water in channel will not affect the River bank. Riparian buffer zone widths more than 30 m are very useful for bank stabilization and aquatic food web. Dredger can target the desired or planned area anywhere in the river and provides better selective and design capabilities	Excavator only has a limited access along the river shore line causing higher risks of cave in shore land and river widening which may not be desirable. Excavator damage the river bank.
Extraction with dredger will lower river bed will increase flow carrying capacity during high flood period, it will also reduce the flood risk in that area.	Excavator cause erosion at the river banks, resulting in eroding river banks and at the time of high rainfall causing flood to the area
Turbidity can cause serious damage to the ecosystem to prevent serious damage to the ecosystem. This problem will be solved by Drag flow by the production of a bell to limit water turbidity. Due to the particular design it will allow getting only good quality of material avoiding waste of energy and provide the good quality of sand for construction purpose.	Increase the turbidity of water
Being based on submersible pump it is more efficient and it drastically reduces the fuel consumption compared to the other old technologies. Most of the developed countries are using this	Old Conventional method
technology.	

2.11 Assembling of Machine

Dredge flow is specifically designed and manufactured for easy assembly. The installation of dredger requires three easy steps which can be carried out in five working hours





- Positioning of the hull and clamping through vertical pins
- Positioning of the power unit
- Pump fixing

2.12 The dredging process

The dragging process consist of two steps

- 1. Digging the sand from the river for making it available to the water flow at the inlet of the suction pipe
- 2. Generating the water sand mixture and moving it to the suction inlet of the dredging pump.

The dredge is provided by a "cutter device" which excavate the sand before it sucked up by the flow of water. Dragflow cutters are couple of excavators, running in counter direction for keeping fix the position of the system as well as for conveying the material to the suction mouth.

In dragflow the mixture is generated by the mechanical effect of the agitator. Once the mixture is generated it is transferred to the pump inlet, the inlet mouth of impeller is so closed to the mixture generator area (agitator) that no pipe is required so the solid sedimentation is not an issue.



The

2.13 Process Flow Diagram

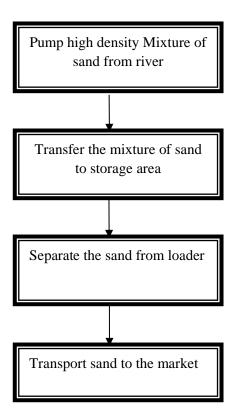


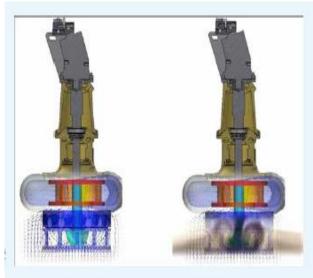
Figure 2-1 Process Flow Diagram





2.13.1 <u>Description of Process with Pictures</u>





2.14 Specifications

Length (a)	12 m
Width (b)	8 m
Height (c)	1.8 m
Modular structure	4 steel floaters



The

Oil capacity	430 liters		
Fuel capacity	1260 liters		
Protection	Antifouling paint and cathodic protection		
	Beam anti break through		
Certification	R.I.N.A Certification		
Pump handling			
Dredging depth	Up to 10 m		
Hydraulic power pack			
Engine	Diesel motor		
Electric plant	12/24V		
Hydraulic plant	No. 1 oil pump variable flow-dredging pump		
	No. 1 oil pump variable flow- excavator		
	No. 1 oil pump variable flow-winches and hoist		
Dredging unit			
Dredging Pump	Drag flow pump HY 300		
Delivery	From 250 to 350mm		
Impeller diameter	760 mm		
Capacity	720 to 1200 m ³ /h of mixture		
Solid capacity	25-30%		
Discharge distance	Up to 1 km		
Solid handling	120 mm		
Weight	From 3500 to 3600 kg		





Excavators and Jet Ring					
Excavators	Dragflow EXHY20 EXHY35				
	Power from 11 kw/30RPM To 30kw/50RPM				
Jet Ring	Breakup with jet of water at high pressure				
	From 30-200m3/h at 6-8 bar				
Operator cabin					
Features	Side opening doors with lock				
	Air conditioning with heat pump				
	Hydraulic & electric control				
	Front position, navigation and maintenance lights				

2.14.1 High Productivity

The pumps are designed to pump fluid containing a high percentage of solids the agitator rotates at the same speed as pump producing an active cone that can put the solids in suspension and produce a homogeneous mixture which can easily pumped.

2.14.2 High Abrasion resistance

The material specification of the components allows the pumping of highly abrasive slurries. All wearing parts are made up of chrome VI with hardness 600/650 Brinnell

2.14.3 Anti-Turbidity Bell

Sediments can be polluted by metals, hydrocarbons, bacteria and chemical substances which in most cases are toxic, resilient and accumulate as debris. A digging operation without turbidity limitation of surrounding waters could prevent serious damage to the ecosystem

This problem has been solved by the production of a bell to limit water turbidity.





2.15 <u>Dredging monitoring system</u>

The monitoring system allows the display of work in progress on a PC screen with a top side view of the dredging unit.

Several kits are available starting from one for tracking the location for dredging up-to a kit for complete monitoring of work in progress

2.16 Restoration/Rehabilitation plans and Compensation

Land rehabilitation is the process of returning the area to some degree of its former state, after some process (industry, natural disasters, etc.) has resulted in its damage. Many projects and developments will result in the land becoming degraded, for example mining, farming etc.

After sand extraction area must undergo rehabilitation. Native species of the plants will be planted during the rehabilitation phase. The proponent may be carry out adequate restoration including landscaping. After the proposed extraction activity the area will be restored and reclaimed with maximum plantation. None of the locals or residents will be relocated or any vegetation or infrastructure affected or destructed. The area is acquired on lease from mines and mineral department.

2.17 Changing in Planning and Design

Proponent has not any plan during lease period to change in planning and design.

2.18 Road Access

The area is easily assessable.

2.19 Suitability of the site

The project site is not located in any prohibited, environmentally sensitive area.

2.20 Government and other Approvals

Lease documents are attached in annexure.

Environmental approval is the major requirement



3 <u>CHAPTER 3: FEASIBILITY STUDY OF THE PROJECT</u>

3.1 Introduction

Economic development is one of the main objectives of developed and developing nations worldwide. Development comes with growth of urban areas. Urban growth is achieved through sand and gravel mining for construction of modern, attractive and durable structures. Today, the demand for sand materials in Pakistan continues to rise. Ensuring their availability is vital for the development of the infrastructure in the country. There are many different sources of sand and gravel, the most important among them is the river. As the requirement of these construction materials is on rise, they also are very vital for the health, physical character of the river and the different important functions of the river. The extraction of sand and gravel from the river bodies has to be regulated and done with adoption of required environmental safeguards.

Tawi is a river that flows through the city of Jammu. Tawi River is considered sacred and holy, as is the case with most rivers in India. River Tawi (referred in ancient literature as Surya Putri) originates near Kaplas Mountains and flows westward between Jug Dhar and Trisul Dhar in a westerly direction till Udhampur where it takes a southerly bend across the Sivalik range and again resumes a westerly course passing along the Jammu City till it joins Chenab River in Sialkot District in Pakistan.

The length of Tawi River is about 141 km (88 mi). The river in general flows through steep hills on either side excepting the lower reach for about 35 km (22 mi). The river is about 300 m (980 ft) wide at the bridge in Jammu city. After transversing Jammu city, the river crosses into Pakistan's Punjab and joins Chenab River. Tawi is a major left bank tributary of river Chenab.

The constant deposit of sediment raises the surface of river channel when Tawi enters the plain area. Heavy sediment loads from huge catchment area and garbage dumps are the main hurdles to block the holding capacity of water during monsoons and flash floods.

HEC-RAS model was used for computation of cross-section hydraulic parameters and river discharge capacity. Sediment transport computation and deposition study of project area performed at river cross-section# 1085 by using Acker-White and Engelund-Hansen



the

equations. The sediment rating equation was developed by Acker –White equation to determination of sediment flow rate at other cross-section in project areas. Daily river discharges measured at Marala Barrage were used to computation of time frame for sand mining in dry season. River morphology at project area reach in last few years was computed with GIS. Average River riparian buffer zone width was computed using statically approach employing spatial analysis tool of Geographic information system. The statistical model input parameters such as slope and overland flow length was computed from digital elevation model of 30 m resolution. Bank erosion of river can be controlled with re-plantation, brash, grass and small trees.

3.2 Purpose of the Study

The purpose of the study to develop Best Management Tools (BMT) for sand mining and guideline:

The main aim of this study

- ✓ To guide river management authority, water resources management department, irrigation department, government agencies and local development and management department in minimizing and monitoring impacts of in-stream sand extraction on the quality of River in Pakistan.
- ✓ To develop the best sand mining guide tools for sand mining operators in implementing Best Management Practices (BMPs) and appropriate in-stream sand extraction techniques by carrying out field investigation and community engagement as well as undertaking closing plans and rehabilitation work in mining areas.
- ✓ To address the advanced and modeling exercise to determine how much sediment is moving into and through a reach, and how this affects channel hydraulics.
- ✓ To guide the sand mining operators and river management authority with basic modeling exercise to determine how sediment is moving into and through a reach and how much volume they will extract.



3.3 Background

The rapid construction for economic development in worldwide especially in developing countries are required sand mining from pit; river and agricultural land have positive and negative impacts to the environment. Sand and gravel have long been used as basic aggregate for construction of urban infrastructure, roads and building. Today, the demand for sand materials in Pakistan continues to rise. Sand and other sediments are generated from rock weathering and erosion from topsoil layer, with a yield that depends on the soil composition, the vegetation cover, the intensity of rainfall, and the slope of the terrain. Soil is a shoddy regular asset made up of rock, sand, dirt, topsoil which constitutes the diverse kinds. Pit sand, stream sand and rock are parts of soil which take a very long time to be shaped yet separated in a matter of days. Sand and rock are underground topographical assets framed from dissolving mountain rocks conveyed by streams and waterways. Soil has much utilization, it is required for horticulture, as a territory and in development yet the beginning of money economy brought many benefit driven organizations to be associated with its mining both legitimately and illicitly with some having no respect for the earth. Soil mining and reaping has both positive and negative ecological effects (Mwangi, 2007).

Sand and rock are essential assets to monetary improvement exercises in created and creating countries. Recuperation from stream channels, surge fields and glacial stores and additionally handling of these assets is expensive yet significant in development and industry (Draggan, 2008). Improvement is a procedure of step by step getting to be plainly greater, better, further developed in business, exchange and mechanical exercises. Development of towns and urban areas requests substantially more foundation and development of solid structures, for example, tarred streets, business shopping centers and settlement for the consistently expanding populace(Draggan, 2008). Effects of sand mining and rock extraction can be arranged into three classes as introduced (Stebbins, 2006). There are physical effects which are an aftereffect of mining from streambed causing modification of direct slant and changes in channel morphology. Water quality effects are caused by sand mining and digging exercises, lessening water quality for downstream clients and increment treatment costs. Environmental effects, for example, loss of territories and species unsettling influence are an aftereffect of mining rock and sand persistently prompting expulsion of channel substrate, suspension of silt and leeway of vegetation. Uncovered illicit sand mining going ahead in India, is generally done on streams. The ecological effects noted were changes in fluvial



morphology, profound passages on stream overnight boardinghouses in speed of streaming water bringing about disintegration on waterway banks. At times there is exhaustion of water assets prompting sustenance deficiencies and hardships for individuals (Bagchi, 2010).

Understood that sand mining is done and essential in South Africa for development purposes yet forms included have incredible potential in upsetting the regular habitat. They noticed that inordinate soil mining cause antagonistic effects to biota and their living spaces. Extraction in close stream bed harms vegetation and sea-going environments (Hill & Kleynrans, 1999). Instream sand mining can harm private and open properties and additionally sea-going environments. Inordinate expulsion of sand may altogether contort the regular harmony of a stream channel. By expelling silt from the dynamic channel bed, in-stream mines interfere with the progression of dregs transport through the waterway framework, disturbing the residue mass adjust in the waterway downstream and inciting channel changes (generally entry point) expanding impressive separations (usually 1 km or more) past the extraction site itself. The extent of the effect essentially relies upon the sizes of the extraction with respect to bed stack residue supply and transport through the reach (Kondolf, Smeltzer, & Kimball, 2001). The magnitude of the impact basically depends on the magnitudes of the extraction relative to bed load sediment supply and transport through the reach. Implementation of the principles and processes outlined in these Guidelines will limit the negative externalities of sand and gravel mining.

3.4 **Sand Mining Effect**

EPA Punjab (2017) summarized the following effects of sand and gravel mining as listed below

- I. Extraction of bed material in excess of replenishment by transport from upstream causes the bed to lower (degrade) upstream and downstream of the site of removal of sand.
- II. Degradation may change the morphology of the river bed, which constitutes one aspect of the aquatic habitat.
- III. Lowering of the water table can destroy riparian vegetation.
- IV. Rapid bed degradation may induce bank collapse and erosion by increasing the heights of banks.



3.5 Sand Mining Guideline

EPA Punjab (2017) summarized following Guideline after studying relevant literature for sand mining projects

- I. There is need to ensure conservation of the river equilibrium and its natural environment.
- II. There is need to ensure that the rivers are protected from bank and bed erosion beyond its stable profile.
- III. No obstruction to the river flow and water transport is necessary.
- IV. There is need to avoid pollution of river water leading to water quality deterioration.
- V. There is need to avoid aggradation at the downstream reach especially those with hydraulic structures such as jetties, water intake etc.
- VI. The distance between sites for sand and gravel mining should be depends on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand and gravel.
- VII. Layers of sand and gravel which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river.
- VIII. Sand should not be extracted within 1,000 meter from any crucial hydraulic structure such as pumping station, water intakes, bridges, buildings and such structures.

3.6 Impacts of Sand Mining

Ministry of Environment, Forest and Climate Change India (2016) summarized the following the impacts of sand mining can be categorized as follows shown **Table 3-1**;

Table 3-1 Impacts of Sand Mining and Description

Sr. #	IMPACTS ON	DESCRIPTION			
1	Biodiversity	Impacts on related ecosystems (for example; fisheries)			
2	Land losses	Both inland and coastal through erosion			
3	Hydrological functions	Change in water flows, flood regulation and marine currents			
4	Water supply	Through lowering of the water table and pollution			
5	Infrastructures	Damage to bridges, river embankments and coastal			
		Infrastructures			



6	Climate	Directly through transport emissions			
7	Landscape	oastal erosion, changes in deltaic structures, quarries,			
		pollution of rivers			
8	Extreme events	Decline of protection against extreme events (flood, drought,			
		storm surge)			

3.7 Site Selection and Limitations

3.7.1 <u>Introduction</u>

River flows carries sediment from steep slope and high elevation catchment which is naturally erodes sediment from the bed, banks of rivers in steep mountain areas and move toward downstream gradually over time, particularly during high flows and floods. Extensive volumes of sediment can be moved rapidly in extreme high floods and deposited at near flat valley and river meanders on a temporary basis then moved along to another location during the next high flood event. In determining suitable sites for in-stream sand mining extraction the following factors should be considered:

- Select the sites if sand removal reduce the risk of flooding and investigate how much it and sediment deposition continue to increase or will it reach a stable state that will not increase flood risk.
- II. Minimize the sand lease area affected: If possible, extract sand only from the dry deposits (evade working in the low flow channel (see FIGURE 3-1). Do not extract excess sand in anticipation of future floods.
- III. Only remove sand from dry un-vegetated deposits such as gravel bars and islands.
- IV. Sand Removing areas must be away from the river reserve.
- V. Sand mining at the concave side of the river channel should be eschewed to obviate bank erosion. Similarly meandering segment of a river should be culled for mining in such a way as to eschew natural eroding banks and to promote mining on naturally building (aggrading) meander components(EPA Sabah, 2011)
- VI. Sand mining should be avoided at V-shaped and fast flowing river sections with steep channel slopes and high risk river bank erosion sites.





VII. When sand extraction is being carried out, measures should be taken to reduce the peril of fine sediments causing pollution of other sections of the river.

Ideally sand should be extracted from a depositional area as it accumulates, commensurable to the natural rate of sediment movement.

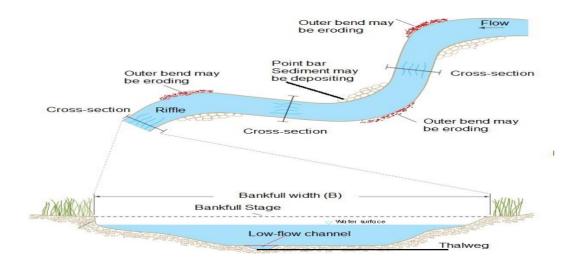


Figure 3-1Typical channel reach and cross section for measurement of channel features (USGS, 2004)

3.8 Sand Mining Recommendations from Civil Structure

Sand volume abstraction should only be considered if there is a peril to infrastructure (outfalls, intakes, bridges) or other sustainable activity (navigation, flood risk management, water supply) because it also plays crucial role to improve country economic activities. If there is no consequential risk to these activities then the requisite for sand abstraction should be reconsidered. There are studying literatures relevant to the sand mining projects following limitation was workout.

- I. Sand and gravel shall not be extracted within 1,000 m from any crucial hydraulic structure such as pumping stations, water intakes, bridges, buildings and such structures (DID, 2009).
- II. The site must be at least 500 m away from the nearest sensitive civil structure such as water intake points, fish breeding areas, irrigation areas and river sections used for navigation, recreational areas or riverine settlement (EPA Sabah, 2011)



the

- III. Mining shall not be undertaken in a mining lease located in 200-500meter of bridge, 200 meter upstream and downstream of water supply /irrigation scheme, 100 meters from the edge of National Highway and railway line, 50 meters from a reservoir, canal or building, 25 meter from the edge of State Highway and 10 meters from the edge of other. For carrying out mining in proximity to any bridge or embankment, appropriate safety zone (not less than 200 meters) should be worked out on case to case basis, taking into account the structural parameters, location aspects and flow rate, and no mining should be carried out in the safety zone so worked out. Mining activities shall not be done for mine lease where mining can cause danger to site of flood protection works, places of cultural, religious, historical, and archeological importance (MEFACC, 2016).
- IV. According assistant director mines and minerals, Pakistan lease (2017), Sanding mining not is undertaken in a mining lease area located in 200 meter of railway line, roods, water reservoir, electricity transmission line, pipe line of Sui gas, historical places and others important civil structure.

3.9 Guideline and Sand Extraction Limitation from Civil structure in Project Area

Tawi River originates from the lap of Kali Kundi glacier and adjoining area southwest of Bhadarwah in Doda district. Its catchment is delineated by latitude 32°35'-33°5'N and longitude 74°35'-75°45'E. The catchment area of the river up to Indian border (Jammu) is 2168 km² and falls in the districts of Jammu, Udhampur and a small part of Doda. Elevation in the catchment varies between 400 and 4000 m.

Tawi River flows through the city of Jammu and considered sacred and holy, as is the case with most rivers in India. River Tawi (referred in ancient literature as Surya Putri) originates near Kaplas Mountains and flows westward between Jug Dhar and TrisulDhar in a westerly direction till Udhampur where it takes a southerly bend across the Sivalik range and again resumes a westerly course passing along the Jammu City till it joins Chenab River in Sialkot District in Pakistan.

The length of Tawi River is about 141 km (88 mi). The river in general flows through steep





hills on either side excepting the lower reach for about 35 km (22 mi). The river is about 300 m (980 ft) wide at the bridge in Jammu city. After transversing Jammu city, the river crosses into Pakistan's Punjab and joins Chenab River. Tawi is a major left bank tributary of river Chenab.

The hilly catchment areas above Marala Barrage are about 32659 Km2. Discharges of the Chenab starts rising in the later part of May and pass the 1416 m³/s mark in June. A high flow above 1416 m³/s continues till the middle of September, the peak discharge months being July and August. Whereas the maximum flood was recorded 6931 m³/s at upstream Marala Barrage and 6715 m³/s at downstream in 15 august 2015. The Chenab flows through the alluvial plains of the Punjab province in Pakistan for a distance of 5467 Km. It is then joined by the Jhelum River at Trimmu. The location map of project study area are shown in **Figure-3.2** below

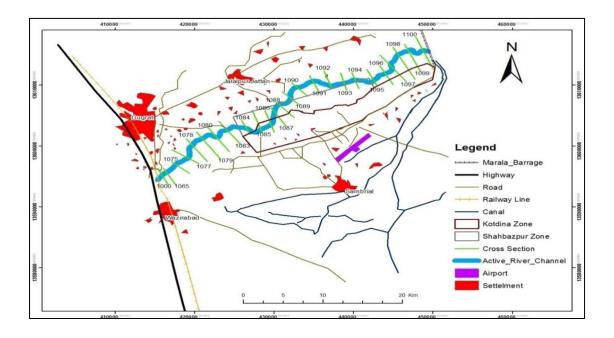


Figure 3-2 Sand mining location area

HEC-RAS steady flow model was used to determination of velocity using different river flow value including maximum flood discharge 6715 m3/s. The computed velocity at 500 m to 1300 m downstream Marala Barrage and 750 m to 1500 m upstream Alexandria Bridge as shows in **Table 3-2** below,

Table 3-2 The computed velocity at 500 m to 1300 m downstream Marala Barrage and 750 m to 1500 m upstream Alexandria Bridge



Downstream Marala Barrage (XS# 1100 & XS 1099)		Upstream Alexandria Bridge (XS# 1000 & XS# 1065)				
Flow (m3/s)	Velocity (m/s)		Fla / 3 /a\	Velocity	Velocity (m/s)	
Flow (m ³ /s)	500 m	1300 m	Flow (m ³ /s)	750 m	1500 m	
6715	1.59	1.25	6715	2.08	3.67	
5000	1.58	1.24	5000	2.06	3.61	
4000	1.52	1.16	4000	1.86	3.2	
3000	1.49	1.11	3000	1.73	2.92	
2000	1.45	1.05	2000	1.57	2.97	
1500	1.32	0.97	1500	1.38	2.5	
1000	1.28	0.9	1000	1.25	2.22	
500	1.15	0.82	500	1.1	1.87	
200	0.83	0.72	200	0.87	1.4	

The velocity at straight river reach is very high to avoid sand extraction or extract sand with proper technique and create meander which slow the velocity that area (see Figure-3-3), because after riffle a straight portion of started and end at again rifle the velocity of these area are shown in **Table 3-3** below

Table 3-3: River Velocity at riffle and straight cross-section

Flow (m3/a)	Velocity (m/s)				
Flow (m ³ /s)	XS 1096	XS 1095	XS 1094	XS 1093	
6715	2.3	2.17	2.05	2.35	
5000	2.2	2.34	2.03	2.33	
4000	2.1	2.22	1.89	2.15	
3000	2.0	2.1	1.8	2.05	
2000	1.9	1.96	1.7	1.91	
1500	1.7	1.79	1.58	1.68	
1000	1.6	1.69	1.5	1.57	
500	1.5	1.57	1.4	1.37	
200	1.3	1.43	1.4	1.2	





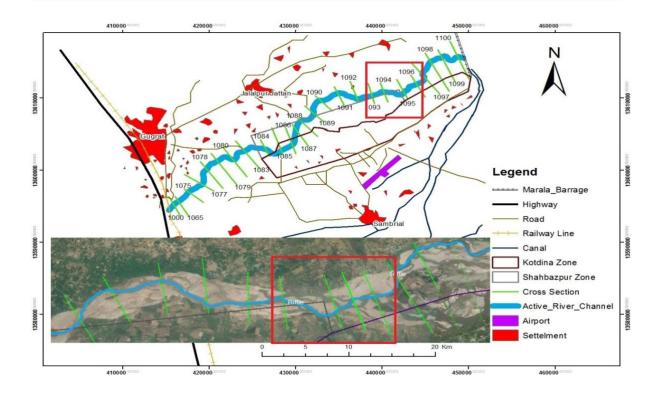


Figure 3-3 Very high velocity reach

The sand extraction in River must be away at least 1500 m from the Marala Barrage, 1000 m to 1500 m away from civil structure such as railway bridge, road bridge and 500 m to 1000 m away from water intake points, fish breeding areas, irrigation areas riverine settlement.

3.10 Setback and Sand Mining in River Bed

Besides, expelling riparian vegetation from the banks of little, intensely shaded streams will have a significantly more prominent effect on stream temperature and amphibian territory all through the watershed than expelling vegetation from larger waterways, where just a small amount of the water is shaded. As opposed to overlooking these streams totally, a tradeoff is making a littler setback. Guidelines issue by Ministry of Environment, Forest and Climate Change India (2016) the maximum depth in-stream mining.

- I. In the case of mining leases for riverbed sand mining, concrete river stretches should be identified and mining sanctions/lease should be granted stretch sagacious, so that the requisite safeguard measures are duly implemented and are efficaciously monitored by the respective Regulatory Ascendant entities.
- II. Mining depth should be restricted to 3 meter and distance from the bank should be 3 meter or 10 percent of the river width whichever less.





III. For carrying out mining in proximity to any bridge and / or embankment, congruous safety zone should be worked out on case to case substratum, taking into account the structural parameters, locational aspects, flow rate etc. and no mining should be carried out in the safety zone so worked out.

Guidelines issue by Sabah State DID the maximum depth in-sin-stream mining

- I. Sabah State DID in its guidelines for river sand mining has mentioned that extraction of sand can only be carried out on 1/3 of the river and the allowable portion of extraction is the middle third of the river.
- II. The depth of extraction from the base of the river is dependent on the width of the river and the amount to be extracted as well as the replenishment rate of the sand.
 Figure 3-4,
- III. illustrates the width of river in relation to its allowable depth of extraction.

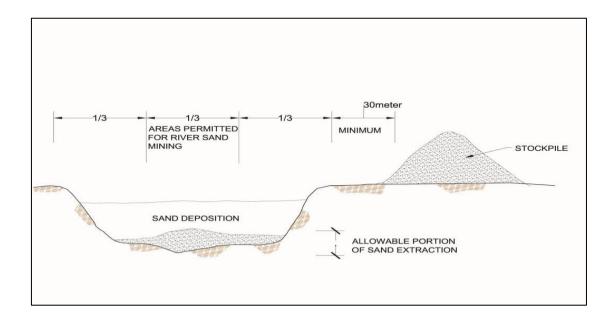


Figure 3-4Setback, Allowable Mining Portion for In-Stream Mining by the State DID, Sabah (EPA Sabah, 2011)

Guidelines issue by (SEPA, 2010) sediment removing in River the based on the following option:



- i. Minimize the area affected: only abstract sediment from less than 50% of the surface area of individual dry deposits. The total length of sediment abstraction should not exceed 30m when quantified along the bank.
- ii. Do not remove sediment more than once every three years within a distance equal to the average river width multiplied by 25 (eg. if average river width is 5m the operation cannot be repeated within a distance of (5 * 25) = 125m).
- iii. Maintain a distance of at least 2m between the wet edge of the low-flow channel and the area of removal.
- iv. Removed sediment should not be used to form bank-top embankments.
- v. Consider reintroducing removed sediment downstream

Determining the sand budget for a particular stream reach requires site-concrete topographic, hydrologic, and hydraulic information. This information is utilized to determine the amount of sand that can be abstracted from the area without causing undue erosion or degradation, either at the site or at a nearby location; upstream or downstream (see Figure 3.5).

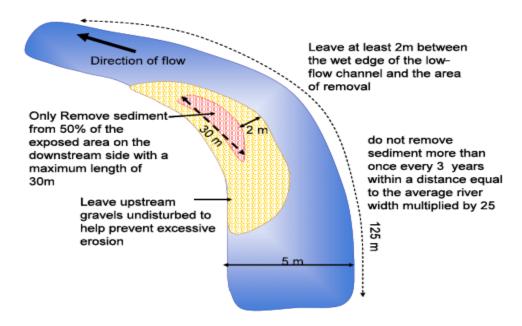


Figure 3-5: Good practice, small scale sediment removal from dry un-vegetated deposits (SEPA, 2010).

Sand is major requirement for construction of road, building, bridge and much other structure and it play crucial role country economic. River bring sediment from steep slope area during high flood and deposited it in or near river and it can be remove these sediment with next coming flood event. The extraction sediment/sand from subsisting pools: do not engender pools where none have subsisted anteriorly. Pools should not be incremented significantly in



size or over-deepened; this could increment the peril of destabilizing the channel leading to incremented erosion. Do not transmute pools in size (width, length, depth) or frequency. **Figure 3-6,** illustrates the Good practice sand/sediment extraction in river pool.

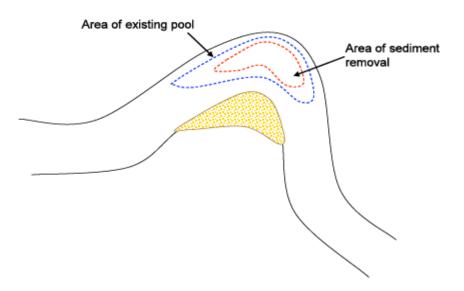
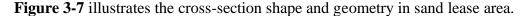


Figure 3-6 Good practice. Do not increase the area of the original pool

The all above guideline of sand extraction is mostly demonstrated for small watershed and based on sediment replenishment. The watershed area of river is large the average width of the active river reach flowing between Marala barrage and Alexandria bridge is varies between 200 m to 300 m and the average width of river at flow rate 5000 m³/s is approximated 2500 m at cross-section 1085.



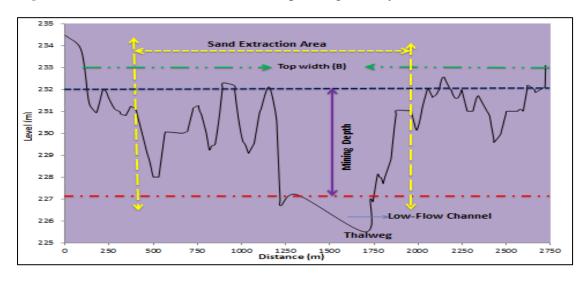


Figure 3-7 Cross-section # 1085 and guideline sand extraction depth, redline low-flow channel divide



If average river width is greater than 1500 meter operation cannot be repeated within a distance of (5 *25)/500 = 2.5 * Average Width (m). The total length of pool in that section is 3.5 km and the area of actual pool 2 Km² and the area of sediment removing is 1.53 Km² (see **Figure 3-8**)

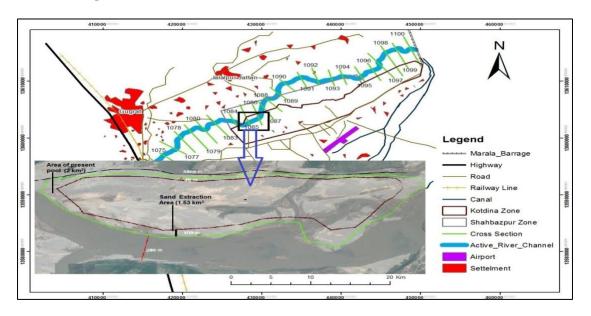


Figure 3-8 Good practice sand extraction in-stream

Setbacks need, for instance, insurance of surface waters from contamination, security of structures from flooding or disintegration, and safeguarding of riparian natural surroundings and shoreline comforts. The sand excavation must be setback for distance 10% total width of cross-section from the both side of main channel bank toward the flow channel. The setback for each cross-section for selected reach of River is given below **Table 3-4.**

Table 3-4 Recommended Setback for River Project Area

XS#	River Width	100 m + Setback
	M	M
1100	-	-
1099	1788.48	178.8
1098	1397.49	139.7
1097	1298.59	129.9
1096	1231.97	123.2
1095	2174.55	217.5
1094	682.74	68.3
1093	961.12	96.1
1092	1667.2	166.7
1091	1779.32	177.9
1090	1107.54	110.8



The

1089	1345.92	134.6
1088	1087.76	108.8
1087	1124.23	112.4
1086	1612.79	161.3
1085	2707.08	270.7
1084	973.5	97.4
1083	1245.29	124.5
1080	1187.46	118.7
1079	1433.73	143.4
1078	1308.58	130.9
1077	1130	113.0
1075	1300.2	130.0
1065	1374.65	137.5
1000	1389	138.9

3.11 Stockpiling and Management Practice

For thousands of years, sand have been utilized in the construction of roads and buildings. Today, demand for sand perpetuates to increment. Mining operators, in conjunction with cognizant resource agencies, must work to ascertain that sand mining is conducted in a responsible manner.

Sand stockpiles must be located more than 30m away from the river bank to avert the sand stockpile from being washed away if the river water level elevates or during hefty rain (DID, 2009).

Sand stockpiles must be located more than 30m away from the river bank to prevent the sand stockpile from being washed away if the river water level rises or during heavy rain (EPA Sabah, 2011); Recommended Stock piles distance for Tawi River Project Area is given in **Table 3-5** below.

Table 3-5 Recommended Stock piles distance for River Project Area

	River	100 m +	a
XS#	Width	Setback	Stock Piles
	M	M	m
1100	-	-	-
1099	1788.48	178.8	208.8
1098	1397.49	139.7	169.7
1097	1298.59	129.9	159.9
1096	1231.97	123.2	153.2
1095	2174.55	217.5	247.5
1094	682.74	68.3	98.3
1093	961.12	96.1	126.1
1092	1667.2	166.7	196.7
1091	1779.32	177.9	207.9
1090	1107.54	110.8	140.8
1089	1345.92	134.6	164.6



Environmental Impact Assessment (EIA) Report 1088 1087.76 108.8 138.8 1087 1124.23 112.4 142.4 1086 1612.79 161.3 191.3 1085 2707.08 270.7 300.7 1084 973.5 97.4 127.4 1083 1245.29 124.5 154.5 1080 1187.46 118.7 148.7 1079 143.4 173.4 1433.73 1078 1308.58 130.9 160.9 1077 1130 143 113 1075 1300.2 160 130 1065 1374.65 137.5 167.5 1000 1389 138.9 168.9

Direct release fine sediments discharge into river has wide-ranging impacts on aquatic biota, both when in suspension and when they are deposited on the river-bed. The effect that a sediment load has on an aquatic community is dependent on few factors, including the biological community and life stage in relation to sediment grain size, concentration, and transport method. But it can be controlled by using proper management tools a basic outline is given below:

River sand mining activities currently result in silt run-off and discharge into the river. This silted run-off water contributes to better total suspended particulates inside the river thereby growing its turbidity. Sand mining operators should be build ponds to contain their wash- out water or proper drainage to channel their run-off. Sedimentation ponds and siltation structures are used to minimize sediment contributions to surface waters but sediment ponds need to not be constructed on pinnacle of natural waterways or streams. Discharge silted water into river with proper drainage design where outfalls of the drainage have to be located with riprap to prevent scouring of river banks.

3.12 Operational Guide Line

According to (DID, 2009) in-stream operation should be limited during low flow season and Sand may be extracted across the entire active channel during the dry season (May to September).

Mining operation in active river channel should be limited during low-flow Season (Feb and October to December). There are river flows during year downstream Marala Barrage was shown in **Figure 3-9**



Environmental Impact Assessment (EIA) Report 3000 2500 ■ Mean Monthly Flow at D/S Marala 2000 Maximum River Flow at Marala 1500 1000 500 0 Oct Dec Feb Mar Apr May Jul Aug Sep Nov Jan Jun Date (month)

Figure 3-9 Monthly River discharge variation at Downstream Marala Barrage

3.13 <u>SEDIMENT TRANSPORT FUNCTION AND METHODOLGY</u>

3.13.1 Sediment Transport in Rivers

The free limit (comprising of mobile material) of an alluvial channel misshapes under the activity of streaming water and the twisted bed with its evolving harshness (bed frames) collaborates with the stream (Nalluri & Featherstone, 2001). The subsequent development of the bed material (residue) toward stream is called silt transport and a basic bed shear pressure must be surpassed to begin the molecule development. Such a basic shear pressure is alluded as early (limit) movement condition, underneath which the particles will be very still and the stream is like that on an unbending limit. Some dregs particles roll or slide along the bed irregularly and some others saltate (jumping or skipping along the bed). The material transported in either of these modes is called 'bed stack'. Better particles (with low fall speeds) are entrained in suspension by the liquid turbulence and transported along the direct in suspension. This method of transport is called 'suspended load'. At times better particles from upland catchment (sizes which are absent in the bed material), called 'wash stack', are likewise transported in suspension. The consolidated bed material and wash stack is called total load. Bed stack ranges from a couple of percent of aggregate load in marsh streams to maybe 15% in Mountain Rivers to more than 60% in some bone-dry catchments. Despite the fact that a moderately little piece of the aggregate dregs stack, the course of action of bed stack silt constitutes the design of sand, and rock bed channels. The rate of residue transport normally increments as a power capacity of stream; that is, a multiplying of stream commonly creates more than a multiplying in dregs transport and most silt transport toward



flood plan and mostly sediment deposed in river meander or where river flat (see figure). The natural effects from in-stream mining can be kept away from, if the yearly bed stack is figured and total extraction is limited to that esteem or some bit of it. As far as possible extraction to some segment of bed stack, the measure of residue that passes the in-stream mining site amid a given timeframe must be computed. The river sediment flow and deposition system was shown **Figure 3-10**.

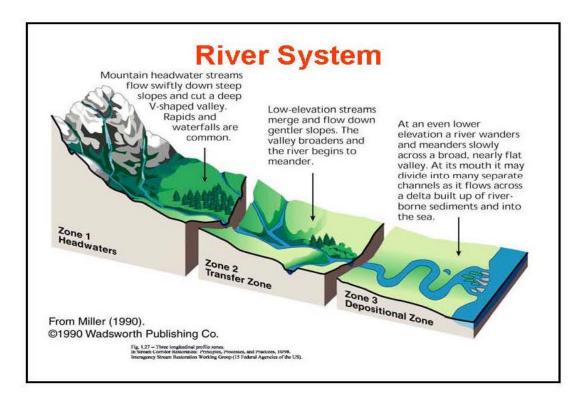


Figure 3-10 The river sediment flow and deposition system

Shield (see *Delft Hydraulics*, 1972) introduced the concept of the dimensionless entrainment function plain part of the river , $F_{rd}{}^2(=\tau_o,cr/\rho g\Delta d)$ as a function of shear Reynolds number, Re^* (= U^*d/v) where is ρ density of the fluid and Δ is the relative density of sediment in the fluid, d the diameter of sediment, g the acceleration due to gravity, U^* is the shear velocity $(\sqrt{-\tau} \ _o/\rho)$ and v the kinematic viscosity of the fluid, and published a curve defining the threshold or incipient motion condition. Initiation of Motion and Suspension for a Current over a Plane Bed was shown in **Figure 3-11**



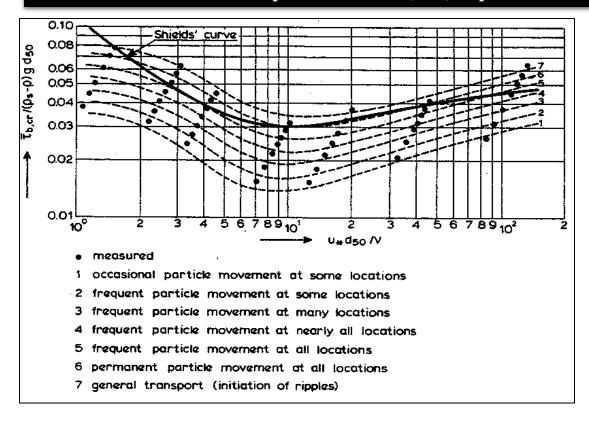


Figure 3-11 Initiation of Motion and Suspension for a Current over a Plane Bed (Delft Hydraulics, 1972)

3.14 <u>Sediment Transport Capacity</u>

The dregs transport limit work in HEC-RAS has the ability of anticipating transport limit with respect to non-firm residue at least one cross areas in view of existing pressure driven parameters and known bed silt properties. It doesn't consider dregs inflow, disintegration, or statement in the calculations. Traditionally, the dregs transport limit is included both bed stack and suspended load, both of which can be represented in the different silt transport indicators accessible in HEC-RAS. Results can be utilized to create silt release rating bends, which help to comprehend and anticipate the fluvial procedures found in characteristic waterways and streams.

3.14.1 Background

Transported sediment is comprised of bed load, suspended load, and wash load. Van Rijn (1993) defines them as:

a. Suspended load

That piece of the aggregate dregs transport which is kept up in suspension by turbulence in the streaming water for impressive timeframes without contact with the



streambed. It moves with basically an indistinguishable speed from that of the streaming water.

b. Bed load:

The residue in relatively persistent contact with the bed, is conveyed forward by rolling, sliding, or bouncing.

c. Wash load

That piece of the suspended load which is made out of molecule sizes littler than those found in considerable amounts in the bed material. It is in close perpetual suspension and, thusly, is transported through the stream without statement. The release of the wash stack through a compass depends just on the rate with which these particles end up plainly accessible in the catchment zone and not on the vehicle limit of the stream. Since wash load volume is absolutely an element of the upstream catchment and not the investigation achieve, it is disregarded in the silt transport calculations. Be that as it may, a molecule measure considered wash stack at one cross area in a scope, may end up plainly suspended load at a downstream segment, and in the end may move toward becoming bed stack. Subsequently, it is imperative to represent the wash stack in a framework wide residue examination. The start of movement of particles in the bed relies upon the water powered attributes in the close bed district. In this manner, stream qualities in that locale are of essential significance. Since deciding the genuine speed at the bed level is troublesome, especially with 1-D show comes about, shear pressure has turned into the more pervasive, however not select, method for deciding the purpose of nascent movement. Shear stress at the bed is represented by the following:

$$\tau_h = \gamma RS$$

Whereas,

 $\tau_h = \text{Bed shear stress}$

 γ = Unit weight ofwater

R = Hydraulic radius

S = Energy Slope

There a few other factors that plays an important role in the initiation and continued suspension of particles is the turbulent fluctuations at the river bed level. A measure of the



turbulent fluctuations near the bed can be represented by the current-related bed shear velocity:

$$\mu = \sqrt{\frac{\tau_b}{\rho}}$$

Or

$$\mu = \sqrt{gRS}$$

Where: μ = Current-related bed shearvelocity

Additionally, the size, shape, roughness characteristics, and fall velocity of the representative particles in the stream have a significant influence on their ability to be set into motion, to remain suspended, and to be transported. The particle size is frequently represented by the median particle diameter (dm). For convenience, the shape is typically represented as a perfect sphere, but sometimes can be accounted for by a shape factor, and the roughness is a function of the particle size.

In general, a typical sediment transport equation for multiple grain size classes can be represented as follows:

$$g_{si} = f(D, V, S, B, d, \rho, \rho_s, sf, d_i, P_iT)$$

Where:

 g_{si} = Sediment transport rate of size class

D = Depth of flow

V = Average channel velocity

S = Energy slope

B = Effective channel width

d = Representative particle diameter

 ρ = Density of water

 ρ_s = Density of sediment particles

sf = Particle shape factor

d_i = Geometric mean diameter of particles in size class i

p_i = Fraction of particle size class i in the bed.



T = Temperature of water

Not all of the transport equations will use all of the above parameters. Typically one or more correction factors (not listed) are used to adapt the basic formulae to transport measurements. Refer to the respective references for more detail.

3.14.2 <u>Sediment Gradation</u>

The user enters gradation information as particle sizes with an associated percentage value that indicates the amount of material within the sediment mixture that is finer by volume (percent finer). HEC-RAS then interpolates logarithmically to determine a representative percent finer for the standard grade class sizes. The standard grade class sizes are based on the American Geophysical Union (AGU) classification scale shown in **Table 3-6**.

Table 3-6 Grain Size Classification of Sediment Material American Geophysical Union

Sediment	Grain Diameter	Geometric Median
Material	Range(mm)	Diameter (mm)
Clay	0.002-0.004	0.003
Very Fine Silt	0.004-0.008	0.006
Fine Silt	0.008-0.016	0.011
Medium Silt	0.016-0.032	0.023
Coarse Silt	0.032-0.0625	0.045
Very Fine Sand	0.0625-0.125	0.088
Fine Sand	0.125-0.250	0.177
Medium Sand	0.250-0.5	0.354
Coarse Sand	0.5-1.0	0.707
Very Coarse Sand	1-2	1.41
Very Fine Gravel	2-4	2.83
Fine Gravel	4-8	5.66
Medium Gravel	8-16	11.3
Coarse Gravel	16-32	22.6
Very Coarse Gravel	32-64	45.3
Small Cobbles	64-128	90.5
Large Cobbles	128-256	181
Small Boulders	256-512	362
Medium Boulders	512-1024	724
Large Boulders	1024-2048	1448

3.15 Sediment Transport Functions in HEC-RAS

Commonly, sediment transport capacities anticipate rates of dregs transport from a given arrangement of consistent state water driven parameters and silt properties. A few capacities figure bed-stack transport, and some register bed-material load, which is the aggregate load



less the wash stack (add up to transport of particles found in the bed). In sand-bed streams with high transport rates, it is basic for the suspended load to be requests of greatness higher than that found in rock bed or cobbled streams. It is along these lines imperative to utilize a vehicle indicator that incorporates suspended dregs for such a case. The following sediment transport functions are available in HEC-RAS:

- i. Ackers-White
- ii. Engelund-Hansen
- iii. Laursen
- iv. Meyer-Peter Müller
- v. Toffaleti
- vi. Yang

These capacities were chosen in view of their legitimacy and aggregate scope of appropriateness. These capacities, with the exception of Meyer-Peter Müller, are analyzed broadly by Yang and Schenggan (1991) over an extensive variety of silt and water powered conditions. Results changed, contingent upon the conditions connected. The Meyer-Peter Müller and the bed-load segment of the Toffaleti work were contrasted and each other by Amin and Murphy (1981). They inferred that Toffaleti bed-stack methodology was adequately precise for their test stream, whereby, Meyer-Peter Müller was not helpful for sand-bed channels at or close beginning movement. The scopes of information parameters utilized as a part of the improvement of each capacity are appeared in **Table 3-7**. Where accessible, these reaches are taken from those exhibited in the SAM bundle client's manual (Waterways Experiment Station, 1998) and depend on the designer's expressed extents when introduced in their unique papers. The reaches accommodated Engelund and Hansen are taken from the database (Guy, et al, 1966) principally utilized as a part of that capacity's improvement. The parameter ranges introduced are not constraining, in that every now and again a silt transport capacity will perform well outside the recorded range. For instance, Engelund-Hansen was produced with flume investigate just, and has been generally connected effectively outside its advancement go. The parameter ranges are exhibited as a rule as it were.

Table 3-7 Range of input values for sediment transport functions (Sam User's Manual, 1998)

Function d d _m	S	V	D	S	W	T
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Ackers-White (flume)	0.04 - 7.0	NA	1.0 - 2.7	0.07 - 7.1	0.01 - 1.4	0.00006 - 0.037	0.23 - 4.0	46 - 89
Englund- Hansen (flume)	NA	0.19 - 0.93	NA	0.65 – 6.34	0.19 – 1.33	0.000055 – 0.019	NA	45 - 93
Laursen (<i>field</i>)	NA	0.08-0.7	NA	0.068 – 7.8	0.67 – 54	0.0000021 - 0.0018	63 – 3640	32 - 93
Laursen (flume)	NA	0.011 – 29	NA	0.7 - 9.4	0.03 - 3.6	0.00025 - 0.025	0.25 – 6.6	46 - 83
Meyer-Peter Muller (flume)	0.4 – 29	NA	1.25 - 4.0	1.2 – 9.4	0.03 – 3.9	0.0004 - 0.02	0.5 – 6.6	NA
Tofaletti (<i>field</i>)	0.062 - 4.0	0.095 – 0.76	NA	0.7 - 7.8	0.07 – 56.7 (R)	0.000002 - 0.0011	63 - 3640	32 – 93
Tofaletti (flume)	0.062 - 4.0	0.45 – 0.91	NA	0.7 - 6.3	0.07 – 1.1 (R)	0.00014 – 0.019	0.8 – 8	40 – 93
Yang (field-sand)	0.15 – 1.7	NA	NA	0.8 - 6.4	0.04 - 50	0.000043 – 0.028	0.44 – 1750	32 – 94
Yang (field-gravel)	2.5 – 7.0	NA	NA	1.4 - 5.1	0.08 – 0.72	0.0012 – 0.029	0.44 – 1750	32 – 94

Where:

d = Overall particle diameter, mm

dm = Median particle diameter, mm

s = Sediment specific gravity

V = Average channel velocity, m/s

D = Channel depth, m

S = Energy gradient

W = Channel width, m

T = Water temperature, °C

(R) = Hydraulic Radius, m

NA = Data not available

3.15.1 Ackers-White Sediment Transport Equation

Ackers and White (1973) is a total load function, developed from flume data for relatively uniform gradations ranging from sand to fine gravels. Ackers and White derived the equation dimensional analysis and did not include a grain shear partition. They fit coefficients to the equation based on experiments that included a range of bed configurations including ripples, dunes, and plane bed conditions. The Ackers-White method is described by the following relationship

$$\omega = \rho \times g \times Q \times X$$





Where g = acceleration due to the gravity; Q = flow in the river; X = dimensionless factor of sediment transport; ρ = water density; ω = sediment stream.

The dimensionless factor of sediment transport results from:

$$X = \frac{S_s \times d_{50}}{H_D} \times (\frac{v_o}{U_*})^n \times G_{gr}$$

Where the following symbols were introduced into the above relationships: S_s = Specific gravity; d_{50} = sediment diameter; U_* = shear velocity.

$$G = \gamma QX$$

$$n = 1 - 0.56\log(D_{gr})$$

$$G_{gr} = C \times (\frac{F_{gr}}{A} - 1)^m$$

$$D_{gr} = d_{50} \times \left[\frac{g(S_s - 1)}{V^2}\right]^{\frac{1}{3}}$$

$$m = \left(\frac{6.83}{D_{ar}}\right) + 1.67$$

$$A = \left[\frac{0.23}{(D_{qr})^{1/2}} \right] + 0.14$$

$$C = 10^{2.79} \times \log(D_{ar}) - 0.98 \lceil \log(D_{ar}) \rceil^2 - 3.46$$

Where; A, C, n, $m = constant values depending on <math>D_{gr}$



$$F_{gr} = \left[\frac{v_o}{\sqrt{g \times d_{50}(S_s - 1)} \times \sqrt{32 \times \log \frac{\alpha H_D}{d_{50}}}}\right] \times \left[\frac{v_*}{v_o} \sqrt{32} \times \log \frac{\alpha H_D}{d_{50}}\right]^n$$

Whereas the following symbols were introduced into the above relationships: D_{gr} = dimensionless grain diameter; H_D = water depth; S_s = sediment grain density to water density ratio; α = constant value (according to Ackers a = 12,3); F_{gr} = mobility function; u_o = mean water velocity

3.15.2 Engelund-Hansen Sediment Transport Equation

Engelund-Hansen (1967) is a total load transport equation, developed from flume data, using relatively uniform sand sizes between 0.19 mm and 0.93 mm. England Hansen is the simplest transport equation, an explicit function of channel velocity, bed shear (not even excess shear), and the d_{50} of the material. Application should be restricted to sand systems. Engelund-Hansen (1967) applied Bagnold's stream power concept and the similarity principle to obtain a sediment transport equation as below.

$$\varphi = \frac{0.1}{f} (\psi)^{2.5}$$

$$f = \frac{2gRxS_o}{V^2}$$

$$\phi = q_s \left[\rho_s \left(\frac{\rho_s - \rho}{\rho}\right) g d^3\right]^{\frac{-1}{2}}$$

Whereas the following symbols were introduced into the above relationships; φ = Sediment transport parameter; q_s = Total sediment discharge by weight per unit width ((kg/s)/m); f = Sediment coefficient; g = Gravitational acceleration (m²/s); R = Hydraulic Radius (m)

$$\psi = \frac{\tau}{\left(\rho_{S} - \rho\right)d}$$

The above equation parameter symbols were introduced as; $\psi = \text{Flow parameter}$; $\rho = \text{Density}$ of water (kg/m³); $\rho_s = \text{Density}$ of sediment (kg/m³); $\tau = \text{Shear stress along the bed (kg/m²)}$

$$q_s = 0.05 \, \rho_{\rm s} \times V^2 [\frac{d_{50}}{g(S_s-1)}]^{\frac{1}{2}} [\frac{\tau}{\left(\rho_{\rm s}-\rho\right) d_{50}}]^{\frac{3}{2}}$$





$$Q_s = Bq_s$$

$$\tau = \rho gRS_o$$

$$C_t = \frac{Q_s}{G_w}$$

$$G_w = \rho BRV$$

$$C_v = \frac{C_t(ppm)}{S_s}$$

Whereas,

 Q_s = Total sediment discharge (kg/s)

V = Flow velocity (m/s)

 $G_w = Water$ discharge by weight (kg/s)

 S_o = Slope of flow

 C_t = Sediment concentration by weight (ppm by weight)

 C_{v} - Sediment concentration by volume (ppm by volume)

3.15.3 Yang Sediment Transport Equation

Yang (1973, 1984) is a total load transport equation which bases transport on Stream Power, the product of velocity and shear stress. The function was developed and tested over a variety of flume and field data. The equation includes two separate relations for sand and gravel transport. Yang tends to be very sensitive to stream velocity, and it is more sensitive to fall velocity than most.

$$\begin{split} logC_t &= 5.435 - \ 0.286 log \frac{W_s d_{50}}{\text{v}} - 0.457 log \frac{U_*}{W_s} \\ &+ \left\{ \left(1.799 - 0.409 log \frac{W_s d_{50}}{\text{v}} - 0.314 log \frac{U_*}{W_s} \right) \times log \left(\frac{VS_o}{W_s} - \frac{V_c S_o}{W_s} \right) \right\} \end{split}$$

Whereas

$$C_v(ppm) = \frac{C_t(ppm)}{S_s}$$

Critical velocity V_c can be considered as following



the

$$\frac{V_c}{W_s} = \frac{2.5}{\log \frac{U_*}{V} - 0.06} + 0.06$$

$$R_e = \frac{U_* d_{50}}{V} \ 1.2 \ to \ 70$$

$$\frac{V_c}{W_s} = 2.05 \quad for \, R_e \geq 70$$

 C_t = Total sand concentration (ppm by weight)

 W_s = Terminal fall velocity (m/s)

 d_{50} = Average particle diameter of granular material (m)

 $v = \text{Kinematic viscosity } (\text{m}^2/\text{s})$

 $U* = Shear \ velocity \ (m/s)$

VS = Unit stream power (m-kg/kg)/s)

 V_cS = Critical unit stream power required at incipient motion ((m-kg/kg)/s)

 C_v = Sediment concentration by volume (ppm by volume)

3.16 Volume Extraction Determination Based on Annual Replenishment

The Acker-White and Engelund-Hansen method was used for calculation of sediment transport and sediment rating curve the result obtained from Acker-White equation considered more reliable for sand volume extraction and replenishment. There are 25 cross-section was prepared for this study using HEC-GeoRAS and Global Mapper 19. The sediment rating curve was developed at cross-section no 1085. Hydraulic characteristic of river cross-section such; hydraulic depth (H_d), cross-section area (A), top width (B), and Wetted Perimeter was estimated with HEC-RAS 5.0.3 using steady and value of manning's (n) is adopted 0.033 on the bases of field investigation and river morphology. The basic characteristics of river cross-section, computed velocity and computed river flow discharge was shows in **Table 3-8** therefore the sediment transport basic parameters and sediment discharge results were shows in **Table 3-9 and Table 3-10**

Table 3-8 The Hydraulic parameter of river cross-section # 1085

Υ	В	Α	Р	R S _o		n	V	Q
(m)	(m)	(m²)	(m)	(m)	(m/m)	ı	(m/s)	(m³/s)
0.84	495.7	405.73	495.79	0.818	0.000241	0.033	0.412	167.2136
1.16	504.29	568.91	504.41	1.128	0.000241	0.033	0.509	289.7542



The

	Environmental Impact Assessment (EIA) Report													
1.44	512.38	711.28	512.38	1.388	0.000241	0.033	0.584	415.481						
1.9	525.56	950.68	525.56	1.809	0.000241	0.033	0.696	661.3341						
2.41	539	1219.97	539.26	2.262	0.000241	0.033	0.806	983.6653						
2.91	567.46	1494.37	567.77	2.632	0.000241	0.033	0.891	1331.5						
3.49	676.19	1863.27	676.59	2.754	0.000241	0.033	0.918	1710.557						
4.18	746.91	2354.83	847.43	2.779	0.000241	0.033	0.924	2174.698						
4.46	831.31	2575.38	921.88	2.794	0.000241	0.033	0.927	2386.745						
5.15	1142.59	3226.63	1143.35	2.822	0.000241	0.033	0.933	3010.37						
5.58	1276.6	3754.25	1277.5	2.939	0.000241	0.033	0.958	3597.534						
6.26	1920.01	4773.34	1991.08	2.397	0.000241	0.033	0.838	3998.906						
6.49	2022.24	5242.08	2023.36	2.591	0.000241	0.033	0.882	4622.345						
6.73	2230.13	5739.73	2184.76	2.627	0.000241	0.033	0.890	5107.965						
6.94	2400.2	6232.11	2333.53	2.671	0.000241	0.033	0.900	5606.606						
7.14	2590.29	6739.07	2507.77	2.687	0.000241	0.033	0.903	6087.523						
8.33	2639.17	7153.74	2556.67	2.798	0.000241	0.033	0.928	6636.733						

Table 3-9 Sediment transport parameter and sediment discharge computed by Acker-White Equation

Y	Т	γ	g	u	Ss	d _{gr}	d ₅₀	u*	Fgr	θ	d _{Adjust}	HF _{ratio}	Α	Ggr	Х		G _s
(m)	°C	I£N/m³	(m/s ²)	(m ² /s)			(mm)	(m/s)								(m ³ /s)	Tons/day
0.84	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	4.61	0.17	1.10	0.0018	2.2222	0.1633	0.0152	0.0001868	0.604	50318.6
1.16	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	5.41	0.20	1.11	0.0018	2.2222	0.1633	0.0197	0.0001759	0.985	82080.6
1.44	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	6.00	0.23	1.12	0.0018	2.2222	0.1633	0.0213	0.0001532	1.230	102536.1
1.9	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	6.85	0.26	1.13	0.0018	2.2222	0.1633	0.0230	0.0001249	1.597	133073.9
2.41	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	7.66	0.30	1.14	0.0018	2.2222	0.1633	0.0241	0.0001035	1.967	163957.6
2.91	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.27	0.32	1.14	0.0018	2.2222	0.1633	0.0248	0.0000882	2.269	189110.4
3.49	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.46	0.32	1.14	0.0018	2.2222	0.1633	0.0249	0.0000738	2.439	203252.3
4.18	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	9.05	0.35	1.15	0.0018	2.2222	0.1633	0.0255	0.0000630	2.878	239840.1
4.46	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.97	0.34	1.15	0.0018	2.2222	0.1633	0.0253	0.0000587	2.900	241698.6
5.15	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.56	0.31	1.15	0.0018	2.2222	0.1633	0.0247	0.0000495	2.983	248572.3
5.58	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.74	0.32	1.15	0.0018	2.2222	0.1633	0.0248	0.0000460	3.500	291675.6
6.26	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.03	0.28	1.14	0.0018	2.2222	0.1633	0.0237	0.0000392	3.602	300152.8
6.49	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.20	0.29	1.14	0.0018	2.2222	0.1633	0.0240	0.0000382	3.710	309129.4
6.73	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.26	0.29	1.14	0.0018	2.2222	0.1633	0.0240	0.0000369	3.841	320091.6
6.94	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.33	0.29	1.14	0.0018	2.2222	0.1633	0.0241	0.0000359	3.987	332255.8
7.14	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.35	0.29	1.14	0.0018	2.2222	0.1633	0.0241	0.0000349	4.404	367011.0
8.33	20	9.78	9.80	1.0023E-06	2.65	97.48	0.0039	8.52	0.30	1.14	0.0018	2.2222	0.1633	0.0242	0.0000300	4.351	362610.3

Table 3-10 Sediment transport parameter and sediment discharge computed by Engelund-Hansen Equation

Υ	d ₅₀	τ	(τ) ^{2/3}	qs	Q _s	Gw	C _T	C _v		Q _{st}
(m)	(mm)	(N/m^2)	(N/m ²)	(kg/s)/m	N/s	kg/s	(ppm)	(ppm)	(m³/s)	Tons/day
0.84	0.0039	1.9486	1.5604	0.224	110.91	167183	0.000663	0.00025	0.042	3488.26
1.16	0.0039	2.6856	1.9327	0.553	278.81	289685	0.000962	0.000363	0.105	8769.59
1.44	0.0039	3.3054	2.2198	0.993	508.80	415481	0.001225	0.000462	0.192	15999.98
1.9	0.0039	4.3071	2.6485	2.095	1100.97	661334	0.001665	0.000628	0.415	34621.58
2.41	0.0039	5.3867	3.0746	3.936	2121.64	983191	0.002158	0.000814	0.801	66750.50
2.91	0.0039	6.2670	3.4013	6.032	3422.87	1330773	0.002572	0.000971	1.292	107696.29
3.49	0.0039	6.5573	3.5055	6.853	4634.24	1709546	0.002711	0.001023	1.750	145816.89
4.18	0.0039	6.6165	3.5266	7.029	5250.39	1916741	0.002739	0.001034	2.248	187326.67
4.46	0.0039	6.6518	3.5392	7.136	5932.03	2152260	0.002756	0.00104	2.482	206865.36
5.15	0.0039	6.7196	3.5632	7.343	8389.72	3008369	0.002789	0.001052	3.168	264003.18
5.58	0.0039	6.9974	3.6608	8.231	10508.05	3594999	0.002923	0.001103	3.968	330674.86
6.26	0.0039	5.7083	3.1959	4.636	8900.25	3856168	0.002308	0.001103	4.411	367567.81
6.49	0.0039	6.1689	3.3656	5.769	11666.93	4619786	0.002525	0.001103	4.998	416539.20
6.73	0.0039	6.2555	3.3971	6.001	13382.44	5214040	0.002567	0.001103	5.934	494509.36





6.94	0.0039	6.3591	3.4345	6.285	15085.87	5766789	0.002616	0.001103	6.784	565342.94
7.14	0.0039	6.3986	3.4487	6.396	16567.57	6287838	0.002635	0.001203	7.823	651943.52
8.33	0.0039	6.6624	3.5429	7.168	18917.25	6850890	0.002761	0.001203	8.294	691168.65

A sediment rating curve relates the suspended sediment concentration in a river with flow Discharge. The sediment rating curve for this study was developed with two well-known methods such as Acker-White and England-Hansen. The hydraulic parameter of site was estimated with river analysis model. The rating curves computed by both methods were shoes in **Figure 3-12** and **Figure 3-13**.

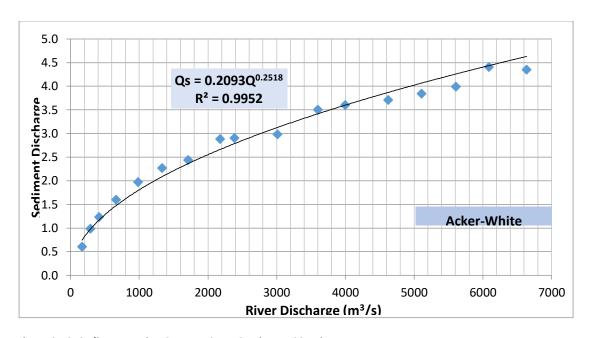


Figure 3-12: Sediment Rating Curve at Cross-Section # 1085 River

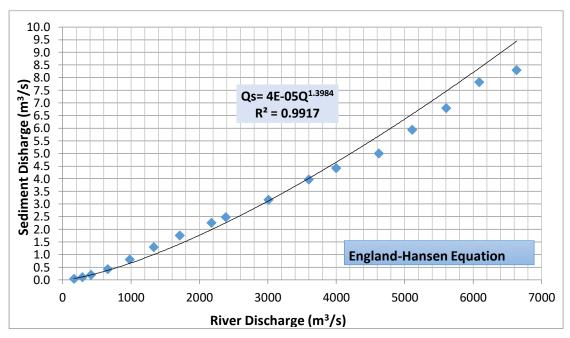




Figure 3-13 Sediment Rating Curve at Cross-Section # 1085 River

In a plot between, discharge and sediment concentration there is not large scatter in points. One reason behind this scatter is that soil erosion rates in a watershed are not the same during different seasons of the days, month or year. If the scatter is large, it might be necessary to develop separate rating curves for different seasons or according to stream flow generation mechanisms, such as rainfall, snowmelt, etc. A sediment rating curve is mainly applied to obtain the value of sediment concentration for a given discharge. Along with the flow duration curve at a given location, the sediment rating curve can also be used to estimate the amount of sediment transport over a period of time. Another important use of sediment rating curve is in estimation of the effect of land use changes at river boundary and watershed management on sediment yield. The equation developed by Acker-White method can be used for sediment discharge computation of different river flow discharge.

$$Q_s = 0.2093*Q^{0.2518}$$

Whereas the above parameter can be described as Q_s , sediment discharge (m³/s) and Q river flow discharge (m³/s).

3.17 Extraction Volume Computation Techniques

The average river flow at downstream Marala barrage in month July is estimated 1060.3 m3/s

$$Q_s\!=0.6043*Q^{0.2518}$$

$$Q_s = 0.2093*(1060.3)^{0.2518}$$

$$Q_s = 1.209 \text{ m}^3/\text{s}$$

Total replenishment volume = Q_s * Flow period*area

Total replenishment volume = 1.209 * 31*24*1530000

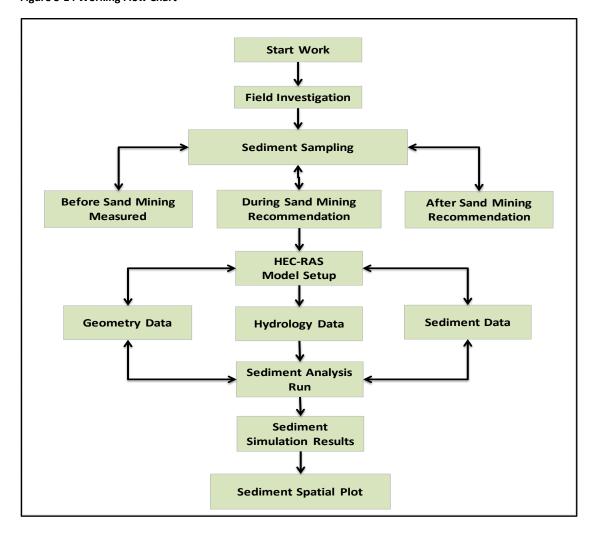


Total replenishment volume = 1376228880m³

The sand extraction and replenishment analysis was performed on cross-section # 1085 it is clear rate of replenishment volume greater than volume extraction.

For the evaluation of in-stream volume extraction and replenishment a 1-D/2-D Quasi-Unsteady Flow and sediment model was built for this study area using the Hydraulic Engineering Center – River Analysis System (HEC-RAS) Version 5.0.3. The current HEC-RAS is capable of performing steady and unsteady flow water surface profile calculations, and sediment modeling.

Figure 3-14 Working Flow Chart





3.18 Model Input Data

3.18.1 Geometry Data

Information needs to be input by the user regarding the geometry of the study site, the hydrology data being used, and the sediment data for the site. For HEC-RAS, the geometry file requires a river path with cross sections along it. For this project, the cross-sections with 100 meter intervals were created using the HEC-GeoRAS model embedded in ArcGIS 10.3 and the 30 m resolution using shuttle radar topography mission (SRTM). Digital elevation Model data from 2005, obtained from the earth explorer. Shape files were created in ArcGIS from using shuttle radar topography mission (SRTM) data with a resolution of 30 m. Cross-sections were cut from these shape files, and oriented along a stream pathway(see **Figure 3-15**).

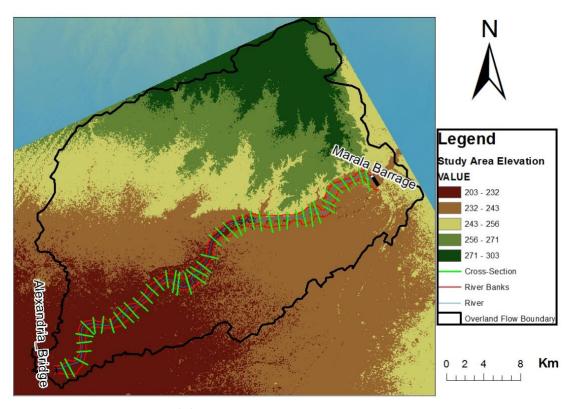


Figure 3-15 River Cross-Section and Elevation Map

Bank stations at each cross-section were set at the elevations of bank full flow, at which the river would be full of water to the bank height. Areas of the cross-section outside the bank stations were defined as the floodplains. HEC-GeoRAS allows creating the geometry files in it, and then be exported to HEC-RAS. After being exported, the geometry file can be opened in HEC-RAS with the flow paths, cross-section locations and elevations, and bank stations.



The

Colored images from Google Earth were used to classify the land uses, and then theses classes are used for the estimation of Manning's n values, which were needed by HEC-RAS for performing hydraulic computations in model. The Manning's roughness values within cross-sections are allowed to be varied, so the roughness was set as 0.033 for the main channel nearly free of vegetation, and 0.04 for the channel floodplain with shrubs.

3.18.2 Schematic River System

The schematic river system defined in the HEC-RAS show the simplified plan view and locations of the cross section data from upstream to downstream of the study site. The setting up of the model was carried out by considering 49 km river length as shown in **Figure 3-16** with 25 cross-sections. The study site is situated at section number 1100 to at section number 1083, respectively. In river system schematic, river was drawn in geometric data editor option of HEC-RAS. In this the name for river reach was specified.

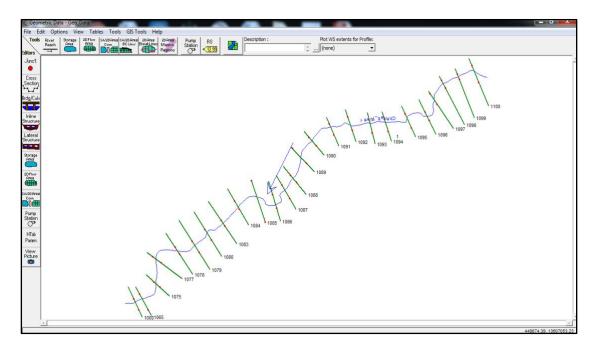


Figure 3-16 The Schematic River System Defined in the HEC-RAS

3.18.3 Cross Sections

Boundary geometry for the analysis of flow in river was specified in terms of ground surface profiles (cross sections) and the measured distance between these (reach lengths at each cross-section). The cross sectional data of river was imported in HEC-RAS by the GIS format file. Cross sections from upstream and downstream were plotted. Downstream reach lengths (i.e., the distance up to next downstream cross section.) for main channel, left over bank and right over bank and Manning's Roughness Coefficient (both vertical and horizontal variation



The

of n- values were considered). The detailed information about the locations of cross sections is shown in **Figure 3-17**.

3.19 Hydrologic Data

The upstream flow boundary condition used for this study was an input hydrograph. As the HECRAS sediment model requires the use of quasi-unsteady flow, the hydrograph is converted into a series of intervals consisting of a steady flow for each time step. Each time step was 1-day long for this project. As mentioned earlier, the gauge data available for this reach over the desired time period was at the upstream & downstream of Marala Barrage. As this Barrage is located in the upstream end of the channel, a different year hydrograph was collected for the upstream boundary condition, in such a way that the model was run four time with this simulated hydrograph at Marala Barrage downstream **Figure3 18, 3-19, 3-20** & **3-21**shows the quasi-unsteady input hydrographs for sediment volume simulation for sand Block River Tawi 1.

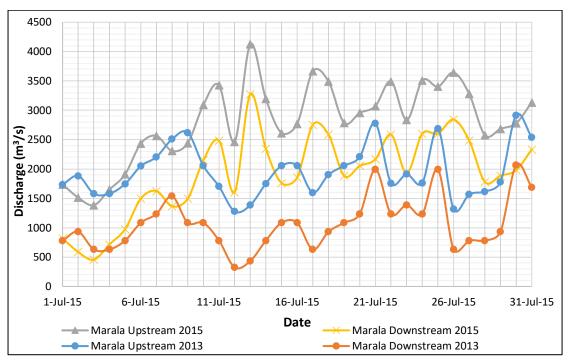


Figure 3-17 Historical Flood Hydrograph at Marala Barrage (July, 2013 & 2015)



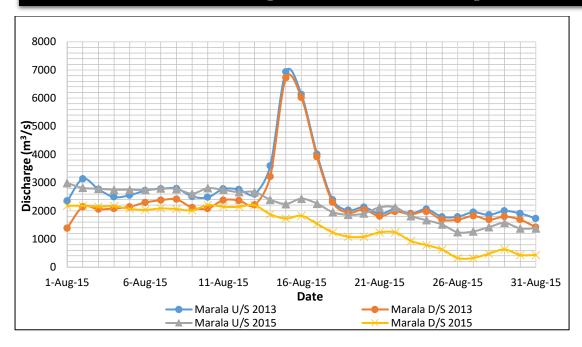


Figure 3-18 Historical Flood Hydrograph at Marala Barrage (August, 2013 & 2015)

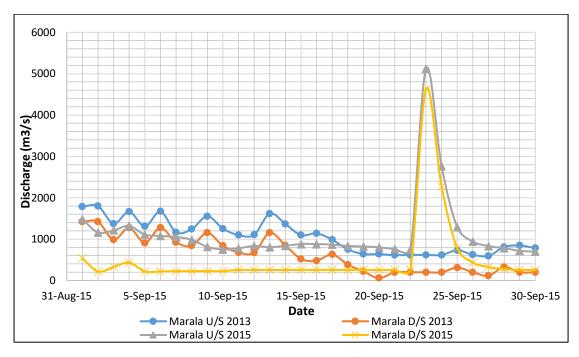


Figure 3-19 Historical Flood Hydrograph at Marala Barrage (October, 2015)

The actual duration of the flood event was about varies with month and year, however, for this project, monthly long periods flow series were used as boundary condition, to both speed up the modeling process and increase model stability. The downstream boundary condition of the flow data used here was at a normal depth, which requires an input of the channel slope and calculates the flow values based on Manning's equation. The slope of the channel was approximated at 0.000241 m/m based on a profile plot of the measured bed elevations along the channel. As there is no gauge at the river reach the hydrograph at the Sand Block No.



River Tawi 1 zone was created using indirect area ration method based on the hydrograph observed in the just downstream Marala Barrage gauge. Indirect area ratio method used for hydrograph calculation at Sand Block No. River Tawi 1 zone cross-section# 1085 is given below;

$$Q_{1085} = Q_{MB} \frac{A_{1085}}{A_{MB}}$$

Where as

 Q_{1085} = computed hydrograph at XS# 1085 (m³/s)

Q_{MB} = Measured Hydrograph at Marala Barrage (m³/s)

 A_{1085} = River Catchment Area at XS# 1085 (Km²)

 $A_{MB} = River Catchment Area at Marala Barrage (Km²)$

3.19.1 <u>Sediment Rating Curve Determination</u>

To appropriately portray the sediment in the model, we are required to enter bed gradation, transport parameters, and limit conditions also. The transport capacities, arranging techniques and fall speed conditions are clarified in Section 3.15. **Figure 3-20** demonstrates the sediment Information input window. For each scope in a model, the cross areas are exhibited alongside the modify height of the most minimal point in each cross segment. This area likewise permits contributions for portable cross segment limits which you can control by a greatest profundity or a base rise and additionally influencing limits for the left or appropriate to bank. For the Tawi River case there were not broad investigations performed on profundity to bedrock so a vast scope of profundities were utilized to examine scour and in addition different streambed widths. After setting the allowable scour area, a bed gradation can be inserted based on percent finer or by grain class fraction by weight. Bed gradations are input into HEC-RAS based on 20 predefined grain sizes. For the River, soil samples were taken at 1085 cross sections. Each of the cross sections had nearly identical distributions and the gradation was input as shown in **Figure 3-21**.



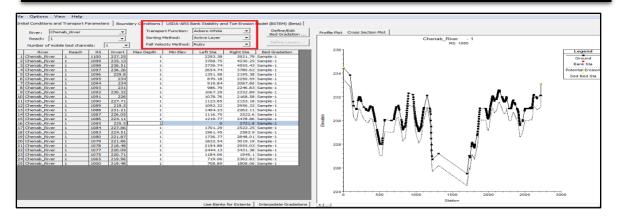


Figure 3-20 Acker-White Equations and Equivalent Load were used River

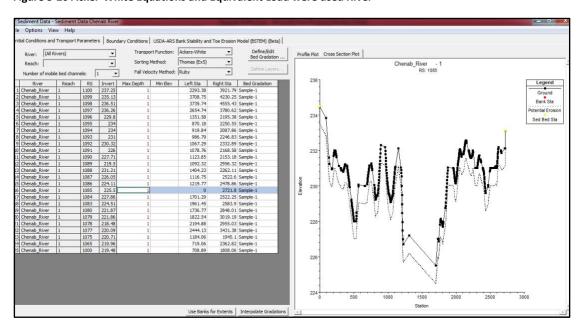


Figure 3-21 Sediment Data Initial Conditions and Transport Parameters

3.19.2 Cross-section and Manning Roughness

Cross section data represent the geometric boundary of the stream. Cross sections are located at relatively short intervals along the stream to characterize the flow carrying capacity of the stream and its adjacent floodplain. Cross sections are required at representative locations throughout the stream and at locations where changes occur in discharge, slope, shape, roughness, at locations where levees begin and end, and at hydraulic structures. Manning's n of 0.033 was used for the stream and 0.04 for the floodplain in River HEC-RAS as shown in







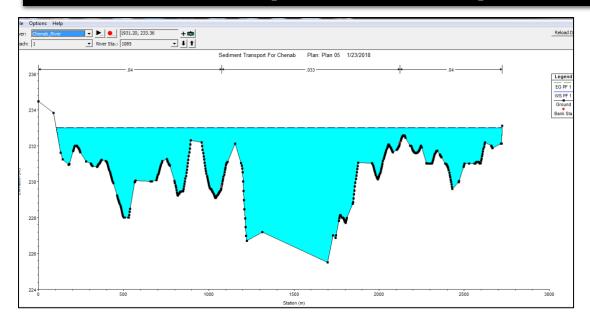


Figure 3-22 Cross-sections and Manning Coefficient

In Quasi unsteady flow editor upstream boundary condition was selected flow series and flow discharge measured at Marala in 2015 was adopted and downstream boundary condition is stage series to simulation sediment deposition in river or river invert level. The level of river existing bed and due to sediment deposition was shown **Figure 3-23** below.

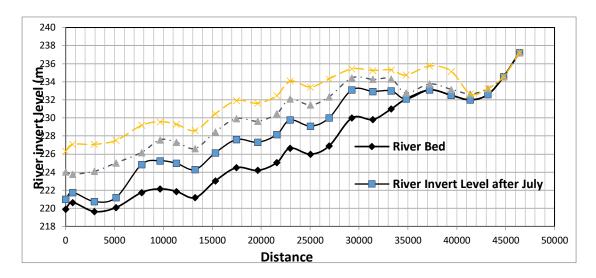


Figure 3-23 River invert level due to sediment deposition in different month





3.20 RIVER DISCHARGE CAPACITY AND MANAGEMENT OPTION

3.21 Flood Risk and Management

General Rivers encompass channel, bank and overbank or floodplain deposits and are accountable for transporting sediment from upstream, overflow land to lowland and the oceans. The quantity of abrasion, transport and deposition of sediment inside a river is determined by means of the interplay among stream glide and channel slope ('movement power'). Stream power/velocity varies from supply to outlet however is generally maximum in the center sections of the river in which tributaries converge and the channel gradient is better (SEPA, 2015).

Tawi is a major left bank tributary of River Chenab. Floods in river end result from heavy rainfall inside the upper drainage basin and excessive deposition of sediment in lowland is a particular problem for flood, whereas snowmelt contributions are on the average forty% of the whole waft in July, while the height softens fees are attained. For this reason, it synchronizes with the early monsoon in July, however not with the height values going on in August and September at some stage in the monsoon; the tributaries flowing into the River can aggravate the floods. The historical intense events in reach at Marala Barrage and Khanki Barrage was shown **Figure-3-24** which is within the study area have serious flood impacts on city or town downstream at Marala Barrage such as Wazirabad, Gujarat and Sialkot it caused losses of life, agriculture crops and urban and rural infrastructure damages.

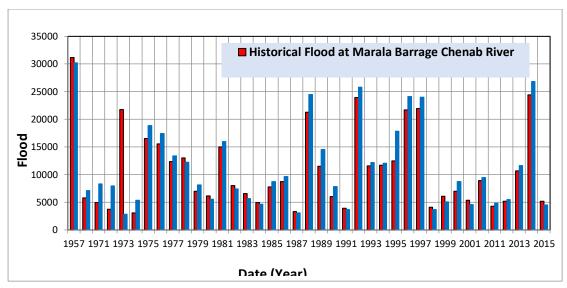


Figure 3-24: Historical Flood Event at Marala Barrage

The design discharge capacity of Marala Barrage is 31144m³/s and the design discharge capacity Khanki Barrage is 24066m³/s. From Figure 24 is cleared most of the flood event



was higher to design discharge capacity of Khanki. These flood value showing that more excessive deposition of sediment is a in that area is particular problem for flood risk management and it reduces the capacity of the river to transport river flow rapidly and may cause river bank overtopping and flooding. Flood risk may also be increased in areas of due to overland high erosion where banks are retreating towards receptors such as property. River restoration increases natural storage capacity and reduces flood risk. Excess water is stored in a timely and natural manner in areas where values such as attractive landscape and biodiversity are improved and opportunities for recreation can be enhanced.

The most common reason for carrying out works to rivers is to increase their capacity to carry flood flows. There are a number of ways that to increase flood carrying capacity in that part of reach, but the two commonest are channel maintained and enlarging the channel cross section (typically by widening or deepening.

3.22 How to increase river (channel) capacity

The most common reason for carrying out works to rivers is to increase their capacity to carry flood flows. There are a number of ways that to increase flood carrying capacity in that part of reach, but the two commonest are channel maintained and enlarging the channel cross section (typically by widening or deepening. There are a few outline also given below

- Considering river channel together with inundation(s) (flood plain) as one water body"(diking, pondering in open landscape environment.
- Necessity to dredging bottom in narrow profiles?
- River restoration increases natural storage capacity and reduces flood risk.
- Restoring meanders to rivers that have been straightened not only restores river
 habitat degraded by past flood management projects, but also increases the in stream
 storage capacity and slows the downstream propagation of the flood peak, thereby
 decreasing downstream flood risk and the need for flood management dams.



3.23 Discharge Flow Capacity Management Method

The intense flood event between Marala Barrage and Khanki Barrage was causing serious damages at reach area. Both barrages have very important role to development of country economic. There are many techniques how control the high flood in this reaches. The main objective is usually the maintenance of channel capacity to ensure it is adequate for flood conveyance. In the past, rivers were left much sediment deposited. This led to the need for a regular programme of sediment to maintain the depth of the reach, and this is still an important activity on some other rivers, especially in the vicinity of lock structures. The discharge of each river cross-section carryout by using HEC-RAS based on manning equation. The most familiar Manning equation which was introduced by Engineer Robert Manning in 1889 M can be used to estimate the river inflow capacity using basic hydraulic characteristic of selected cross-section. It is a useful way of obtaining a rough idea of flow capacity and of checking the impact of maintenance works. Manning equation was used in many researches and project would be written as:

$$v = \frac{1.486}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

And

$$Q = AV$$

For design of composite drain roughness coefficient was calculated by using following expression:

$$n_W = \frac{P_1 n_{1+} P_2 n_{2+\cdots+} P_m n_m}{P}$$

Where:

v = Flow velocity (m/s)

 $Q = discharge in m^3/s$

n = Roughness coefficient (dimensionless)

R = Hydraulic Radius (m) (A/P)

S = Slope of drains gradient

A = area of cross section of flow (m²)

 n_w = Weighted coefficient of roughness for the drains

P₁, P₂, & P_m = Wetted perimeter in meter for each side of roughness



 n_1 , n_2 , & n_m = Roughness coefficients corresponding to each wetted perimeter P = the total wetted perimeter, in meter, for the River.

The flood conveyance capacity of River was computed using normal and high flood measured at Marala Barrage downstream as shown below **Figure 3-25 to 3-30.**

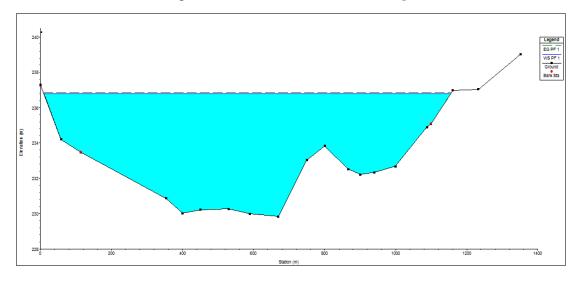


Figure 3-25 5000 m3/s Flow discharge conveyance capacity of River (XS 1092)

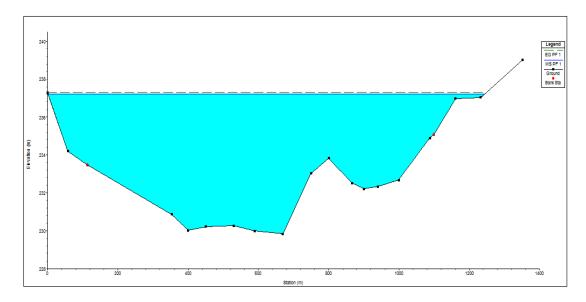


Figure 3-26 Figure 25: 6000 m3/s Flow discharge conveyance capacity of River(XS 1095)





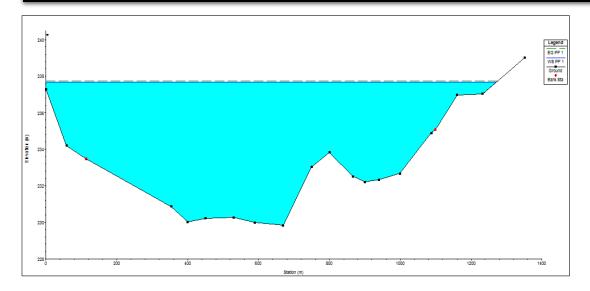


Figure 3-27 7000 m3/s Flow discharge conveyance capacity of River (XS 1095)

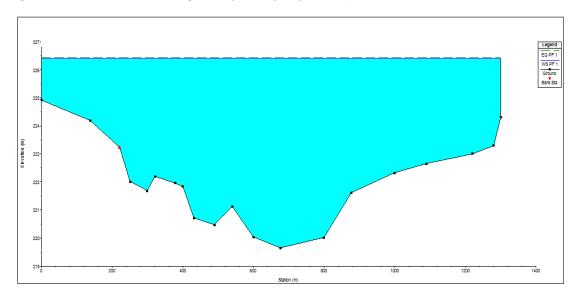


Figure 3-28 5000 m3/s Flow discharge conveyance capacity of River (XS 1075)





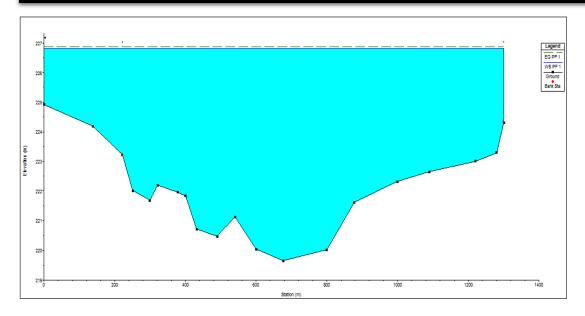


Figure 3-29 6000 m3/s Flow discharge conveyance capacity of River (XS 1075)

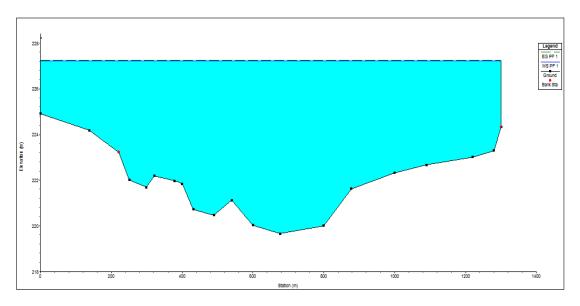


Figure 3-30 7000 m3/s Flow discharge conveyance capacity of River (XS 1075)

There are many cross-section computed at project area do not have enough capacity to pass the normal flood (7000 m³/s0 see Figure 24 historical flood event at river much higher and cause dangerous flood in that part of river. The removing sand with proper method in River can increased the river capacity of carrying flood discharge and it will reduced the flood impacts in this part of river reach. Restoration of straightened channel to meander also reduced the flow velocity. During low flow season removing sand should be away 20-30 m low flow active channel. Setback also supports the river flow discharge capacity in low active channel and protects river banks. Vegetation on both sides of river banks will also increase the flow discharge carrying capacity of river and protects the bank erosion.





3.24 <u>RIPARIAN BUFFERS</u>

3.24.1 Functions of Riparian Buffers

Riparian buffers are very important component of watersheds, primarily due to their protection of banks erosion, surface flow velocity and ground water quality from impacts related to human activities and change of surrounding land use due to rapid development. These vegetated buffers on river bank are complex ecosystems that provide food and habitat for unique plant and animal species, and are essential to the mitigation water quality, soil erosion and runoff in the stream. The vegetation reduction of streamside for development and production purposes degraded water resources quality and soil stability. Sedimentation increases turbidity and contributes to rapid siltation of water bodies, negatively impacting water quality. Increased sediment loads also narrow channel widths and provide substrate for colonization of invasive aquatic plant species. Intact riparian buffers ameliorate these negative impacts by stabilizing stream banks. Roots of riparian vegetation deflect wave action and hold bank soil together. The buffer vegetation also decreases erosional impacts during flood events and prevents undercutting of stream banks. There are many different types of pollutant especially originating from pesticides, herbicides, excess nitrogen, phosphorus and waste of human and animals often directly or indirectly bond to soil particles. The sediment load with full of pollutant move with surface runoff into nearest stream and is deposited. This process is the initial cause of accelerated eutrophication of ponds, reservoirs, lakes and rivers (Hawes & Smith, 2005; Jontos, 2004). The forest, grass, shrub and other vegetation in both sides of stream function as protect the banks, filter the soil and sinks for harmful nutrients and pollutants (Welsch, 1991). The buffer plants slow river runoff velocity, sediment-laden which depends upon riparian buffer width and many types of vegetation complexity absorb 50 to 100% of sediments as well as the nutrients and pollutants attached to them. The buffer vegetation are captured phosphorous approximately 80 to 85% from surface water runoff (Connecticut River Joint Commission, 2005). Probably Vegetated buffers are working as safe screens along waterways, protecting the privacy of riverfront landowners and blocking views of any unsightly development. Hiking and camping opportunities are also facilitated by forested buffers, which if large enough, allow outdoor enthusiasts to enjoy the proximity of the water. The diversity of plant species provides visual interest and increases aesthetic appeal. Riparian buffer's one of the most important functions of is increased surface runoff infiltration. Riparian vegetation in the buffer slows overland flows of water body due to high surface roughness (see Figure 3-31. The slow reduced surface runoff movement so



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that water is more easily absorbed and allows for groundwater recharge. These slower flows also regulate the volume of water entering rivers and streams, thereby minimizing flood hazard and scouring of the streambed. Many plant and creature species rely upon the unmistakable living space of riparian buffer, which incorporate components of both earthbound and oceanic biological communities. Forested cushions enhance living space quality by giving shade that cools water temperatures, in this way hoisting the broke down oxygen content that is essential for some types of fish and amphibian creepy crawlies. Woody flotsam and jetsam from bushes and trees inside the vegetated support give nourishment and cover to a large number of amphibian species. In the event that sufficiently huge, riparian buffer additionally give halls basic to earthly untamed life development (Hawes & Smith, 2005).

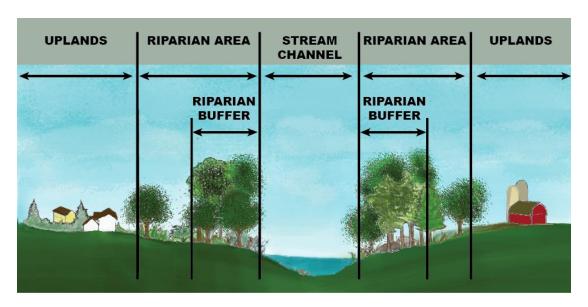


Figure 3-31 Riparain Buffer Area and Land Use USEPA 2012

3.25 Factors influencing buffer width

There are many factors that influence the effectiveness buffers. These include steep and moderate slope, high rainfall intensity, and the amount of water can be absorbed into the soil, type of vegetation in the buffer, the amount of impervious surfaces, and other characteristics specific to the site. The description of few factors given below:

i. Climate

The wide effect of climate on riparian capacities may expect climate to be considered while organizing administration goals where predominant stream ways impact reclamation



endeavors. Maybe for instance, where precipitation in agricultural catchments (with significant N and P sends out) is sufficiently high to bring about regular overland streams, riparian zones ought to be expanded to take into consideration effective silt catching. The scene setting and overwhelming administration objective on location will figure out what modifications for climate will be required. In wet (mesic) situations, where precipitation is more prominent, the overwhelming stream ways are subsurface: overland stream is less normal the dominant flow paths are subsurface: overland flow is less common (Rassam, Fellows, De Hayr, Hunter,, & Bloesch, 2006). Groundwater is shallower therefore riparian and upland zones availability around water regime is more regular. It is possible that water use by riparian vegetation might be dominatingly interference of precipitation and invading surface water, as opposed to by getting to further groundwater (as may be normal in drier atmospheres where water accessibility is less dependable(Naiman, Decamps, , & Mcclain, 2005)

ii. Slope and Topography

The topography (particularly slant) and seepage territory impacts the hydrologic stacking of the catchment, and in this way, the conveyance of dregs to the riparian zone by means of groundwater, subsurface and surface stream ways (Bren, 2000; Vidon & Hill, 2004b). As slope expands the speed at which water streams is over and through the buffer increases. Along these steeper land within the buffer, the more extreme the land inside the buffer, the more extensive it should be to have sufficient energy to moderate the stream of water and retain the contaminations and residue inside it. Numerous specialists propose that particularly steep slope serve little an incentive as a cradle, and prescribe barring zones of steep slope while figuring buffer width. The meaning of "steep" differs from more than 10% to more than 40% slope. (Wenger, 1999).

iii. Soil type

The type of soil influences how rapidly water can be consumed. Soils that are high in clay are less porous and may have more prominent spillover. Then again, soils that are to a great extent comprised of sand may deplete water so quickly into the groundwater that roots are not ready to viably trap contaminations. Besides, soils that are moister and more acidic have a superior ability to take up nitrogen from the soil and discharge it to the atmosphere through denitrification. The extent to which soil type and permeability is used to modify riparian zone



widths will depend on restoration goals. If the goal is to improve water quality, and soils contain predominantly sand, riparian zones will need to be very wide to ensure adsorption of excess (Mckergow, Weaver, Prosser, Grayson, & Reed, 2003).

vi. Flow and disturbance regimes

Flow and disturbance regimes control the pattern of stream evolution and floral community created structure and composition in riparian area (Naiman and Décamps, 1997). The continual geomorphic change of rivers channel and the water flow regime because of hydrological processes causes aggradation and degradation and shaping stream geometry. By the mobilization sediment deposition and transport into downstream stream and meander rivers. (Naiman and Décamps, 1997). These In addition to base flow discharge, the magnitude and extent of flooding dictate the rate at which stream evolution occurs. Flow regimes also exert a strong influence on in-stream biogeochemical processes by affecting nutrient processing rates and organic matter transfer.

iv. Edge effects

Edge effects may occur due to encroachment or invasion by feral and exotic species or changes in microclimate at interfaces (e.g. clearings). The configuration of the riparian zone dictates the magnitude of edges and the influence of edge effects on riparian communities. Edge effects are known to have a significant impact on breeding birds in some landscape contexts, for example, nesting success may be impacted from 15m and up to 50m from forest edges (Catterall et al., 2001, Paton, 2004); although neither of these specifically refer to riparian landscapes. Similarly, noisy miners may have severe detrimental impacts on avifauna diversity for distances of 150-300 m into woodland blocks (Clarke and Oldland, 2007, Taylor et al., 2008). The influence edge effects have on riparian zones may be significant where invasive species can penetrate well into the riparian zone, as may be the case with long, narrow riparian planting

v. Vegetation mix

Structurally diverse riparian buffers, i.e. those that contain a mix of trees, shrubs and grasses, are much more effective at capturing a wide range of pollutants than a riparian buffer that is solely trees or grass. Removal efficiencies range from 61% of the nitrate, 72% of the total phosphorous and 44% of the orthophosphates from grass buffers to 92% of the nitrate 93% of the total phosphorous and 85% of the orthophosphates from combined grass and woody buffers(Jontos, 2004)



3.26 Recommended Riparian buffer widths and Purpose

The width of a buffer depends greatly on what resource you are trying to protect. Scientific studies have shown that efficient buffer widths vary for bank stabilization and stream shading, for wildlife habitat based on catchment characteristic and geometry. Furthermore, the necessary width for an individual site may be less or more than the average recommendations, depending on soil type, slope, land use and other factors. An ordinary planting adjustment to consider is the inconstancy in the width of land accessible for planting inside the riparian zone. The width of a riparian buffer is a key factor in the general outline of the planting (Agriculture and Agri-Food Canada, 2018). Cross-section of a stream and the adjacent riparian area was shown in **Figure 3-32.**

3.26.1 One-zone design

This zone starts at the stream or lake edge and is the zone that gives stream bank adjustment and territory to both oceanic and earthly living beings. Essential capacity of this zone incorporates arrangement of shade and contribution to the lake or stream of garbage and vast woody flotsam and jetsam from develop woodland vegetation.

Vegetation in this zone additionally diminishes surge impacts, balances out the bank, and evacuates a few silt and supplements. Vegetation ought to be made out of local trees and bushes of a thickness that grants understory development. This zone ought to be a 'no touch' zone, be that as it may, constrained shoreline access might be given. Access ways ought to be developed to limit disintegration, soil compaction and unsettling influence to living space. The width of this zone changes in the vicinity of 5 and 8m (Fischer, & Fischenich, 2000)

3.26.2 Two-zone design

Zone two is made out of lush species. Select grass assortments for their capacity and match their development attributes and necessities to the site. The base width of a two-zone cushion strip is 5.0 m (Agriculture and Agri-Food Canada, 2018).

3.26.3 Three-zone design

This plan is appropriate for low request streams with more extensive flood plains; limit waterways with little flood plain; exceptionally erodible grounds; or delicately inclining shorelines or riverbanks. It is less reasonable for wetlands (marshes, fens, swamps, fleeting



wetlands, potholes, and so forth.) or seriously edited farmland. The three-zone buffer strip should be a minimum of 10 m wide(Agriculture and Agri-Food Canada, 2018).

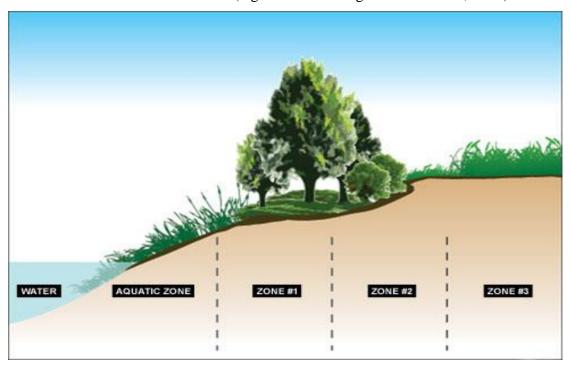


Figure 3-32: Cross-section of a stream and the adjacent riparian area (Agriculture and Agri-Food Canada, 2018)

The following zone, Zone 1, is a two-push planting of trees and bushes. Zone 2 is made out of grass species in a two-zone framework and a blend of trees and bushes in a three-zone framework, and grasses and forbs in a three-zone framework.

This progression requires the assessors to characterize the particular capacities the buffer is intended to satisfy. The required buffer capacities are picked by the wants of the defender, and the material buffer width is taken from a straightforward table that gives the base extents as indicated by the coveted capacity (**Table 3-11**. Should any numerous capacities yield covering comes about, the greatest width will be picked with a specific end goal to satisfy every single wanted capacity. The accompanying table is a rule to these widths:

Table 3-11 Buffer widths for specific buffer functions (Palone, &Todd , 1997)

Buffer function	Buffer Width (feet)	Buffer Width (m)		
Wildlife habitat	40-270	12-82		
Flood mitigation	60-225	18-59		
Nitrogen removal	55-260	17-79		
Water temp/ moderation	15-60	5-18		
Bank stabilization and aquatic food web	15-40	5-12		





Cited Conversion factor 3.28

The given below **Table 3-12** buffer width is figured by surveying a scope of scene qualities encompassing that can impacts environmental and hydrological forms and accordingly the level of effect that a land utilize movement has on the wetland.

Table 3-12 Catchment position and suggested associated buffer increases (Graham, & De Winnaar, 2009)

River Criterion used	Buffer Width (m)	Rationale			
Mountain streams and upper foothills of all 1:500 000 rivers	50	These longitudinal zones generally have more confined riparian zones than lower foothills and lowland rivers are generally less threatened by agricultural practices			
Lower foothills and lowland rivers of all 1:500 000 rivers	100	These longitudinal zones generally have more confined riparian zones than mountain streams and upper foothills and are generally threatened by agricultural practices. These larger buffers are particularly important to lower the amount of crop-spray reaching the river			
All remaining 1:50 000 streams	32	Generally smaller upland streams corresponding to mountain streams and upper foothills, smaller than those designated in the 1:500 000 rivers layer.			

3.27 Statistical and Scientific Applications for Riparian Buffer Width

i. Variable Width

Several models have been created to consider individual site factors in determining buffer width. These range from the complex to the relatively simple. The more complex models take into account multiple factors, such as slope, erodibility and infiltration rates. Examples of such models include Brown et al. (1987),

$$B_W = (\frac{S_a}{K})^{\frac{1}{2}}$$

Whereas

 B_w = width of riparian buffer zone

 S_a = average slope (%)

K = erodibility factor





The erodibility factor (K) requires long-term data and time consuming of using direct measurement method. There are as several methods was developed to estimate the value of K-factor from readily available data on soil properties (Manyiwa & Dikinya, 2013). The high value K- factor in eroded soils was primarily due to low organic matter content (0.75%) because organic matter has the capacity to bind soil particles together(Brady & Weil , 2008). Other than relatively low clay and organic matter in non-eroded areas, the high K- factor value is a result of granular soil structure since it is generally more stable than and crumb structure (Daum , 1996). The nomograph (which relates K to soil properties) was developed by (Wischmeier , Johnson, & Cross , 1971) with the following equation form:

$$K = \frac{2.1\,\times\,10^4\,\times\,(2-OM)\,\times\,M^{1.14} + 3.25\,\times(St-2) + 2.5\,\times(Pt-2)}{100}$$

Where as

K = erodibility factor

OM = Organic matter content (%),

M = Silt (%) * (100 - Sand %),

 S_t = Soil structure code (very fine granular = 1, fine granular = 2, coarse granular = 3, blocky, platy or massive = 4),

 P_t = Permeability class (rapid = 1, moderate to rapid = 2, moderate = 3, slow to moderate = 4, slow = 5, very slow = 6).

According to (Trimble, & Sartz, , 1957) buffer widths can be determined based on a simple formula, W=8+0.6S, where W is the buffer width and S the slope in %

3.28 Riparian Buffer Zone Determination River Study Reach

There are many theoretical Riparian buffer width was recommended in literature based on its function, but statistical and satellite approaches was adopted for evaluation buffer width for both banks of river. Digital elevation model SRTM of 30 m resolution was used with spatial



applications of ArcGIS 10.3. Because GIS-based methodologies make utilization of accessible scene data to survey the joined impact of various factors on riparian capacity. These are regularly used to organize destinations for reclamation to meet a give administration objective, for instance, disintegration control. They may likewise utilize scene data to build up a record of execution or quality, which is hence converted into a misfortune width identified with the size of the index. An empirical equation proposed by Brown et al. (1987) are modified with overland flow surfaces length and it can be expressed as

$$B_W = \left(\frac{S_a}{K}\right)^{\frac{1}{2}} * FL_0$$

Whereas

 B_w = width of riparian buffer zone

 S_a = average slope (%)

K = erodibility factor

 $FL_O = flow \ length \ of \ over \ land \ flow$

There is the slope should be depended on the paths of flow of selected overland flow block, and it measured from each raster cell after running the flow direction cell by cell using ArcGIS application. The slope of each block area only considering over land flow was characterize are computed from raster based on spatial analysis tools of geographic information. The Zonal Statistical tool (Esri, 2013) was used and calculated the zonal sum of specific block from resulted multiplication of slope raster zonal sum and flow accumulation (zonal sum) modified raster. The weighted slopes were obtained for all sub-catchment after dividing zonal sum obtained after multiplication with flow accumulation zonal sum. The final slope map for selected reach of catchment are presented in **Figure 3-34.**



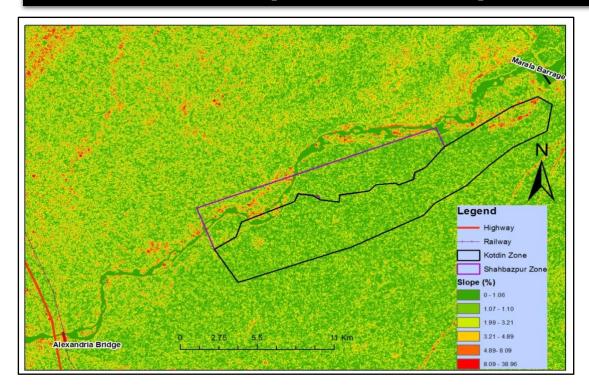


Figure 3-33 Slope map of project area

Soil samples were collected from eroded surface soils that is, from sampling points; 1, 2, 3, 4, 5, 6 7, 8, 9, 10, 11, 12, 13, 14, and 15, respectively whereas the sample locations, slope, and soil particle distribution presented in **Table 3-13.** Sampling depth was 0-30 cm and 30-100 cm Samples from the eroded sites were collected to the slope direction. Soil morphological properties including soil structure type, class and permeability class were also collected using The Harmonized World Soil Database based viewer software (FAO, 2012)

Table 3-13 Soil Particle size distribution with location coordinate and Slope

SR.#	Latitude	Longitude -	sand Silt		Clay	Organic Matter	Slope	
			%	%	%	OM %	%	
1	32.694310°	74.358101°	42	36	22	0.7	17	
2	32.715862°	74.269403°	42	36	22	0.7	14.6	
3	32.658689°	74.227108°	34	47	18	0.8	13.5	
4	32.605684°	74.213997°	34	47	18	0.8	12.9	
5	32.616078°	74.117873°	35	47	18	0.75	10.2	
6	32.551671°	74.132052°	35	47	18	0.8	11	
7	32.514883°	74.109910°	35	47	18	0.8	15.3	
8	32.621069°	74.452809°	46	39	15	0.75	8	
9	32.613429°	74.399649°	35	47	18	0.8	6.7	
10	32.603429°	74.319649°	35	47	18	0.8	3.3	
11	32.575476°	74.358917°	35	47	18	0.8	2.9	
12	32.591813°	74.308079°	35	47	18	0.8	1.9	
13	32.547809°	74.286914°	42	36	22	0.69	3.1	
14	32.521737°	74.215303°	35	47	18	0.8	2.2	
15	32.499363°	74.153716°	35	47	18	0.8	2.4	



Longest overland flow path lengths were also computed with ArcGIS spatial tools (concept of over land flow **Figure 3-34 and** study area overland flow map was shown **Figure 3-35**) based on given below methodology.

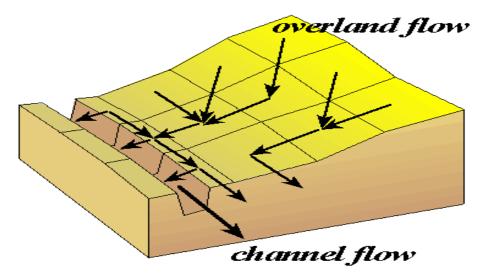


Figure 3-34: Concept of overland flow

- I. Spatial analyst Tools
- II. flow direction cell by cell using Flow Length Tools
- III. Flow direction was used as input raster
- IV. Zonal Statistics as Table tool

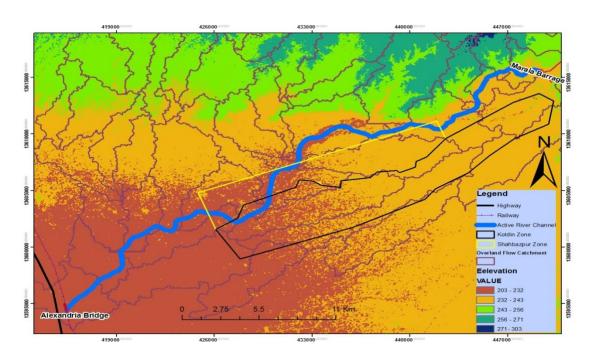


Figure 3-35 Overland Flow catchment boundary and Elevation Map of Project Area





The buffer zone width was computed using equation 32 there are soil sample 1 to 7 was taken left bank side of Study river and soil sample 8 to 15 was collected left bank side of the river reach. Permeability Class according (FAO, 2012)is to moderately well, soil structure class 1 and soil structure "granular". The computed buffer with for river reach is shown in **Table-3-14** below:

Table 3-14Computed Buffer zone width for river Reach b/w Marala Barrage and Alexandria Bridge

SR.#	Latitude	Longitude	sand	Silt	Clay	Organic Matter	Slope	Overland Flow Length	K-Factor	Buffer Width
			%	%	%	OM %		m		m
1	32.694310°	74.358101°	42	36	22	0.7	17	67	0.014747	227
2	32.715862°	74.269403°	42	36	22	0.7	14.6	61	0.014747	192
3	32.658689°	74.227108°	34	47	18	0.8	13.5	66	0.026053	150
4	32.605684°	74.213997°	34	47	18	0.8	12.9	59	0.026053	131
5	32.616078°	74.117873°	35	47	18	0.75	10.2	51	0.024953	103
6	32.551671°	74.132052°	35	47	18	0.8	11	71	0.024823	149
7	32.514883°	74.109910°	35	47	18	0.8	15.3	31	0.024823	77
8	32.621069°	74.452809°	46	39	15	0.75	8	22	0.014764	51
9	32.613429°	74.399649°	35	47	18	0.8	6.7	44	0.024823	72
10	32.603429°	74.319649°	35	47	18	0.8	3.3	35	0.024823	40
11	32.575476°	74.358917°	35	47	18	0.8	2.9	48	0.024823	52
12	32.591813°	74.308079°	35	47	18	0.8	1.9	21	0.024823	18
13	32.547809°	74.286914°	42	36	22	0.69	3.1	21	0.014747	30
14	32.521737°	74.215303°	35	47	18	0.8	2.2	19	0.024823	18
15	32.499363°	74.153716°	35	47	18	0.8	2.4	22	0.024823	22
	Average		37.0	44.3	18.6	0.8	8.3	42.5	0.022310	89

3.29 RIVER MARPHALOGY

3.29.1 Background

Three simple channel patterns are detected in alluvial plains. They are braided, meandering and straight. River morphology is defined via channel patterns and channel characteristics s, and is decided by such factors as discharge, water surface slope, water velocity, depth and width of the channel, and river mattress materials, and so on. These factors aren't independent but inter-associated with every different. A river channel consists of water, sediment and solute from the drainage vicinity to the ocean and is for that reason of interest to hydraulic engineers, geomorphologists and sedimentologists, that is critical to engineers because water is used for a diffusion of purposes with the aid of humanity; water courses are used as navigation channels, and additionally erosion, transportation and deposition of sediment motive some of troubles in the river and within the catchment that should be solved pragmatically. The direct impact of transportation of sediment and water from the geologist's and geomorphologies' point of view is that the structure and shape of the river and adjacent regions are constantly modified due to erosion and sedimentation(Grade, 2006). The geologists and geomorphologists are concerned approximately river channel changes taking



place in 10³ to 10⁶ years or extra, engineers are concerned with modifications in a river during a particularly short duration, say 10–20 years to possibly 50–one hundred years. Those channel changes may be in the shape of length, form, composition of mattress material, slope and plan-shape (Grade, 2006). This study also identifies the natural changes that have occurred in the active river channel and flood plain change morphology of the River between the Marala Barrage and Alexandria Bridge for the period 1984 to 2016. The recent changes in channel morphology are discussed within the context of longer term trends and analysis through historic aerial photography and cross-section analysis.

3.30 Impact on River Morphology

One of the principal reasons of environmental impacts from in-stream mining is the elimination of extra sediment than replenishments.

3.31 Streambed Erosion

There are four fundamental procedures that add to bed disintegration (DERM, 2009):

- Diminish in sediment supply. This can happen when the characteristic section of sediment through the system is hindered by upstream dams, weirs, catchment disintegration control works, or excavations in the streambed
- Increment in bed incline. This can be because of fixing the waterway, expelling a bed control, for example, a stone bar, weir or crossing, or excavations the bed of the stream for extractive ventures, amusement or substantial pump openings
- Increment in speed (not related with an expansion in incline). This can be because of a channel tightening, for example, flotsam and jetsam, fill, and vegetation on the riverbed or scaffold projections
- Increment in release. This can be because of expanded urban run-off, catchment clearing or increments in precipitation. It can likewise be from directed water exchanges for water system supplies.

3.32 Basic River Typology (BRT)

The first simple level of morphological classification of river reaches, derived from (Rinaldi , Surian , Comiti , & Bussettini , 2013), is based on river channel plan form character (number of threads and plan form pattern) in the context of valley setting (confinement). This



basic river typology (BRT) defines seven river types (plus a type 0 for highly altered reaches) using readily available information, mainly remotely sensed imagery (**Figure 3-36**). Different types are associated with two broad categories of valley confinement (1) confined reaches, and (2) unconfined and partly confined reaches. Confined reaches are divided into three morphological types based on the number of threads, i.e. single-thread; transitional (wandering); multi-thread. "Six broad types of unconfined and partly confined reaches are distinguished (2. single-thread: straight; 3. single-thread: sinuous; 4. single-thread: meandering; 5. transitional: wandering; 6. multi-thread: braided; 7. multi-thread: anabranching using a plan form assessment of sinuosity, braiding, and anabranching indices". The sinuos- ity index (Si) is the ratio of reach length measured along the (main) channel and measured following the direction of the overall plan metric course (or 'meander belt axis' for single thread rivers (Rinaldi, Gurnell, Gonza lez del Ta nago, Bussettini, & Hendriks, 2016)

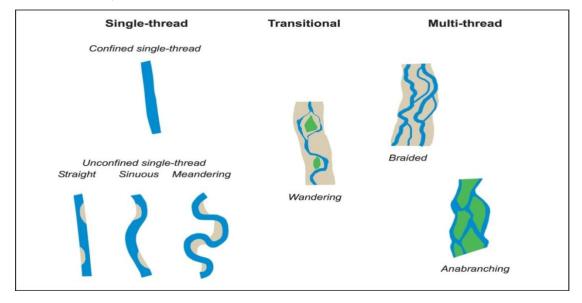


Figure 3-36 The seven river types of the basic river typology

3.33 Active channel

The active channel of the River between Marala and Alexandria Bridge is a dynamic system where flood events and sediment movement regularly cause changes in the channel morphology. Changes in the longitudinal profile are constantly occurring, due to aggradation and degradation along the channel and lateral bank erosion. This report summarizes the changes that have occurred since the last 1984 to 2016 and places these changes within the context of longer term trends was shown in **Figure 3-37** and 3-**38**.





Figure 3-37 River Active River Channel 1984



Figure 3-38 : River Active River Channel

3.34 Historic change

The historical Changes in the river morphology over time can be attributed to several factors such as the presence of bedrock, sediment supply, frequency and magnitude of flood events, and human intervention. **Figure 3-39** shows the lower area of River between 1984 and 2016 highlighting the low flow carrying active channel.



The

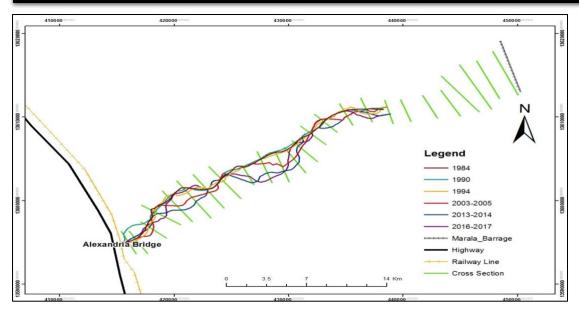


Figure 3-39 Historical Change in Low-Flow Active Channel of River

3.35 Longitudinal profile

River selected reach generally increase or decrease in size (width/depth) as they flow in a downstream direction as they receive additional flow from overland due to heavy rainfall. This is the case for the River during normal and flood flow conditions, however during low flow conditions the River (upstream of the Marala Barrage flow recorder) is subject to flow losses due to irrigation abstraction. Longitudinal profiles change over time in response to several factors including: river flow behavior, sediment size and location, flow resistance, velocity, width, depth, and slope (Leopold, , Wolman , & Miller, 1964). The longitudinal profile of the River will change over time in response to changes in the factors discussed above; it displays a typical concave shape with steeper areas in the 1500 m downstream Marala and a shallower profile closer to the Alexandria Bridge (Figure).

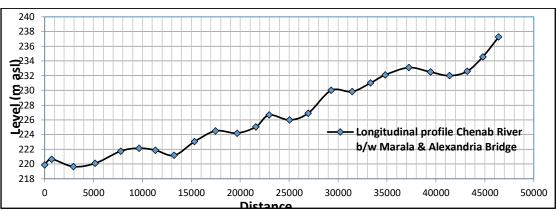


Figure 3-40 Longitudinal profile of River b/w Marala and Alexandria Bridge





3.36 Hydrology and flood hazard

Changes in the morphology of the River are in part driven by the hydrological characteristics of the river including the magnitude and frequency of flood flows. Between 1957 and 2015 there were three flood events in the study area that ranked in the top 10 largest flood events at the Marala Barrage flow recorder (Figure 10). The River has experienced big flood events in the past with the **1957** (31143 m³/s) and **1992** (23924 m³/s) event being the largest on record at the Marala flow recorder (Figure 11). Recently India build many dam at upstream of river which causing serious impacts on at downstream river reach. On 6th September, 2014, warning of Exceptionally High Flood was received from PMD and flow increased to 861,000 cusecs (24390 m3/s on the same day at 1800 hrs event caused significant damage to the bed and banks of the River. Historical flood event measured at Marala Barrage at was shown below **Figure-3-41**

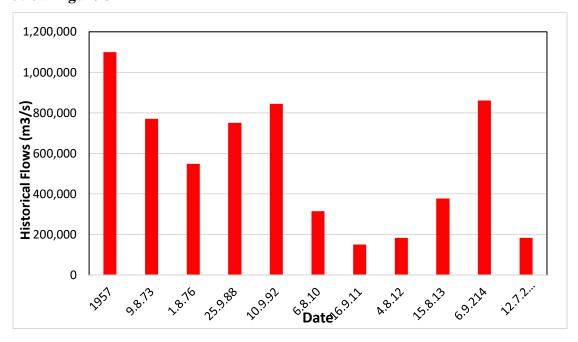


Figure 3-41 Ten highest flows at the U/S Marala Since 1957 to 2015.

3.37 Bank erosion

Bank disintegration is a characteristic and fundamental process that happens in all stream frameworks. Without it, waterways would have no wanders, there would be no supply of rock for bringing forth riffles and the course of each channel would stay unaltered throughout the centuries. Bank erosion is considered to be the erosion of the margins of the active channel fairway and not the erosion of the low flow channel or channel braid migration. Bank erosion



the

was observed at one of the forty two surveyed cross-sections. Other areas of bank erosion were identified using satellite images and site visits (**Figure 3-42 to Figure 3-43**).



Figure 3-42 river Fairway in 1990 (Source: Google Earth)

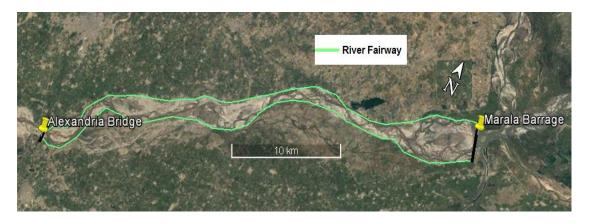


Figure 3-43 River Fairway in 2000 (Source: Google Earth)

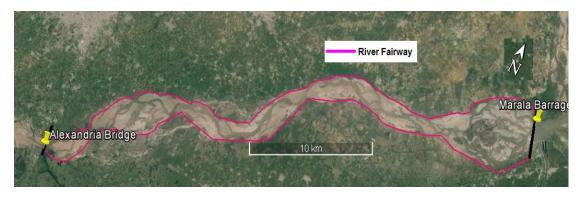


Figure 3-44 River Fairway in 2016 (Source: Google Earth)

3.38 Sand Mining Management Plan

Physical checking prerequisites of sand extraction exercises ought to incorporate studied channel cross-segments, longitudinal profiles, bed material estimations, geomorphic maps, and release and sediment transport estimations. The physical information will outline bar renewal and any adjustments in channel morphology, bank disintegration, or particle size



measure. Notwithstanding checking for replenishment at particular mining locales, observing of the whole reach to the estuary will give data on the aggregate reaction of the framework to sand extraction. For instance, it is imperative for downstream bars and the estuary to get adequate sand to keep up estuarine structure and capacity. Since the height of the bed of the channel is variable from year to year, an achieve based way to deal with observing will give a bigger setting to site-particular changes. If long-term monitoring data show that there is a reach-scale trend of bed lowering (on bars or in the thalweg), the extraction should be limited.

3.39 River Cross-sections

Overviewed channel cross-section ought to be situated at for all time observed destinations upstream, downstream and inside the extraction region. Cross-section proposed to demonstrate achieve scale changes ought to be reliably situated over geomorphic highlights, for example, at the head of riffles, over the most profound piece of pools, or crosswise over specific kinds of channel bars. Cross-section area dividing ought to be sufficiently close to characterizing the morphology of the stream channel. Cross-section information ought to be overviewed after the flood season to assess changes that may have happened. Cross-section data should be collected over the reach to the estuary, and locally upstream, downstream, and within each mining site (EPA Sabah, 2011).

3.40 Mining Site Cross-sections

According to (EPA Sabah, 2011) given below information should be follow during sand extraction and River Morphology

- i. One set of cross-sections at each extraction site to illustrate local changes related to specific in-stream extraction activities.
- ii. At least 10 survey points to be measured for each cross-section at 20 to 30 m interval.
- iii. Cross-sections should illustrate the upstream, mid-, and downstream portion of the site being excavated, and at least one cross-section upstream and one cross section downstream of the bar.
- iv. Thus, at least five (5) cross-sections should be located at every extraction site to illustrate local changes. Cross-sections should be oriented perpendicular to the channel, extend from the top of bank to the opposite top of bank, and show the morphology of the channel (including the portion below the water surface).



3.41 Riparian vegetation and River Morphology

The riparian zone forms the link between the environments of water and land. The structure, species creation and degree of riparian vegetation all have an essential influence in the nature of the water condition. The riparian zone has numerous essential advantages counting:

3.41.1 Rivers bank Protection

The riparian vegetation can tie stream banks together, forestalling disintegration and ensuring critical farmland or house for instance. Without vegetation, waterway banks are a considerable measure weaker and there is a far more prominent shot that the bank will be too much disintegrated by the stream; it can likewise be vulnerable to disintegration by rain. Materials washed into the stream because of the bank disintegration can present unnecessary supplements and furthermore cover natural surroundings in stream that plants and creatures rely upon. Channel frame and habitat is controlled by numerous variables, one of which is bank quality. Riparian vegetation is a key factor in deciding bank quality and along these lines has a noteworthy part in deciding channel frame and living spaces; for instance weaker banks can prompt more extensive shallower channels with more extreme bed inclines, which can influence the nature of in-stream living spaces (SEPA, 2009). During sand mining operation, operator should be harvest small trees and grass along the river bank.

3.41.2 Habitat and habitat connectivity

Numerous types of plants and creatures use riparian vegetation; for instance, otters utilize tree pulls as spots for rest and safety, and bats utilize trees as perches. Species in the water condition can be exceptionally reliant on riparian vegetation; for instance, creepy crawlies tumbling off plant foliage can frame a huge part of the nourishment for salmon and trout. For sure, leaves and other plant materials falling into conduits from riparian vegetation can shape the reason for the whole natural way of life in the water condition. Woody garbage, regularly sourced from the riparian zone, assumes a critical part in putting away/reusing natural material in waterways, which thusly nourishes spineless creatures. It likewise gives asylum to angle. The shade and cover which riparian vegetation makes can likewise be essential for amphibian living beings. What's more, the segments of riparian territory along conduits are frequently the main semi-common natural surroundings show in a zone (SEPA, 2009).



The

3.42 Recommendation

- I. Before sand removing must be checked it that there increase in sediment due to a rare flood event.
- II. Only sand Remove from dry or un-vegetated deposit such as sand bars and island in very low season. The total length of sand extraction should not exceed 20-30m toward the river banks.
- III. Minimize the area affected
- IV. Use advance technology for sand removing in the river bed and minimized the environment impacts on river banks.
- V. Follow the river flow discharge chart throughout the year of sand removing during high rain and very low-flow season.
- VI. At sand mining sites/cross-section brash, grass or small trees simply put in place in front of the eroding bank.
- VII. Avoid sand manning below redline
- VIII. Sand mining in river bed will be one meter depth layer by layer
 - IX. Maintained the river flow carrying capacity in active channel without any serious activities.
 - X. Avoid pollution of river water leading to water quality deterioration.



4 CHAPTER 4: STATUTORY REQUIREMENT & STANDARDS

4.1 General

This Section provides an overview of Policy Framework, Legislation, Acts, Laws and Guidelines relevant for preparation of EIA report of the proposed project. In this context, the Pakistan Environmental Protection Act, Laws, Regulations, Ordinances are discussed in the ensuing Section of the report.

4.2 National Policy and Administration Framework

The Pakistan National Conservation Strategy (NCS), approved by the Federal Cabinet in March 1992, is the principal policy document on environmental issues in the country (EUAD/UCA, 1992). The NCS outlined the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed project are pollution prevention and abatement, increasing energy efficiency, conserving biodiversity, supporting forestry and plantations and the preservation of cultural heritage.

The Government of Pakistan promulgated "Pakistan Environmental Protection Act (PEPA) in 1997. Two organizations, the Pakistan Environmental Protection Council (PEPC) and the Pakistan Environmental Protection Agency (Pak-EPA), are primarily responsible for administering the provisions of the Act at the federal level. The PEPC oversees the functioning of the Pak-EPA. Its members include representative of the government industry, non-governmental organization, and the private sector. The Pak-EPA is required to ensure compliance of the National Environmental Quality Standards (NEQS) and establish monitoring and evaluation systems. As the primary implementing agency in the hierarchy, it is responsible for identifying the need for, as well as initiating legislation whenever necessary. The Pak-EPA is also authorized to delegate powers to its provincial counterparts, the provincial EPAs or EPD (Environmental Protection Department in Punjab). One of the functions delegated by the Punjab-EPA to provincial EPAs/EPD is the review and approval of environmental assessment reports of projects undertaken in their respective jurisdictions.



4.3 Punjab Environmental Protection (Amendment) Act, 2013

The Punjab Environmental Protection (Amendment) Act, 2013, empowers the Punjab-EPA to:

- Identify categories of the projects to which the environmental examination/ impact assessment provisions will apply.
- Develop guidelines for conducting IEE/ EIA and procedures for the review and approval of the same.
- Develop environmental emission standards for parameters such as air, water and noise pollutants.
- Enforce the provisions of the Act through environmental protection orders and environmental tribunals headed by magistrates with wide-ranging powers, including the right to fine violators of the Act.

Under the provisions of the 2013 Act, the Punjab-EPA is empowered to manage the environmental concerns of their respective projects. The provincial EPAs/ EPD can frame environmental regulations tailored to the requirements of their province, provided these regulations meet or exceed the minimum standards set by the Pakistan EPA. They are also required to review and approve IEEs/ EIAs of all the developments projects.

4.4 Punjab Environmental Quality Standards

The PEQS specify the following parameters:

- Maximum allowable concentration of pollutants in municipal and liquid industrial
 effluents discharged to in land waters, sewage treatment facilities, and the sea (three
 separate sets of numbers).
- Allowable concentration of pollutants in gaseous emissions from industrial sources.
- Allowable noise levels.

4.5 <u>Interaction with Other Agencies</u>

It is the responsibility of project proponent to ensure that project complies with the laws and regulations controlling the environmental impacts at both construction and operation stage of the project and that all pre-construction requisites, such as permits and clearances are met.



4.5.1 Punjab Environmental Protection Department

The Proponent will be responsible for providing the complete documentation required by the Punjab Environmental Protection Department and remain committed to the approved project design. No deviation is permitted during the project implementation without the prior and explicit permission of the Punjab EPA/ EPD.

4.5.2 Provincial Departments of Forest and Wildlife

In case the implementation of the proposed project involves the clearing of vegetation and trees in project area, the project contractor will be responsible for acquiring "No Objection Certificate" (NOC) from concerned provincial Department. The application for NOC will need to be endorsed by the Proponent. Where the construction is to be carried out in close proximity of protected forests and wildlife areas, the Proponent is required to coordinate with the departments to ensure that impact on vegetation and wildlife are minimized.

4.5.3 Provincial Revenue Departments

Under the National laws, the matters relating to land use and ownership are provincial subjects, and the Revenue department of the concerned province is empowered to carry out the acquisition of private land and built-up property for public purposes, including on behalf of another provincial or federal agencies. For those purpose, the lead department must lodge an application with the concerned provincial government to depute a Land Acquisition Collector (LAC) and revenue staff, which will be responsible for handling matters relating to land in case of any issue arises, although the project proponent presently owned the project site.

Furthermore, it also requires a liaison with the provincial departments of agriculture, horticulture and forestry in case of issues associated with these departments. The concerns could be relating to the affected vegetation resources, such as trees and crops. In case of some public buildings/ infrastructure is involved, proponent will approach the building department for relocation/ assessment of compensation.

4.5.4 Coordination with Provincial Governments

The Project Proponent (PP) will coordinate with all concerned government department and ensure that the project meets the criteria of district government/ authorities as related to the establishment of construction camps and plants and the safe disposal of waste, solid waste



and toxic material. PP will also ensure to periodic monitoring of the EMP during both construction and operation period through deployment an Environment Specialist.

4.6 Other Relevant Acts

4.6.1 Forest Act, 1927

The Forest Act, 1927 establishes the right of the government to designate areas for reserve forest, village forest and protected forest, and may acquire such areas for prohibiting or restricting the public use of the resources or other activities.

4.6.2 Punjab Wildlife Protection Act, 1974

The Punjab Wildlife Protection Act, 1974 was passed by the provincial assembly of Punjab in 1974. This Act is applicable to the whole of the Punjab province for protection, conservation, preservation and management of Wildlife. This Act also designated areas of sanctuaries and protection of rare and endangered species.

4.6.3 Canal and Drainage Act, 1873

The Canal and Drainage Act, 1873 under Section 32 (e and f), elucidate that: unless with the permission of the Superintending Canal Officer, no person is entitled to use the water of any canal, or any work, building or land appearing to any canal, shall sell or sublet or otherwise transfer his right to such use and no right to the use of the water of a canal shall be, or be deemed to have been, acquired under the Indian Limitation Act, (XV of 1877), Part IV, nor shall '(the Provincial Government) be bound to supply any person with water except in accordance with the terms of a contract in writing.

4.6.4 Local Government Act 2001 and Amended in 2003

These ordinances, issued following the devolution process, establish regulations for land use, the conservation of natural vegetation, air, water, and land pollution, the disposal of solid waste and wastewater effluents, as well as matters related to public health and safety.

4.6.5 Land Acquisition Act, 1894

The land acquisition Act 1894 is a law for the acquisition of land and implemented to fulfill the needs of government and companies for land required by them for their projects, and secondly, to determine and pay compensation to those private persons or bodies whose land



is to be acquired. The experience of the power of acquisition has been limited to a cash compensation policy purposes. The LAA is limited to a cash compensation policy for the acquisition of land and built-up property, and damage to other assets such as, crops, trees and infrastructure. The LAA does not take into account the rehabilitation and settlement of displaced population and restoration of their livelihoods. Presently, the requisite land for the proposed project is already owned by the project proponent, so that no additional private or government land will need to be acquired for the project.

4.6.6 Protection of Trees and Brushwood Act, 1979

This Act prohibits cutting or lopping of trees and brushwood without permission of the concerned Forest Department as a no objection certificate needs to be acquired from Forest Department for cutting of trees.

4.6.7 Alternative Energy Development Board Act, 2010

The Alternative Energy Development Board (AEDB) Act, 2010 refers to the objective of the Alternative Energy Development Board is to assist and facilitate development and generation of Alternative/Renewable Energy in order to achieve sustainable economic growth with transfer of technology for development of an indigenous technological base through a diversified energy generation, the elected government intends to substitute the Alternative Energy Development Board Ordinance, 2007 (LVI of 2007) by a democratic and people friendly Act of the Parliament, "Alternative Energy Development Board Act, 2009" to ensure generation of Alternative/Renewable Energy keeping in view its potential in the country.

4.6.8 Industrial Relation Ordinance, 2002

The ordinance has been promulgated to amend, consolidate and rationalize the law relating to formation of trade unions, regulation and improvement of relations between employers and workmen and avoidance and settlement of any differences or disputes arising between them Pakistan's labour laws trace their origination to legislation inherited from India at the time of partition of the Indo-Pak subcontinent. The laws have evolved through a continuous process of trial to meet the socio-economic conditions, state of industrial development, population and labour force explosion, growth of trade unions, level of literacy, Government's commitment to development and social welfare. To meet the above named objectives, the government of the Islamic Republic of Pakistan has introduced a number of labour policies,



since its independence to mirror the shifts in governance from martial law to democratic governance.

While Article 18 of the Constitution affords every citizen with the right to enter upon any lawful profession or occupation, and to conduct any lawful trade or business, the Industrial and Commercial Employment (Standing Orders) Ordinance was enacted in 1968 to address the relationship between employer and employee and the contract of employment. The Ordinance applies to all industrial and commercial establishments throughout the country employing 20 or more workers and provides for security of employment. In the case of workers in other establishments, domestic servants, farm workers or casual labour engaged by contractors, their labour contracts are generally unwritten and can be enforced through the courts on the basis of oral evidence or past practice.

The Constitution of Pakistan contains a range of provisions with regards to labour rights found in Part II: Fundamental Rights and Principles of Policy.

4.7 <u>International Environmental & OSH Laws and Regulations</u>

4.7.1 <u>International and National NGOs</u>

International and national Non-Government Organizations (NGOs), such as the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), have been active in Pakistan for some time. Both of these NGOs have worked closely with the governments at the federal as well as provincial levels and have positively contributed to the cause of environment. They have played significant role with regard to the formulation of environmental and conservation policies. And last but not the least, another the most prominent NGO namely "Sustainable Development Policy Institute (SDPI) "has also played very significant role in upholding the cause of environmental protection in Pakistan.

Environmental NGOs have been particularly active in the advocacy for promoting sustainable development approaches. Most of the government's environmental and conservation policies, even at the provincial and federal levels, has been formulated in consultation with these leading NGOs, who have also been involved in drafting new legislation on conservation.



4.7.2 <u>International Framework</u>

For the assessment of the environmental impacts of the proposed project on air, water and noise according to the international legal framework, this report has also incorporated the requirements of the IFC EHS Guidelines for Thermal Power Plants (Dec. 19, 2008) and the "Pollution Prevention and Abatement Handbook" by the World Bank Group- effective July 1998.

Within this handbook, different guidelines are mentioned for the purpose of assessing industrial facilities with respect to their environmental compliance. In the present case, the guidelines for new thermal power plants are applicable for the preparation of the environmental impact assessment.

4.8 Relevant International Agreements in Pakistan's Context

Pakistan is a party to the following treaties and agreements in furtherance of its environmental goals and programme:

Treaty	Pakistan Status			
Convention on the Protection of Ozone Layer on Dec 18, 1992.	Ratified			
The Amendment to Montreal Protocol on Substance that	Signed			
Depleting Ozone layer				
UN Framework Convention on Climate Change on June 13, 1992	Signed			
Convention on the Continental Shelf on October 31, 1958	Signed			
The Convention on High Seas on October 31, 1958	Signed			
Convention on the Fishing and Conservation of the living	Signed			
Resources of the High Seas on October 1958.				
The UN Convention on Law of the Sea on December 10, 1982	Signed			
The Convention on Territorial Sea and the Contagious Zone and	Signed			
the Agreement for the establishment of Network of Aquaculture				
Centers in Asia and the Pacific				
The Convention on Wetlands of the International Importance on Ratified				
July 23, 1976				
The Convention on protection of the World Cultural and Natural	Ratified			
Heritage on July 23, 1976				
The Convention on International Trade in Endangers Spice of	Signed			



the

Wild Fauna and Flora

The Convention on Conservation of Migratory Specie of Wild Signed Animal on Dec 01, 1987

The Convention on Biological Diversity in 1994 and became Ratified party to the CBD, Convention duly recognizes the intrinsic value of biological diversity, genetic, social, economic, cultural, educationist, recreational and esthetic values of biodiversity and its components

The International Plant Protection Convention. Signed

The Plant Protection Agreement for Area & pacific region Signed

The Agreement for the establishment of a convention for Signed controlling the desert lost in eastern region of its Distribution

Area in South East Asia

The Treaty Banning Nuclear Weapon Test in the Atmosphere, in Signed Outer Space and under Water on March 3, 1988

The International Convention on Oil Pollution Preparedness Signed Response and Corporation

The Convention on prohibition of Military or any other Hostile Acceded Use of Environmental Modification Techniques and Accession of Feb 27, 1986

Pakistan became a party to Montreal Protocol by Ratifying the Signed protocol and its London amendment on Dec 18, 1982.the subsequent amendments known as Copenhagen Amendment which, accelerate the phase out for rectified in Jan 1995.

Convention of International trade Endangerous Species (CITS) Signed

World heritage Convention Ramsar Convention Signed

United Nation Convention to Combat Ozone Depletion (CCD). Signed

The convention signed and ratified in 1996

Stockholm Convention for Phasing out Parenting Organic Signed pollutants (POPs) in 2001.



4.9 Requirements of Potential Investors, Lenders and Insurers

The client intends to get finances for the project under reference from International Finance Corporation - IFC/WB (World Bank), therefore, requirements of potential investors; lenders and insurers are to be followed as described hereunder:

A. INTERNATIONAL FINANCE CORPORATION'S (IFC) POLICY ON ENVIRONMENTAL AND SOCIAL SUSTAINABILITY, EFFECTIVE JANUARY 1, 2013

International Finance Corporation (IFC) is the private sector arm of the World Bank Group. Summarily, it aims at fighting poverty with passion and professionalism for lasting results and to help people help themselves and their environment by providing resources, sharing knowledge, building capacity, and forging partnerships in the public and private sectors.

International Finance Corporation's (IFC) Policy on Environmental and Social Sustainability, Effective January 1, 2013 supersedes the IFC Disclosure of Information Policy (April 2006) in its entirety. This Policy is not an express or implied waiver of IFC's privileges and immunities under its Articles of Agreement, international conventions, or any applicable law, nor does it provide any contractual or other rights to any party.

At IFC while transparency and accountability are fundamental to fulfilling its development mandate, IFC encourages its clients to be more transparent about their businesses and believes that when clients are committed to transparency and accountability they help promote the long-term profitability of their investments.

IFC strives for positive development outcomes in the activities (including (i) investments financed directly by IFC; (ii) investments implemented through financial intermediaries (FIs) or managed by IFC's Asset Management Company or any other IFC subsidiary, as well as investments funded in part or in whole by donors; and (iii) advisory services) it supports in developing countries.

IFC believes that an important component of achieving positive development outcomes is the environmental and social sustainability of these activities, which IFC pursues and expects to achieve through the application of this Policy on Environmental and Social Sustainability (the Sustainability Policy or the Policy), and a comprehensive set of environmental and social Performance Standards. Through this Policy, IFC puts into practice its commitments to



environmental and social sustainability. Activities supported and financed by IFC include a wide range of investment and advisory products including technical, financial and/or regulatory advice, project structuring as well as training to companies, industries, and governments.

Within the scope of an agreed advisory activity, all advice and training will be consistent with the Performance Standards. The Performance Standards consist of the followings:

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 2: Labor and Working Conditions

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 7: Indigenous Peoples

Performance Standard 8: Cultural Heritage

These Performance Standards help IFC investment and advisory clients manage and improve their environmental and social performance through a risk and outcomes based approach. While managing environmental and social risks and impacts in a manner consistent with the Performance Standards is the responsibility of the client, IFC seeks to ensure, through its due diligence, monitoring, and supervision efforts, that the business activities it finances are implemented in accordance with the requirements of the Performance Standards. As a result, the outcome of IFC's environmental and social due diligence of a proposed business activity is an important factor in its approval process, and will determine the scope of the environmental and social conditions of IFC financing.

IFC's development mission are its efforts to carry out investment and advisory activities with the intent to "do no harm" to people and the environment, to enhance the sustainability of private sector operations and the markets they work in, and to achieve positive development



outcomes. IFC is committed to ensuring that the costs of economic development do not fall disproportionately on those who are poor or vulnerable, that the environment is not degraded in the process, and that renewable natural resources are managed sustainably.

IFC recognizes that climate change is a serious global challenge and that climate-related impacts may impede economic and social well-being and development efforts. Working with the private sector and other parties to address climate change is therefore a strategic priority for IFC. IFC will engage in innovative investments and advisory services to support climate-friendly solutions and opportunities for business.

IFC support for low-carbon economic development is one dimension of a balanced approach to development, including supporting access to modern, clean, and reliable energy services. IFC pursues this objective through the use and development of relevant products, instruments, markets, and advisory services as well as through the adoption of appropriate technologies, processes, and practices in the activities it supports.

The desired outcomes are very briefly described in the objectives of each Performance Standard as below:

Performance Standard 1

Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the clients, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders. Drawing on the elements of the established business management process of "plan, do, check, and act," the ESMS entails a methodological approach to managing environmental and social risks and impacts in a structured way on an ongoing basis.

Business should respect human rights, which means to avoid infringing on the human rights of others and address adverse human rights impacts business may cause or contribute to. This Performance Standard applies to business activities with environmental and/or social risks and/or impacts.



Who

Performance Standard 2

Labor and Working Conditions Introduction

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

Performance Standard 3

Resource Efficiency and Pollution Prevention Introduction

Where on the one hand increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels; there on the other hand the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations.

This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices.

Performance Standard 4

Community Health, Safety, and Security Introduction

Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.



This Performance Standard addresses potential risks and impacts to the Affected Communities from project activities.

Performance Standard 5

Land Acquisition and Involuntary Resettlement Introduction

Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition2 and/or restrictions on land use.

Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for the Affected Communities and persons, as well as environmental damage and adverse socio-economic impacts in areas to which they have been displaced. For these reasons, involuntary resettlement should be avoided and where unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts should be carefully planned and implemented.

Performance Standard 6

Biodiversity Conservation and Sustainable Management of Living Natural Resources I

Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems."

This Performance Standard addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project's lifecycle.

Performance Standard 7

Indigenous Peoples Introduction



Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. As a consequence, Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.

Private sector projects can create opportunities for Indigenous Peoples to participate in, and benefit from project-related activities that may help them fulfill their aspiration for economic and social development. Furthermore, Indigenous Peoples may play a role in sustainable development by promoting and managing activities and enterprises as partners in development. Government often plays a central role in the management of Indigenous Peoples' issues, and clients should collaborate with the responsible authorities in managing the risks and impacts of their activities.

Performance Standard 8

Cultural Heritage Introduction

Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.



B. THE WORLD BANK ENVIRONMENTAL ASSESSMENT PROCESS

The principal international guidance utilized in assessing the significance of impacts from the proposed development, and for determining content and form of reporting from the World Bank was also utilized.

World Bank Operational Policies OP4.01 Environmental Assessment (January 1999):

This sets out the World Bank's policy on projects requiring an EIA and defines what the assessment is designed to achieve and what issues must be considered. It also sets out guidance for screening projects and identifies other World Bank guidance and policies that may be relevant.

World Bank – Pollution Prevention and Abatement Handbook (1998):

This handbook sets out the basic principles that are considered appropriate to evaluating and controlling pollution from any defined project. The handbook provides guidance on pollution management and sets out generic environmental standards for air, water and soil pollution. This handbook also provides sector guidance. Of most significance to this project is the guidance for Thermal Power: Guidelines for new plant (July 1998).

The environmental assessment undertaken in this report also utilizes, as a precautionary measure only, The World Bank guidelines presented in the "Pollution Prevention and Abatement Handbook" effective July 1998.



5 CHAPTER 5: BASELINE DATA

5.1 Collection of Baseline Data

Data related to key issues identified during the scoping study for the physical, biological environments and socio-economic parameters were collected from field surveys, relevant agencies, geographical and geological maps, available literature etc. Detailed data related to topography, terrain, surface and groundwater quality and quantity, air quality, soil and geology, flora and fauna, and socio-economic environment were collected keeping in view the key environmental parameters to be effected as per findings of the scooping exercise. Baseline studies facilitate the focusing on the likely significant environmental components and thereby consideration of links among environmental factors. It also provides the basis for impact prediction.

5.2 Description of Environment

Based on the environmental checklist, socioeconomic questionnaires for consultations, field surveys were carried out to collect data on the physical, ecological and socioeconomic environmental aspect of the project site.

i) Physical Environment

The physical aspects of the project site covered the following:

- Soils type of soils, erosion, stability
- Land use pattern of the area including agriculture crops, barren lands, industrial and residential use
- Affected buildings residential, industrial, commercial, and structures of buildings (if any)
- Drainage pattern
- Available energy source(s)
- Other private/ public infrastructure/ utilities like pipelines, electric poles
- Water resources available both surface and groundwater
- Air quality and noise level in the project area



the

ii) Ecological Environment

In consideration of ecological environment, the following main aspects were studied:

- Existing vegetation along the project area
- Trees likely to be affected due to the project implementation (if any)
- Migratory species especially migratory birds
- Endangered species both flora and fauna
- Wildlife in the project area
- Forests and game reserves existing along the project area
- Beneficial plants and animals in the project area
- Aquatic life including fish resources
- Wetlands within the vicinity of the project area

iii) Socioeconomic Environment

Social assessment has attempted to determine the social implications in terms of assumed positive and negative impacts as a result of the implementation of the proposed project. The socioeconomic baseline data covered the following major aspects:

- Demographic profile
- Population
- Number of households
- Literacy status
- Nature of business/ occupations
- Livelihood/income
- Living standard of the population
- Social infrastructure available
- Community perceptions about the Project

5.3 Physical Environment

Sialkot is Pakistan's 12th most populous city. The latitude of the urban center is 32.50°N and the longitude is 74.53°E. The estimated total population of 2015 is about 596000. Sialkot is well known for its sports equipment and surgical instruments manufacturing industry and is



the third largest economic hub in Punjab after Lahore and Faisalabad. It is Pakistan's second largest source of foreign exchange earnings after Karachi, through its exports and remittances from the overseas manpower. The per capita income of Sialkot is ranked among the highest in Pakistan. 24. Sialkot features a humid subtropical climate, with annual average precipitation around 1000 mm. The precipitation is characterized by strong seasonality, with the rainfall of monsoon season between July to August accounting for more than 50% of the annual total. The annual average daily temperature is 23°C. Sialkot is traversed by three seasonal streams, comprising Aik Nullah, to the south of the city, Bhaid Nullah, between the Cantonment and the rest of the city, and Pahlu Nullah, to the north of the Cantonment. Urban flooding occurs frequently during monsoon because of the outburst flood from the three nullahs, particularly Bhaid Nullah. The inadequate storm and sewer system within city worsens the flood at the urban area. The city sits over abundant shallow and deep groundwater aquifers that benefit from the Chenab River flows to the northwest, and the Marala-Ravi Link Canals flow to the west. Tawi is a river that flows through the city of Jammu. Tawi River is considered sacred and holy, as is the case with most rivers in India. River Tawi (referred in ancient literature as Surya Putri) originates near Kaplas Mountains and flows westward between Jug Dhar and TrisulDhar in a westerly direction till Udhampur where it takes a southerly bend across the Sivalik range and again resumes a westerly course passing along the Jammu City till it joins Chenab River in Sialkot District in Pakistan.

The length of Tawi River is about 141 km (88 mi). The river in general flows through steep hills on either side excepting the lower reach for about 35 km (22 mi). The river is about 300 m (980 ft) wide at the bridge in Jammu city. After transversing Jammu city, the river crosses into Pakistan's Punjab and joins Chenab River. Tawi is a major left bank tributary of river Chenab.

The groundwater is used and extracted via wells by both the city water supply system and inhabitants for their water supplies. The water is pumped directly from tube wells to supply pipes. The aquifer is recharged from the Chenab River, which is located some 20 km northwest of the center of Sialkot and from the water channels and bodies within the city. The water channels were originally seasonal water courses but now carry wastewater from the city throughout the year. Local water bodies are heavily polluted.





5.3.1 Topography

The project area (Sialkot) is located at an elevation of about 256 meters above the sea level. The topography is, however, marked by valleys, local depression and relatively high ground. The street pattern comprised of narrow lanes with mostly dead ends which are sharply different from the neighbouring areas.

The primary streets or Bazaars intersects each other at right- angle. The secondary streets, which provide access to the residential areas, are also rectilinear. Sialkot is an industrial city. Sialkot is Pakistan's 12th most populous city. The estimated total population of 2016 is about 920,000.

The length of Tawi river is about 141 km (88 mi). The river in general flows through steep hills on either side excepting the lower reach for about 35 km (22 mi). The river is about 300 m (980 ft) wide at the bridge in Jammu city. After transversing Jammu city, the river crosses into Pakistan's Punjab and joins Chenab River. Tawi is a major left bank tributary of river Chenab.

5.3.2 Geography

Lying between 32 30° north latitude and 74 30° east longitudes at 256 meters above sea level, Sialkot District lies southeast of Gujrat District, southwest of Jammu district, while Narowal District is to the southeast and Gujranwala District is situated to the west.

Sialkot district is spread over an area of 3,016 square kilometers

Sialkot is hot and humid during the summer and cold during the winter. June and July are the hottest months. The maximum temperature during winter may drop to -2 °C. The land is generally plain and fertile. The average annual rainfall is about 1000 mm. Over 25.82% of the population of the district is urban.

5.3.3 Hydrology

Sialkot is situated in the Upper Rachna Doab, which is bounded by the Ravi and Chenab rivers. It sits over abundant shallow and deep groundwater aquifers which are used by both the city water supply system and inhabitants with wells for their water supplies. The Chenab River flows to the northwest of Sialkot, and the Marala Ravi Link Canals flow to the west. Sialkot is traversed by three seasonal streams, comprising Aik Nala, to the south of the city, Bhaid Nala, between the Cantonment and the rest of the city, and Pahlu Nala, north of the



Cantonment. The length of Tawi river is about 141 km (88 mi). The river in general flows through steep hills on either side excepting the lower reach for about 35 km (22 mi). The river is about 300 m (980 ft) wide at the bridge in Jammu city.

After traversing Jammu city, the river crosses into Pakistan's Punjab and joins Chenab river. Tawi is a major left bank tributary of river Chenab.

The groundwater recharge is mainly derived from the seepage of unlined canals, watercourses and from irrigation practices. Recharge directly from rainfall is also present. Also, some recharge takes place from water supply and sewerage systems.

Groundwater is the major source of water in the study area, which is extracted with the help of pumps and motors. The groundwater extracted is used to fulfill various domestic, irrigation and industrial needs. Unfortunately, the ground water of the city is quite contaminated, hence, not acceptable for human intake. A limited quantity of potable water is accessible to the citizens from different scarce resources. In the absenteeism of proper clean water sources, the WASA has to pump water from a depth of about 400-450 ft. for the people to have a healthy consumption.

5.3.4 **Soils**

Soils form major relation with environment. They influence environment by their special qualities and more so through fertility. Types of soils besides providing food, clothes or housing population serve with special food and lumber products, medicinal plants etc.

Soil should not be taken as a lifeless residual layer but it is a very dynamic element of environment in which very complicated physical, chemical and biological activities are constantly proceeding. In this way it is a dynamically changing and developing body. Soil scientists restrict the word soil or solum merely to the surface material, which has come to have distinct layers or horizon over the extended period of time.

Soils have different meanings for different people. To a soil scientist it means the upper a few layers created through weather effect in which plants are grown .The solid portion of soil is both organic and inorganic. The organic part consists of both living and decayed plant and animal materials.



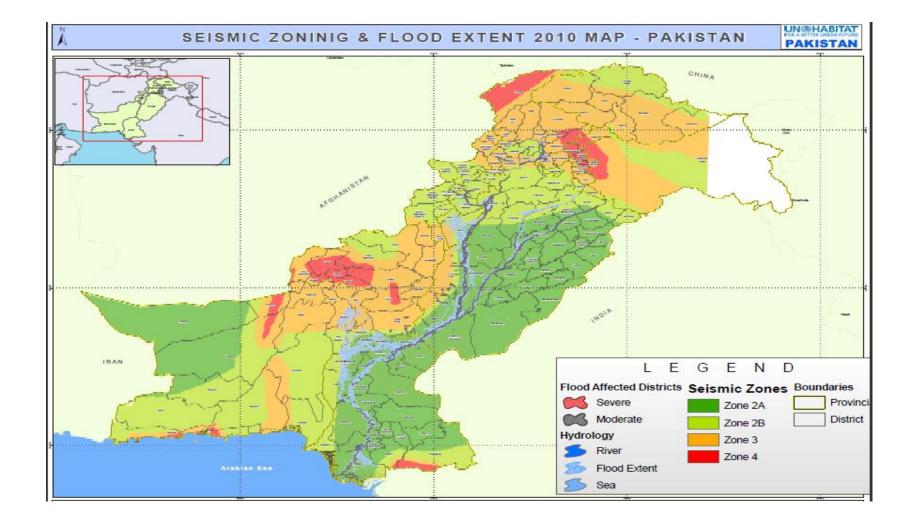
The soil is mostly loamy clay and loamy. Texture of the soil plays a very important role in its water holding capacity of the soil. The same is true for various faunal species, which are important for adding the nutrients in the soil by the breakdown of organic matter and making it suitable for the agriculture. Earthworms are said to play the best in this functioning

5.3.5 **Seismicity**

Seismic Zoning Map of Pakistan showing Proposed Project site area is presented as Figure – 5.1, indicating zones according to the Building Code of Pakistan - 2007. The city of Sialkot, the project site falls in Seismic Zone 2B according to the Seismic Zoning Map of Pakistan.



Figure 5-1 Seismic Zoning and Flood Extent Map of Pakistan







5.3.6 Climate

The project area lies in Sialkot. This Section describes the general climatic condition of district Sialkot.

5.3.6.1 Temperature

Sialkot has a hot semi-arid climate and changes throughout the year. During summer (June to September), the temperature reaches 36–42 °C. The coldest months are usually November to February, when the temperature can drop to an average of 7 °C.

The month-wise minimum and maximum temperature is presented in Table 5.1.

Table 5-1 Month-wise Average Temperature, Sialkot

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Averag e high °C (°F)	19.1 (66.4)	22.1 (71.8)	27.4 (81.3	33.7 (92.7)	39 (102)	40.8 (105.4)	36.1 (97)	34.6 (94.3)	35 (95)	33 (91)	27 (81)	21.2 (70.2)
Daily mean °C (°F)	12.2 (54)	15 (59)	20.3 (68.5)	26 (79)	31 (88)	33.8 (92.8)	31.4 (88.5)	30.2 (86.4)	29.5 (85.1)	25.4 (77.7)	18.6 (65.5)	13.4 (56.1)
Averag e low °C (°F)	5.3 (41.5)	8 (46)	13.3 (55.9)	18.4 (65.1)	23.1 (73.6)	26.9 (80.4)	26.7 (80.1)	25.9 (78.6)	24 (75)	17.8 (64)	10.3 (50.5)	5.7 (42.3)

5.3.6.2 Rainfall

The highest-precipitation months are usually July and August, when the monsoon reaches the Punjab. During the other months, the average rainfall is about 25 mm. The driest months are November to April, with little rainfall.



Table 5-2 Month-wise Rainfall in District Sialkot

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average precipitation mm (inches)	31 (1.22)	30 (1.18)	29 (1.14)	18 (0.71)	19 (0.75)	46 (1.81)	147 (5.79)	168 (6.61)	65 (2.56)	9 (0.35)	5 (0.2)	14 (0.55)

5.3.6.3 Visibility

The visibility in the district usually remains good throughout the year except for Nov., Dec and Jan. where it is lowest relative to other months due to thick fog that disturbs traffic and air travel substantially, which are mainly because of torrential rains.

Month-wise values of mean visibility are depicted in Table 5.3.

Table 5-3 Month-wise Mean Visibility in Sialkot

Visibility	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2012	Oct. 2012	Nov 2012	Dec 2012
Mean visibility (km)	3.5	4.6	3.9	4.6	4.2	4.0	4.1	4.0	3.9	4.3	3.4	3.1

Source: Historical Weather, 2013 and 2012.

5.4 Ecological Resources

5.4.1 **Biodiversity**

Biodiversity is mainly a country's wilderness areas and scenic landscapes with their associated flora and fauna form natural capital of a country. Both collectively and within each level, the range or variety of the resources is referred to as the "Biological Diversity". The contribution of the "Natural capital" is recognized at three distinct levels including genera, species, and community -habitat and ecosystem.

Pakistan comprises of a total of nine major ecological zones and the term has relevance for each of Pakistan's administrative units—district, province, and particularly country. The



greater the number of genera, species and habitats and ecosystems present within these units, the greater is the Biodiversity. It is in this background that the biodiversity of the area is discussed below:

The Sialkot District has been a part of the ecological zone called thorn forest but with the introduction of extensive irrigation network of canals for development of agriculture, industrial development and urbanization has changed its biological features. Most of the part of the district is now agriculture zone with human related or human dependent fauna and flora and for the most part of the district is now an agricultural zone. About 2.17 % of the total area of the district is under human forest plantation of trees of economic importance like Shisham, Keeker, Mulberry that are used in construction and making sports goods and furniture. Other introduced species are Mesquite an invasive species and Safeda Sheesham Bohar and Bakain are also seen in and around the urban areas. The district Sialkot is the host of a variety of flora. The indigenous tress are Lasoora, Bairy, Siris, Keeker, Phali, Khajoor, Toot and Paper Mulberry These are commonly found along the edges of agricultural fields. About 54 km² of the Bajwat region in the Sialkot District is the Bajwat Game Reserve. About 16 km2 of the area around Marala Headworks is also protected within the game reserve and is of considerable importance for wintering waterfowl. Fortunately, from a planning perspective all development activities foreseen under PCIIP will be far away from these environmentally sensitive areas and will therefore not be adversely affected by any of the proposed interventions.

5.4.2 Forestry (Flora)

Since the project site is situated within the urban area of Sialkot, therefore, there is no likelihood of any forest or any type of flora worth mentioning around the project.

5.4.2.1 *Main Fruits*

The commonly occurring main fruits of the area are as below:

Sugarcane, Melons, Mango; Orange; Guava and Jamun.

5.4.2.2 Crops

The following are the major crops being grown during the kharif (summer¹) and rabi (winter²) seasons:

¹Kharif season: 15 Apr.– 15 Sep.



Kharif crops:

* Rice; Maize and Sugarcane

Rabi crops:

Wheat; Gram; Barley and Rabi Fodder

5.4.2.3 Vegetables

The commonly available vegetables of the area are: Carrots, radish, ladyfinger, cauliflower, cabbage, turnip, red and green chilli, spinach, peas, pumpkins, bitter gourd, and tomatoes.

5.4.3 Wildlife (Fauna)

There is no likelihood of any wildlife, game reserves or else around the project site. Buffaloes and sheep are common throughout the city. On very limited scale the following native birds like sparrows, pigeons, crows, doves, rats, lizards, snakes, etc., are found here and there, like in all Punjab.

5.4.3.1 Fisheries and Aquatic Biology

There are no worth mentioning sources of fishery in the form of fresh water fishery or fishing ponds or else in the area of influence of the project.

5.5 Socio-economic Environment

Sialkot is located close to the Indian border some 125 km north of Lahore. It is a major industrial center, specializing in leather products, surgical instruments, diesel engines, pharmaceuticals, steel rolling mills, textiles and sports goods. There are at least 264 tanneries, 244 leather garment producing units, 900 leather sports goods producing units, 57 rice husking mills and 14 flour mills in the city.

5.5.1 Settlement Pattern

The district was subdivided into five tehsils namely: Sialkot, Pasrur, Zafarwal, Raya and Daska, the headquarters of each being at the place from which it is named. The chief towns of the district were Sialkot, Daska, Jamki, Pasrur, KilaSobha Singh, Zafarwal and Narowal

² Rabi season: 16 Sep. – 14 Apr.



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5.5.2 <u>Demographic Characteristics of the Population</u>

The field survey (including interviews, focus group discussions, census, and village profile) was carried out to collect the socioeconomic data from the project affected people as well as other general population to accomplish the baseline information, which will provide the basis for subsequent monitoring and evaluation studies.

The demographic features include the information on household's profile, gender composition, occupations, and literacy status of the population residing in the project area. The information relating to the demographic profile of the people in the project area are described below.

5.5.2.1 Family Size and Gender Composition

Based on the field survey of sample affected people/ local population, the average family size computed to be 6.82, out of which the proportion of male and female members is 59 percent and 41 percent respectively as shown in Table 5.4 and Figure 5.2.

Table 5-4 Average Family Size & Gender Composition of the Sample Households

	Gender Composition (%)					
Average family Size (No.)	Male	Female				
6.82	58.98	41.02				



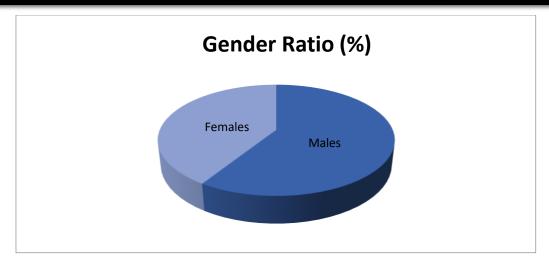


Figure 5-2 Gender Composition in Sialkot

5.5.3 <u>Literacy Status</u>

The general disparity in education exists in low-income communities. Sialkot is blessed with higher educational facilities like Islam College of Engineering & Management sciences. School of Engineering, University of Management & Technology, Sialkot Campus and several government and private colleges for boys and girls and technical/ poly institute.

The field survey has shown that on the whole, in the vicinity of the project site, the average literacy rate of the local population estimated as 61.98%. The percentage of literacy rate among males and females residing in the vicinity of the project area is computed to be 68.53 and 52.55 percent respectively.

Table 5-5 Average Literacy Rate of the Sample Households

	Average Literacy Rate (%)	
Overall	Male	Female
61.98	68.53	52.55

Note: This is the average literacy rate of population resided in the vicinity of project site.

5.5.4 Occupations

In the vicinity of the project area, the sample population is involved in different occupations in order to meet their living expenditure. Out of total sample population, 70 percent are involved in self business like shops/ stores, while 14 percent are employed in various services. About 7 percent population involved in farming activities. The percent of labour both skilled and un-skilled of the area is 15, while 4 percent are daily-wage labourers and



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others respectively. Table 5.6 shows the major occupations of the sample population resided in vicinity of the project area.

Table 5-6 Major Occupations of the Sample Population

Major Occupations (%)						
Business	Service	Farming	Labour (skilled & un-skilled)	Other		
70	14	7	15	4		

5.5.5 Average Income of Sample Households

The assessment of annual household income is one of the important indicators to measure the well-being/ livelihood of the household. In the field survey, the major sources of income include; income from shops, farming, livestock, off-farm work, business, daily wages and remittances etc. Based on the data summarized in Table 5.7, the average annual household income computed to be Rs. 224,400. On annual per capita basis, the corresponding figure is Rs. 32,903.

Table 5-7 Average Annual Household Income of Sample Households

Average	Household	Average	Per Capita		
Incor	ne (Rs.)	Income (Rs.)			
Annual	Monthly	Annual	Monthly		
224,400	18,700	32,903	2,742		

5.5.6 Average Household Expenditure

The annual expenditure and pattern of expenditure provides an indication for assessing standard of living of a household. The expenditure on food items include cereals, pulses, flour, sugar, cooking oil/ghee, milk etc., while the non-food items including the expenditure on education, medical treatment, clothes, shoes, cosmetics.

Total average annual household expenditure on both food and non-food items are estimated as Rs. 210,500. The proportion of expenditure incurred on food and non food items is 68.2 % and 31.8% respectively (Table 5.8).



Table 5-8 Average Annual Expenditure on Food and Non- Food Items

Total Expenditure on Food &	Food	% on Food	Non-Food	% on Non-
Non-Food Items	Expenditure	Expenditure	Expenditure	Food
(Rs./ annum)	(Rs)		(Rs)	Expenditure
210,500	143,561	68.2	66,939	31.8

5.5.7 Availability of Basic Infrastructure

During the field survey, the availability/ or access to basic infrastructure/ services to the local population was recorded. In this context, it was observed that on the whole, all basic infrastructure/ facilities, i.e. drinking water, education & health facilities, electricity, telephone/ cell, roads, fuel/ filling station etc. were available to almost all the sample population resided in the vicinity of the project area.

5.5.8 Women Issues

On overall basis, about 41.02% of the sample population are women. Women are participating to alleviate poverty, enhance economic growth and human well-being of the families by involving in farming and other income generation activities. It can be concluded that in the vicinity of the project area, women are involved in several households and income generation activities. Some of the major activities are listed below.

- Agricultural/ farming activities, wheat harvesting, rice transplanting and harvesting/ threshing.
- Livestock rearing and caring activities fodder cutting, watch & ward to animals, milking, by-product, milk selling, sale of animals
- Poultry& health care.
- Education- teaching, academy, tuitions at home.
- Participate in social obligations/ ceremonies.
- Other Activities washing clothes, cooking, child caring, etc.

In general, there is no issue with the women of the study area associated with the implementation of the project. However, during the consultative meetings, local women



pointed out that some suitable jobs to their male members during the construction activities should be provided. In this way, in addition to their jobs, they can also look after their household activities.

5.5.9 Cultural, Religious & Other Structures

No cultural, religious and other structures are present in the vicinity of the project area.

5.5.10 Indigenous People and Women Headed Households

During the field survey of the project area, no indigenous people and affected women headed households were observed in the project area as well as in the vicinity of the project area. Thus, there would not have any impact on the indigenous people and women headed households' due to the implementation of this project.

5.5.11 Recreational Sites

Sialkot has a lot of tourist attractions and places of interest. There are many modern shopping malls where the visitors can enjoy shopping in controlled environment and can buy local and international brands. There is an Iqbal Manzil. **Tomb of Imam Ali-ul-Haq,** Sialkot clock tower, Holy Trinity Cathedral Church (Sialkot Cathedral). There are modern, innovative landmarks like Jinnah Stadium, Pace Shopping Centre. No recreational Sites are present in the vicinity of the project area.

5.6 Transport

Road Networks Sialkot is about two hours from Lahore and four hours from Islamabad. Sialkot is linked with the National Highway N-5 through Gujranwala and Wazirabad. A dual carriage-way is available between Sialkot and Wazirabad. A new bridge on the Chenab River, called the Shahbazpur Bridge, is under construction these days which is located to the north-east of Gujrat. Once completed, it will connect Sialkot to N-5 at Gujrat. The Sialkot Lahore Motorway (M-11) is also under construction. All the bus and commuter coach stations are located on the Jail Road. A bus service operated by Daewoo Express is available from Sialkot to Rawalpindi, Lahore, Gujranwala and Multan.

<u>Public Transport</u> Recently, public transport has been launched in Sialkot on one route which circle around the city. SCCI Sialkot Chamber of Commerce & Industry has signed an MOU with American bus company FOTON to provide air-conditioned local transport to the citizens with CNG fuel.



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Rail Transport Sialkot is served by Pakistan Railways through the Sialkot Junction. Sialkot used to be a junction in the British era with trains leaving for Jammu and Gurdaspur. Plans are under consideration to open the border for an international train between Sialkot and Jammu. Express trains to and from Narowal, Lahore, Rawalpindi, Faisalabad, Multan, Bahawalpur and Karachi are available daily. The Railway station is situated in the centre of the city. Other suburban train stations are Ugoki and Sambrial.

Air Transport Sialkot International Airport is the first-ever private-sector airport of Pakistan managed by the SIAL consortium. It is located near Sambrial and is noted for having the longest runway in Pakistan. Direct flights are available from Sialkot International Airport to Karachi, Islamabad, Abu Dhabi Sharjah & London, Muscat Kuwait, Dubai & Jeddah.

5.7 **Quality of Life Values**

Sialkot is Pakistan's 12th most populous city. The latitude of the urban center is 32.50°N and the longitude is 74.53°E. The estimated total population of 2016 is about 920,000.

Sialkot is well known for its sports equipment and surgical instruments manufacturing industry and is the third largest economic hub in Punjab after Lahore and Faisalabad. It is Pakistan's second largest source of foreign exchange earnings after Karachi, through its exports and remittances from the overseas manpower. The per capita income of Sialkot is ranked among the highest in Pakistan. 24. Sialkot features a humid subtropical climate, The precipitation is characterized by strong seasonality, with the rainfall of monsoon season between July to August accounting for more than 50% of the annual total. The annual average daily temperature is 23°C. Sialkot is traversed, by three seasonal streams, comprising Aik Nullah, to the south of the city, Bhaid Nullah, between the Cantonment and the rest of the city, and Pahlu Nullah, to the north of the Cantonment. Urban flooding occurs frequently during monsoon because of the outburst flood from the three nullahs, particularly Bhaid Nullah. The inadequate storm and sewer system within city worsens the flood at the urban area. The city sits over abundant shallow and deep groundwater aquifers that benefit from the Chenab River flows to the north west, and the Marala-Ravi Link Canals flow to the west. After traversing Jammu city, the river Tawi crosses into Pakistan's Punjab and joins Chenab river. Tawi is a major left bank tributary of river Chenab. The groundwater is used and extracted via wells by both the city water supply system and inhabitants for their water supplies. The water is pumped directly from tube wells to supply pipes. The aquifer is



recharged from the Chenab River, which is located some 20 km north-west of the center of Sialkot and from the water channels and bodies within the city. The water channels were originally seasonal water courses but now carry wastewater from the city throughout the year. Local water bodies are heavily polluted.

5.8 Lab test reports

Lab Test Reports are attached in the annexure of the report.



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6 <u>CHAPTER 6: POTENTIAL ENVIRONMENTAL IMPACTS AND</u> <u>MITIGATION MEASURES</u>

6.1 Location of the project

Block No. River Tawi 1, near River Tawi, Tehsil District Sialkot.

6.2 Methodologies for Impact Identification

Simple methodologies and tools are applied to identify the impact. These simple methods are of proven value for undertaking a systematic approach to identify impacts. The most common formal methods used for impact identification are:

- Checklists
- Matrices
- Networks
- Overlays and geographic information systems (GIS)

As per project need, ease, time frame, simplicity, credibility the methodology involved in catering and defining environmental impacts for the project was checklists. Checklists are standard lists of the types of impacts associated with a particular type of project. Checklists methods are primarily for organizing information or ensuring that no potential impact is overlooked. Specific areas of impact are listed and instructions are supplied for impact identification and evaluation. Checklists include list of impacts that are either ranked in order of magnitude or severity or in which numerous environmental parameters are weighted (using expert judgment). A basic example is the "to do list."

HEC-RAS model was used for computation of cross-section hydraulic parameters and river discharge capacity. Sediment transport computation and deposition study of project area performed at river cross-section# 1085 by using Acker-White and Engelund-Hansen equations.

6.3 <u>Identification and Analysis of Potential Impacts</u>

This section generally describes the potential environment impacts associated with the construction and operation of the project and accordingly their mitigation measures to minimize the impacts. The initial evaluation of the project was carried out considering location, size, scope, importance, sensitivity and expected environmental impacts.

Potential environmental impacts are identified by comparing the existing environmental conditions with the predicted environmental conditions during the project construction and



operation phases. Summary of impact identification are shown with the help of matrix methodology. The potential impacts will be identified depending on their significance (i.e., major, minor, negligible), duration (i.e., short term and long term), type (i.e., direct and indirect) and speciation (i.e., local or widespread). In this study, each element of the proposed development, which specifically relates to its construction and operations is studied/examined to determine the environmental effects.

Different possible impacts due to the construction and operation of proposed project will be identified. The possible physical impacts could be related to air pollution, noise pollution, mobility hindrance surface and ground water. The impacts on flora and fauna will also be identified. Detailed study will be carried out to identify any possible impacts on endangered species, migratory birds etc. Socio-economic impacts related to any local plan or policy relevant to the project will be identified and analyzed. Impacts on agriculture, recreation, livestock, and conservation areas (if any) will also be considered due to the development.

Impacts during the operation phases will be considered in this step. Different impact identification techniques are available in literature e.g., checklists, matrices, networks, and overlays. Any one or combination of these techniques will be adopted based for impact identification. EIA methods like water balance, surface and ground water assessment methods, and air quality models could be used for the analysis of most critical and adverse impacts depending on the availability of technical resources and data requirements.

6.4 Environmental impacts and their mitigation measures

This section outlines potential impacts during the from a process that included a review of available documentation, verified during the site visit, i.e. how, where and when the proposed development can interact and affect the environment significantly, and details what mitigation measures may be taken to counteract these impacts.

Impacts with possible mitigation measures have been presented in table below.

6.5 <u>Mitigation measures during design Phase</u>

Deposition will be identified first. The Lease holder/ Environmental NOC holder may be allowed to extract the sand deposit in these locations.

Proponent gets the area for sand extraction on lease. The lease documents are attached in annexure.



6.6 Mitigation measures during construction Phase

No construction is involved. Dredge flow is specifically designed and manufactured for easy assembly. The installation of dredge requires three easy steps which can be carried out in five working hours.

- Positioning of the hull and clamping through vertical pins
- Positioning of the power unit
- Pump fixing

Proponent will hire trained staff for the assembly of the dredge flow.

6.7 **Operational Phase**

This section outlines potential impacts during the operation phase gathered from a process that included a review of available documentation, verified during the site visit, i.e. how, where and when the proposed development can interact and affect the environment significantly, and details what mitigation measures may be taken to counteract these impacts.

The impacts with possible mitigation measures have been presented in table below



Table 6-1 Environmental Impacts and their mitigation Measures during operation

Aspects	Mitigation Measure
Ground and surface water Pollution	Ensure that the machinery is properly maintained. Equipment must be regularly serviced and inspected to make sure there are no leaks of oil, diesel, fuel, detergents or hydraulic fluids.
	Servicing and maintenance of vehicles as far as possible must occur outside of the boundaries of permit area. If maintenance does occur on site due to breakdown, all steps must be undertaken to avoid hydrocarbon spills/leakages.
	Minimize petrol, diesel, and oil leaks by allocating a loading zone, which is protected against such leaks. Drip trays must be secured and emptied regularly.
	Secondary containment will be provided.
	Spilled hydrocarbon must be treated as a hazardous waste and needs to be disposed of as it occurs in appropriate hazardous waste containers and removed off site as soon as possible.
	No washing of equipment or machinery may occur on the permit site or in the watercourse
	Spill kit will be used in case of any spill
Maintain the	The extraction of sand must not exceed the replenishment rate of sand during the rainy season.
hydrology of the landscape level	Reduce the turbulence produced from sucking up material from the river bed
	Operate within the thresholds so there isn't an excess of stockpiles, thus causing less resistance by the river channels and undercutting which could result in the bank to collapsing.





Minimize soil	Restrict river access to only one corridor through the Riparian buffer. Ensure water course is not altered to
erosion	the extent that the integrity of the river banks are compromised and eroded.
	Excavated filled slopes and stockpiles must be kept at a stable angle and capable of accommodating normal expected water flows
	Topsoil stripped from the operation footprint must not be spoiled but stockpiled and preserved for use in rehabilitation. Top-soil and sub-soil stockpiles and spoil sites to be placed on opposite sides of the access roads as this is where they will cause the least impact
Limit the	All operation activity will be contained within the designated permit area. The Environment Officer and
disturbance and	Project Manager must establish working and no-go areas, which need to be strictly adhered to.
destruction of	The "no go" areas where possible must be clearly demarcated. There shall be no un-authorized entry, litter,
vegetation,	stockpiling, dumping or storage of equipment or materials within the demarcated "no go" areas. If this does
fauna and habitat	occur the developer shall be reliable for rehabilitation.
	Keep surrounding vegetation, especially larger trees and shrubs, to create a screen that reduces flood impacts
	Protected trees must be marked, their location recorded and must be avoided as best as possible. If any protected species cannot be avoided a permit must be applied for.
	All effort must be made to minimize the disturbance of wild animals on and within the close vicinity of the permit site
	No trapping, snaring, hunting, fishing or killing of any animal may occur on the permit site.
	Disturbed areas will be rehabilitated and vegetation planted to resemble the area prior to operation, both in terms of vegetation cover and habitat
Vehicle access	The access road to the permit area must be established before operation commences and existing roads shall





	be used as far as possible
	Vehicle access must be strictly contained onsite. Vehicles may only use designated roads and access points as determined by the Environment officer and project Manager before operations commence
	When transporting sand on public roads, these will be kept clear of spills, leaks, mud and sand. Access road and loading area will be properly maintained, and this includes appropriate storm water management and dust control.
Waste Management	There is not any worth mentioning solid waste will generate on site. If any solid waste will generate on site it will be disposed of in clearly marked bins and solid waste will be handover to the contractor
	Domestic/general waste and hazardous waste must be separated and bins clearly marked.
	No waste may be buried or burned
	Empty fuel storage drums will be handover to the authorized contractor.
Minimize	Inspection of vehicles and warning systems will be implemented for vehicles emitting excessive emissions.
atmospheric emissions and dust	Rehabilitation will ensure good vegetative cover which will reduce dust creation.
Generation	
Control noise	Hearing protection will be provided for employees operating heavy or noisy machinery.
	Noise level monitoring will be implemented if necessary.
Reduce the visual impact	Site must be kept neat and tidy at all times
Turbidity	Turbidity can cause serious damage to the ecosystem to prevent serious damage to the ecosystem. This





	problem will be solved by Dragflow by the production of a bell to limit water turbidity.
Use of fuel	Being based on submersible pump dredge is more efficient and it drastically reduces the fuel consumption compared to the other old technologies.
Safety	Site access, including stockpile areas and loading areas will be fenced off to prevent unauthorized access.
	Correct signage must be erected at the main access road and entrance of haul road to areas – includes authorization, access authorization, warning activity, safety warning signs (protective equipment, fire & medical equipment) and contact numbers
	No open fires shall be allowed on site under any circumstances
Quality of Sand	Due to the particular design of the dredge it will allow getting only good quality of material avoiding waste of energy and provide the good quality of sand for construction purpose.
Sewage	Septic tank will be available for sewage.





6.8 Potential Environmental Enhancement Measures

The proposed project has a number of positive impacts, which include:

- The project does not involve any land acquisition issue the area is on lease.
- No residential and commercial structures will be affected.
- Proponent will plant indigenous and ornamental plants to increase the aesthetic value of the area.
- Due to the particular design of the dredge it will allow getting only good quality of material avoiding waste of energy and provide the good quality of sand for construction purpose.

6.9 Environmental Management Plan

The environmental management plan contains all aspects of a project's environmental management, and should be prepared before work commences on any construction project.

6.9.1 Site specific environmental management plan

The purpose of site-specific environmental management plan is to provide guidelines for developers, contractors and government agencies involved with commissioning or constructing project.

The main components of site-specific environmental management plan are as follows:

Work scheduling

Actions taken to reduce or avoid environmental impact by rescheduling works, or prohibiting or limiting certain activities from times of the year when unfavorable climatic conditions exist, should be stated.

Land disturbance

Map the existing topography and changes to the landform of each segment, during all progresses.

Design Specifications and control measures

The plan should identify the position and design specification and measures taken to control:

- Dirt on roads
- Noise and vibration
- Dust



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A schedule for these controls should be included in the plan.

Special operational precautions

When work is being done near an environmentally sensitive area, then special precautions should be identified in the plan

Contingency plans

Site-specific contingency plans are required for significant risks that have not been controlled. For example, the plan should include procedures fire safety, noise control, dust control.

Rehabilitation

A rehabilitation plan should be developed. A schedule for stabilizing, cleared areas should be given, and an ongoing program to maintain rehabilitated areas should also be included. The site should be rehabilitated so that the impact on the environment is minimal.

Maintenance, inspections and surveillance

A maintenance and inspection program should be provided. Ongoing surveillance of the site is required to ensure that new risks are identified as they arise. This allows the environmental management plan to be adjusted to ensure that any new risks are adequately managed.

Ongoing risk assessment and management

Work sites are continuously changing. It is therefore important that the initial risk assessment is updated for each segment. This needs to be integrated into the inspection program.

Updating the plan

The plan should be updated to address deficiencies identified by the monitoring or audit program and as new risks are identified through surveillance.

6.10 River and Land Disturbance

Measures to address the impact of river and land disturbance on the environment should be included in the planning and design phase of the project, before any land is cleared. These measures should be placed into the framework of the segment environment control plan.

6.10.1 Dust control

Procedure

• Many of the measures taken to reduce dust problems are outlined below.



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- Prevent the generation of dust in preference to applying dust suppression measures.
- Ensure in the project schedule that the area of cleared land is minimized during the drier months of the year, when dust generation is at its greatest.

6.10.2 Management of stockpile

Stockpiles are a potential source of dust and sediment run-off. Additional controls to those covered previously are outlined below.

Procedure

- Locate stockpiles away from river to where they are protected from wind.
- Minimize the number and size of stockpiles.
- Circle all unsterilized stockpiles with silt fences or a drainage system that will collect and correctly dispose of.
- Hand water or install temporary sprinklers to suppress dust from unsterilized stockpiles.

6.11 Noise and Vibration

All noise nuisance should be reduced wherever possible from vehicles, fixed machinery within the site, general construction activities, and from movements of vehicles servicing the site.

6.11.1 Operating hours

Documentation justifying out-of-hours work should be maintained and authorized by site management. Local residents who are affected by such activities should be notified beforehand. Even with such restricted hours, every effort should be made to reduce the noise of all site activities.

There is not any residential area near the project site.

6.11.2 Vehicles and equipment

Noise from vehicles and equipment on-site should not exceed the manufacturer's specifications, based on the installation of a silencer. Equipment should be regularly serviced. Attention should also be given to muffler maintenance.



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6.11.3 Traffic

There is a conflict between operational efficiency and local amenity, with regard to traffic flows in and out of a construction site. During normal business hours when traffic densities are high, deliveries of materials and large equipment can cause severe traffic snarls and even pose a danger to other vehicles. Out-of-hours deliveries will cause noise pollution from trucks

6.11.4 Noise abatement

Depending on the location of the facility, suitable noise suppression or abatement measures may be required.

6.12 Waste Minimization

When choosing between waste minimization options, the following hierarchy for waste management is preferred:

- Waste avoidance and/or reduction
- Reuse
- Recycling

To identify opportunities, it is necessary to consider all aspects of the project and the wastes it generates. Waste can be minimized by using improved technology, recycled or reused onsite, or by making purchasing decisions that favor recycled products. Wherever possible, include performance measures and targets for reduction, reuse and recycling options in the environmental management plan.

Waste minimization opportunities include:

- segregating and recycling mixed solid waste.
- collecting lubricating oil from the construction vehicle fleet and sending it to a recycler.

6.13 Contaminated Material And Wastes

6.13.1 Waste Management

Procedure

• The small amount of organic waste produced during operation phase, clearing should be mechanically mulched and composted at the site and used for landscaping.



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- Providing adequate number of camps/restrooms for the workmen and waste baskets and dumpsters is essential to keep the construction site clean and pest free.
- Other mixed waste will be handed over to local waste collectors.

6.14 Ambient Air Quality

No construction is involved. Dredge flow is specifically designed and manufactured for easy assembly. The installation of dredge requires three easy steps which can be carried out in five working hours.

The possibility of exhaust emissions increases when old vehicles are utilized for the transportation purpose.

Procedure

Mitigation Measures of Impacts on Ambient Air Quality are given here under;

- Tuning of vehicles should be made mandatory to reduce the emissions.
- Equipment and vehicles powered with diesel should be well maintained to minimize particulate emissions.
- Haul-trucks carrying, sand should be kept covered during transportation of materials and during storage at site, with tarpaulin.
- The fugitive dust emission will be a problem which will be mitigated by sprinkling of water. Also main access roads and exposed terrain should be sprayed by water trucks to minimize the dust.

6.15 IMPACTS AND MITIGATIONS MEASURES DURING THE PROJECT OPERATION

Most of the impacts in project operation has been covered in previous section. However, few of the positive impacts during the project operation is given as under-:

6.15.1 Positive Impacts

A) Job Opportunities

During the design, assembling of machinery and operational phases of the project, there will be a demand for workers, both skilled and unskilled.



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6.16 Characteristics of Impacts

The predicted impacts have been characterized; various aspects of the impact characterized include:

- Nature (direct/indirect)
- Duration of impact (Short term, medium term, Long term)
- Geological extent (local, regional)
- Timing (Project phase)
- Reversibility of impact (Reversible/Irreversible)
- Likelihood of the impact (certain, likely, unlikely, rare)
- Impact consequence severity (major, moderate, minor)
- Significance of impact (High, medium, low)

The above aspects of environmental characterization are defined in Table below-:

Table 6-2 Impact Characterization

Timing	Construction and Operation
Nature	Direct: The environmental parameter is directly changed by the project. Indirect: The environmental parameter changes as a result of change in another parameter.
Duration of Impacts	Short-term: lasting only for the duration of the project such as noise from the construction activities. Medium-term: Lasting for a period of few months to a year before naturally reverting to the original condition such as loss of vegetation due to clearing of campsite, contamination of soil or water by fuels or oil. Long-term: lasting for a period much greater than medium term impact before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical Extent	Local, regional (spatial dimension)
Reversibility of Impact	Reversible: when a receptor resumes its pre-project condition. Irreversible: when a receptor does not or cannot resume its pre-



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	project condition.
Likelihood of the Impact	Almost Certain: Impact expected to occur under most circumstances.
	Likely: Impact will probably occur under most circumstances.
	Possibly: Impact may possibly occur at some time.
	Unlikely: Impact could occur at some time.
	Rare: Impact may occur but only under exceptional circumstances.
Impact Consequences Severity	Major: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora and fauna: has long term effects (period of years) on socioeconomic activities of significance on regional level.
	Moderate: When an activity causes long-term (period of years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one
	generation of a population of flora or fauna: have short-term effects (period of years) on socioeconomic activities of significance on regional level.
	Minor: When an activity causes short-term (period of a few months), reversible damage to a unique environmental feature; slight reversible damage to a few species of flora or fauna within a population over a short period; has short-term (period of months) effects on socioeconomic activities of local significance.
	Negligible: when no measurable damage to physical,
	socioeconomic, or biological environment above the existing level of impact occurs.
Significance of Impact	Categorized as High, Medium, Low
	Based on the consequence, likelihood, reversibility, geographical extent, and duration: level of public concern: and conformance with legislative of statutory requirements.





Table 6-6-3 Impact Characterization of the project

	Strategic Impacts	Nature	Duration	Geological	Reversibility	Likelihood	Consequence	Impact Significance
Surface Water	Quality	Direct	Short term	Regional	Reversible	Possibly	Low	Low
	Flow	Direct	Short term	Regional	Reversible	Possibly	Low	Low
Solid Waste	Generation	Indirect	Short term	Regional	Reversible	Possibly	Low	Low
	Quantity	Indirect	Short term	Regional	Reversible	Possibly	Low	Low
	Collection /segregation /dumping	Indirect	Short term	Regional	Reversible	Possibly	Low	Low
Air Pollution		Indirect	Short term	Regional	Reversible	Possibly	Low	Low
Noise		Indirect	Short term	Regional	Reversible	Possibly	Low	Low

6.17 EMP Reporting and Review Procedures (Communications and Documentation)

For effective management and monitoring of the environmental performance during the project activities, communication will be maintained by the project manager and environmental officer who will coordinate with the proponent and regulatory agency on necessary matters.

Following is suggested for an effective communication of project's performance during the assembling of machinery and operation phase of the project.

Kick-off Meeting to define the environmental responsibilities, awareness of EMP to the proponent and to streamline the work plan according to the EMP. This meeting is to be arranged prior to commencement of activities.

Quarterly Meetings to review the progress of activities performed and effectiveness of measures for pollution control. Deadlines are re-evaluated in meeting and if necessary, the project program is revised in these meetings. In the end of quarterly meetings, minutes will be issued to include the outcome of the meeting, issues discussed, and decisions. The minutes of meeting will also be provided to the project manager and the proponent for their own record.

Quarterly Reports: The purpose of these reports will be to review the performance of the operation by reviewing the number of non-conformances and the environmental incidences that occurred during the operation period, progress on daily action items and to list recommendations for additional controls, mitigation measures or monitoring requirements. The main contents of report will include the introduction, details of activities, resource use, environmental non-compliances, H&S records social issues (if any), photographic records, approvals, inspection and audits, change managements (if any) and trainings etc.



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6.18 Consultation/Case Studies

Dredger machine is in use in Indonesia and Nigeria since 2015.







7 CHAPTER 7: ENVIRONMENTAL MANAGEMENT PLAN

7.1 <u>Introduction</u>

This document provides an overall approach for managing and monitoring environment and social related issues and describes the institutional framework and resource allocations proposed by Proponent to implement the Environmental Management Plan (EMP) for the "Sand extraction with Dredger Machine". During the EIA process mitigation measures have been identified to minimize the adverse environmental impacts of the proposed project and to keep it within acceptable limits. The Environmental Management Plan (EMP) has been developed to effectively implement the monitoring and mitigation measures identified in the EIA. PEPA 1997 (Amended 2012) places strong emphasis on the preparation of EMP during project processing and on setting out conditions and targets to be met during project implementation.

7.2 <u>Institutional Arrangement</u>

The project will be implemented and monitored by the Proponent which will assign Engineer and over-all management support shall be handled by Contractor.

The Contractor

This individual / agency:

- complies with all applicable legislation, is conversant with the requirements of the EMP, and briefs staff about the requirements of same
- Ensures any sub-contractors/ suppliers, who are utilized within the context of the contract, comply with the environmental requirements of the EMP. The Contractor will be held responsible for non-compliance on their behalf
- Supplies method statements for all activities requiring special attention as specified and/or requested by the Engineer or Environmental Expert during the duration of the Contract
- provides environmental awareness training, to the staff
- bears the costs of any damages/ compensation resulting from non-adherence to the EMP or written site instructions



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- conducts all activities in a manner that minimizes disturbance to directly affected residents and the public in general, and foreseeable impacts on the environment
- ensures that the Engineer is inform timely manner of any foreseeable activities that will require input from the Environmental Expert
- appoints one fulltime Environmental Safeguard Officer for implementation of EMP, community liaison and reporting on day to day basis

Project Manager

This agency:

- is conversant with the requirements of the EMP and all applicable legislation
- Monitor the implementation of EMP on site and recommends requisite measures in case of non-compliances to proponent.

Engineer

This agency:

- Complies with all applicable legislation and is conversant with the requirements of the EMP
- arranges information meetings for and consults with interested and affected parties about the impending project activities
- enforces and monitors compliance with the requirements of EMP on site
- assesses the Contractor's environmental performance in consultation with the Environmental Expert
- documents in conjunction with the Contractor, the state of the site prior to commencing project activities

Environmental Officer

This individual:

- briefs the Contractor on the requirements of the environmental specification and/or EMP
- advises the Engineer on the interpretation, implementation and enforcement of the environmental specifications and other related environmental matters
- monitors and reports on the performance of the contractor/ project in terms of



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environmental compliance with the EMP to the Engineer/proponent

• provides technical advice relating to environmental issues to the Engineer

7.3 Training Schedules

Training and orientation programmes will be organized by the Environmental Experts, Engineers and proponent for the contractors, laborers, and technical/ office staff of the contractors, site engineers and the relevant staff or building their capacity with regards to principles and procedures of environmental management, pollution abatement measures, health and safety measures and implementation of EMP. Employees will be trained to use fire extinguishers in case of fire break out.

The potential impacts, mitigation measures, monitoring mechanism and responsibility of concerned institution are presented in Table 6.1

7.4 Equipment maintenance details

The maintenance of equipment is necessary for

- Achieving the best performance for the equipment and facilities.
- Reduction of the risks resulting from operation conditions to minimum levels.

For the current proposed project, it is therefore recommended to

- Prepare and keep the record of equipment maintenance log.(template of maintenance log is attached in annexure of the report)
- Prepare proper maintenance sheets for vehicles.
- Use fully tuned vehicles and machinery.

7.5 Environmental budget

Environmental budget for the project is 0.2 million. The proponent will plant ornamental and indigenous specie.

7.6 Environmental Monitoring Plan

Environmental monitoring is normally undertaken during the operational stage to ensure the effectiveness of the proposed mitigation measures. In order to respond to unexpected environmental concerns at an early stage and to determine the accuracy of impact, predictions are also required.



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The Proponent will manage all the environment related activities including its monitoring and reports. The Proponent will be responsible for all Environment related issues and the proponent has complete monitoring plan for project which will be strictly adhered.

7.7 Scope of Environmental Management Plan

The Environmental Management Plan (EMP) provides the framework for the implementation of mitigation measures and environmental management and monitoring for the project. This document contains all commitments made in the EIA Report to ensure that all environment protection measures are implemented.

Several measures have been identified in this EIA Report to prevent or mitigate the adverse environmental impacts generated by the project to ensure that these measures are incorporated in the operation phase of the project, it is necessary to develop a comprehensive Environmental Management Plan (EMP), this section outlines the EMP. The plan addresses the mechanism through which the measures will be implemented; defines the responsibilities of the workers and the management.

7.8 Roles and Responsibilities of EMP Team

Environmental Management Plan Team will have responsibility to implement the environmental mitigation measures and monitor environmental compliance of different activities during operation phase.

The responsibilities of EMP Team are as follows:

- To ensure implementation of all the proposed mitigation measures while the project is working.
- To implement the Environmental Management Plan.
- To ensure that the project is implemented in an environment friendly manner, causing least harm to the existing environment including flora and fauna, site of religious and cultural significance and minimal land acquiring etc.



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7.9 Environmental Management Plan

Table 7-1 Environmental Management Plan (EMP)

Aspects	Action	Frequency	Responsibility
Minimize the ground and surface water Pollution	Ensure that the machinery is properly maintained. Equipment must be regularly serviced and inspected to make sure there are no leaks of oil, diesel, fuel, detergents or hydraulic fluids. Servicing and maintenance of vehicles as far as possible must occur outside of the boundaries of permit area. If maintenance does occur on site due to breakdown, all steps must be undertaken to avoid hydrocarbon spills/leakages. Minimize petrol, diesel, and oil leaks by allocating a loading zone, which is protected against such leaks. Drip trays must be secured and emptied regularly. Secondary containment will be provided. Spilled hydrocarbon must be treated as a hazardous waste and needs to be disposed of as it occurs in appropriate hazardous waste containers and removed off site as soon as possible. No washing of equipment or machinery may occur on	Continuous	Project manager/ Environmental officer and contractor





	the permit site or in the watercourse Water quality monitoring of the river and storm water course will be implemented Spill kit will be used in case of any spill		
Maintain the hydrology of the landscape level	The hydrology of the landscape will be maintained by ensuring that extraction takes place away from the riparian zone along the north and south river banks and the stockpile area drainage is monitored.	Continuous	project manager/ Environmental officer
	The extraction of sand must not exceed the replenishment rate of sand during the rainy season.	Continuous	Project manager/ Environmental officer
	During flooding, siltation of the river will take place due to increased incidence of erosion of alluvial sand into the river from disturbed areas devoid of vegetation. Mitigation will involve ripping the soil in these areas and planting obligate and facultative wetland species to bind the soil prevent erosion and consequent siltation.	Continuous	project manager/ Environmental officer
Minimize soil erosion	Restrict river access to only one corridor through the Riparian buffer. Ensure water course is not altered to the extent that the integrity of the river banks are compromised and eroded.	On commencement of rehabilitation	Environmental officer





	Excavated filled slopes and stockpiles must be kept at a stable angle and capable of accommodating normal expected water flows	Continuous	Project Manager
	On any areas where the risk of erosion is evident, special measures may be necessary to stabilize the areas and prevent erosion.	Continuous	Project Manager
	Topsoil stripped from the operation footprint must not be spoiled but stockpiled and preserved for use in rehabilitation. Top-soil and sub-soil stockpiles and spoil sites to be placed on opposite sides of the access roads as this is where they will cause the least impact.	Continuous	Project Manager
Limit the disturbance and destruction of vegetation, fauna and habitat	All activity will be contained within the designated permit area. The Environment officer and Operation Manager must establish working and no-go areas, which need to be strictly adhered to.	Continuous	Project Manager / environmental officer
	The "no go" areas where possible must be clearly demarcated. There shall be no unauthorized entry, litter, stockpiling, dumping or storage of equipment or materials within the demarcated "no go" areas. If this does occur the developer shall be reliable for rehabilitation.	Continuous	Project Manager / environmental officer





	Keep surrounding vegetation, especially larger trees and shrubs, to create a screen that reduces flood impacts	Continuous	Project Manager / environmental officer
	All effort must be made to minimize the disturbance of wild animals on and within the close vicinity of the permit site	Continuous	Project Manager / environmental officer
	No trapping, snaring, hunting, fishing or killing of any animal may occur on the permit site.	Rehabilitation Phase	Project manager/ environmental officer
	Disturbed areas will be rehabilitated and vegetation planted to resemble the area prior to operation, both in terms of vegetation cover and habitat	Rehabilitation Phase	Project manager/ environmental officer
Vehicle access	The access road to the permit area must be established before operation commences and existing roads shall be used as far as possible Vehicle access must be strictly contained onsite. Vehicles may only use designated roads and access points as determined by the Environmental Officer and project Manager before operations commence	Continuous	project manager/ environmental manager
	When transporting sand on public roads, these will be kept clear of spills, leaks, mud and sand. Access road		





	and loading area will be properly maintained, and this includes appropriate storm water management and dust control		
Waste Management	There is not any worth mentioning solid waste will generate on site. If any solid waste will generate on site it will be disposed of in clearly marked bins and solid waste will be handover to the contractor Domestic/general waste and hazardous waste must be separated and bins clearly marked. No waste may be buried or burned Empty fuel storage drums will be handover to the authorized contractor.	Continuous	project manager
Sewage	Septic tank will be available. No disposal of sewage will occur on or near the site.	Continuous	Project Manager
Minimize atmospheric emissions and dust	Inspection of vehicles and warning systems will be implemented for vehicles emitting excessive emissions	Continuous	project manager
generation	Rehabilitation will ensure good vegetative cover which will reduce dust creation.	Rehabilitation Phase	project manager





Control noise	Hearing protection will be provided for employees operating heavy or noisy machinery. Noise level monitoring will be implemented if necessary.	Continuous	project manager
Reduce the visual impact	Site must be kept neat and tidy at all times A limit to the number of vehicles permitted access to the site per day must be enforced.	Continuous	project manager
Safety	Site access, including stockpile areas and loading areas will be fenced off to prevent unauthorized access. Correct signage must be available at the main access road and entrance of haul road to operation areas - includes authorization, access authorization, warning of activity, safety warning signs (protective equipment, fire & first aid boxes) and contact numbers No open fires shall be allowed on site under any circumstances	Continuous	HSE Officer





7.10 Costed Environmental Management Plan

Table 7-2 Costed Environmental Management Plan

Aspects	Action	Cost	Frequency	Responsibility
Health & Safety	Site access, including stockpile areas and loading areas will be fenced off to prevent unauthorized access. Correct signage must be available at the main access road and entrance of haul road to operation areas - includes authorization, access authorization, warning of activity, safety warning signs (protective equipment, fire & medical equipment) and contact numbers No open fires shall be allowed on site under any circumstances 0.1 million is reserved for Health and safety budget.	Ten Thousand rupees for Safety Signs Forty Thousand Rupees for Fire Fighting Equipment Forty Thousand Rupees for Personal Protective Equipment (PPEs) and First Aid Boxes Ten Thousand Rupees for bin for solid waste	Or when required.	HSE Officer
Tree Plantation	Ensure the re-establishment of riparian vegetation 0.2 million reserved for Tree Plantation	0.2 Million Rupees	Every month 8 thousand rupees	Environmental Manager





	or when required	

7.11 Rehabilitation Plan

Table 7-3 Rehabilitation Plan

Objective	Action	Time Frame	Responsibility
Prevent erosion of site If any topsoil removed during the operation phase it must be conserved and used in the rehabilitation and close out phase. No topsoil will be sold. This soil must be kept safe from erosion		Continuous	Environmental Officer
	The stockpile pad will be Re-shaped to remove any steep embankments and Re-vegetated during the final rehabilitation and closure phase.	Rehabilitation Phase	Environmental Officer
	After rehabilitation is complete, no topsoil will be left over.	Rehabilitation Phase	Environmental Officer
Rehabilitation	Any access road or portions thereof, constructed	Rehabilitation	Environmental Officer





of access roads and surrounding site	by the permit holder shall be removed and or rehabilitated to the satisfaction of the Environmental Officer.	Phase	
Site	Any gate or fence erected by the permit holder which is not required by the landowner, shall be removed and the land restored to the pre-mining state.	Rehabilitation Phase	Environmental Officer
Removal of infrastructure	There must be a removal of all toilets, bins, machinery and other equipment on site.	Rehabilitation Phase	Environmental Officer
Rehabilitate access to river	Rehabilitating the access point, the original profile of the river-bank will be re-established by backfilling the access point with the original material excavated or suitable material	Rehabilitation Phase	Environmental Officer
	Ensure the re-establishment of riparian vegetation	Rehabilitation Phase	Environmental Officer
Monitoring	Monthly Environmental Control Inspections will take place during operation and during rehabilitation to ensure that objectives are being met.	Monthly	Environmental Officer





Rehabilitate	All scrap and other foreign materials will be	Rehabilitation	Environmental Officer	
River	removed from the site.	Phase		ì
				ì





8 <u>CHAPTER 8: PROPONENT, RESPONSIBLE AUTHORITY, OTHER</u> <u>DEPARTMENTS, STAKEHOLDERS/ PUBLIC CONSULTATIONS</u>

8.1 General

Public consultation is a systematic process, which provides an opportunity for planners, citizens, managers and selected representatives to share their experience, knowledge and concerns and perceptions about any proposed development. The objectives of the public consultation for the proposed Project are to:

- Share information with the stakeholders on the proposed Project works and their expected impact on the socio-economic environment of the Study Area.
- Understand the stakeholder's concerns regarding the various aspects of the Project, including the existing condition of the Study Area, upgrade requirements, and the likely impacts of the construction related activities and operation of the Project..

The following methodologies were used for carrying out public consultation:

- Local communities, individuals affected and owners and employees of affected commercial establishments who are directly or indirectly affected were given priority while conducting public consultation.
- Walk-through informal group consultations in the proposed project area
- The local communities had been informed through public consultation with briefing on project interventions including its benefits.

The environmental concerns and suggestions made by the participants were listed out, discussed and suggestions were accordingly incorporated in the EMP.

8.2 <u>Identification of Stakeholders</u>

First setup for the stakeholder consultation is the identification of stakeholders.

Mr. Hafeez ur Rehman is the Proponent of this Project. The project has both primary as well as secondary stakeholders. As per definition, stakeholder is an entity which is concerned with the proposed project in any way. Direct stakeholders are those entities which are directly concerned with the project. The primary stakeholders include in the project are the affected persons according to the conditions, Environmental Protection Authority and District level



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concerned departments whereas the secondary stakeholders include the public and private agencies involved in the implementation of the project.

8.2.1 Consultation with Proponent's Environment Management Team

Findings of the consultations with proponent's environment management team are summarized in Table 8-1.

Table 8-1 Views of Proponent's Environment Management Team

Sr. No.	Name of respondent	Organization	Designation	Views
1.	Proponent's Environ	ment Managem	ent Team	Proponent will take care of surrounding environment. Plantation will be done. Water will be sprinkled on the site on daily basis to minimize the dust. Vehicles used for transportation of sand will be covered. Provision of Personal Protective Equipment (PPE) to all the workers. First aid will be provided immediately and in case of any serious accident, affected person will be shifted to the nearest hospital immediately. Unauthorized persons will not allow
				at the project site.

8.2.2 <u>Consultation with the Responsible Authority</u>

Findings of the consultations with Responsible Authority/EPA's team are summarized in Table 8-2.

Table 8-2 Views of Responsible Authority

Sr. No.	Name of respondent	Organization	Designation	Views
	EPA Officials			Consider all guidelines of Punjab EPA during preparation of





Environmental Impact Assessment Report.
Public consultation should be conducted.
Baseline study should be conducted. Primary and updated data should be used.
As the project is sand extraction/mining from river, proponent has to submit Environmental Impact Assessment Report.

8.3 Consultation with the Environmental Practitioners and Other departments

Findings of the consultations with Environmental Practitioners & other departments are summarized in Table 8-3.

Table 8-3 Findings of the consultations with Environmental Practitioners & other departments

Sr. No.	Name of respondent	Organization	Designation	Views
Enviro	nmental expert from	EnviroSafe Soc	ciety	Proponent should strictly follow Environmental Management plan Consider all guidelines of Punjab EPA during preparation of Environmental Impact Assessment. Proponent should plant trees.

8.3.1 Consultation with locals

Findings of the consultations with affected & wider community are summarized in Table 8.4

Table 8-4 List of Participants during the Public Consultations& Concerns

Sr. Location/ No. of Names of main Feedback/ Co	cerns
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No.	Venue	participants	Participants	Participants Concerns (Positive)	
1	River Tawi District Sialkot	1	Mr. Ashfaq Ali	Provide labor opportunities to locals.	None
2	River Tawi District Sialkot	1	Mr. Arslan Ahmad	In favor because sand quality is good and it is really good for construction purpose.	None
3	River Tawi District Sialkot	1	Mr. M. Imran	this is the batter option of sand extraction as compared to excavator.	None
4	River Tawi District Sialkot	1	M. Tahir Waseem	Proponent should cover the sand during transportation.	None
5	River Tawi District Sialkot	1	Mr. M. Arif	No issues regarding this project. Because this project improve the economic condition of the nearby area.	None
6	River Tawi District Sialkot	1	Mr. Bilal Qayyum	Remove the excess sand from river	None
7	River Tawi District Sialkot	1	Mr. Khalid	Sand is the Basic raw material for construction.	None
8	River Tawi District Sialkot	1	Mr. Ibrahim Ahmad Khan	People are satisfied with the project. On overall basis, this is a good project because it will provide raw material for construction Sand is used in all kind of construction which include, road,	None





				building etc.	
9	River Tawi District Sialkot	2	Mr. Masroor Ahmed Mr. Sami Ullah	No issues regarding this project because Sand extraction will reduce the danger of flood because it will increase the carrying capacity of the river.	None

8.3.2 <u>Feedbacks/Concerns Highlighted</u>

The people of the area are satisfied with the project because the project will provide the labor opportunities to the locals and improve the economic condition of the area.

The project will also provide the good quality of sand which is the basic raw material of construction.

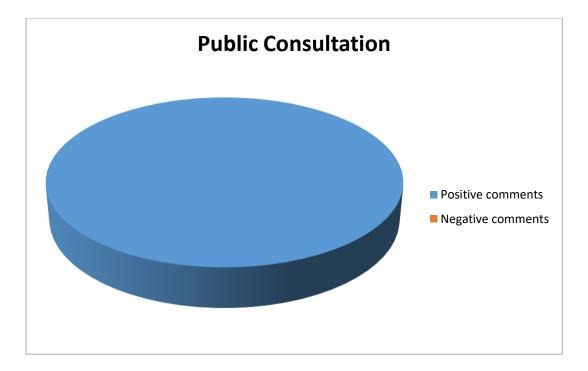


Figure 8-1 Statistical model for public consultation results





9 CHAPTER 9: RECOMMENDATIONS AND CONCLUSIONS

9.1 Recommendations

The Environmental Impact Assessment (EIA) Report and survey results are finally evaluated to recommend the following:

The present Environmental Impact Assessment (EIA) Report for Sand extraction from the River Bed with Dredger Machine meets the administrative and legal framework of the EPA Punjab.

- Provide all required PPEs to the workers.
- Diesel will be stored on site secondary containment will be provided. Spilled hydrocarbon must be treated as a hazardous waste and needs to be disposed of in appropriate hazardous waste containers and removed off site as soon as possible.
- No washing of equipment or machinery may occur on the permit site or in the watercourse. Spill kit will be used in case of any spill.
- The hydrology of the landscape will be maintained by ensuring that extraction takes place away from the riparian zone and the stockpile area drainage is monitored.
- The extraction of sand must not exceed the replenishment rate of sand during the rainy season.
- The area within the river must be contained and the stockpile area is limited to 0.5 hectares.
- All operation activity will be contained within the designated permit area. The Environment Officer and Project Manager must establish working and no-go areas, which need to be strictly adhered to. Keep surrounding vegetation, especially larger trees and shrubs, to create a screen that reduces flood impacts. Protected trees must be marked, their location recorded and must be avoided as best as possible. If any protected species cannot be avoided a permit must be applied for. No trapping, snaring, hunting, fishing or killing of any animal may occur on the permit site.
- The Proponent assign task of proper housekeeping near in and around the project site.



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- The Proponent plant indigenous plants and trees to increase the aesthetics of the inner and the surrounding area.
- Consider Fire safety precautions to prevent or reduce the likelihood of a fire to break out.
- Follow the maintenance and cleaning plan to keep the machines running smoothly and to avoid any spillage, leakage or shutdown.
- Placing and maintaining fire extinguishers in easily accessible places.
- Display of Safety and Information Sign Boards at required places.
- Adequate training of workers on use of firefighting system to deal with the situation as well as environmental and waste management trainings.
- Proper training of workers to operate the machine.
- Use advance technology for sand removing in the river bed and minimized the environment impacts on river banks.
- Sand mining in river bed will be one meter depth layer by layer up to 5 meters
- Maintained the river flow carrying capacity in active channel without any serious activities.
- Avoid pollution of river water leading to water quality deterioration.

9.2 <u>Conclusion</u>

The EIA Report for "Sand extraction with Dredger Machine from Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot, is made to fulfill the legal requirement of Pakistan Environmental Protection Act 1997 (amended 2012). In order to address the potentially adverse impacts of the project, particularly during the operational phase, an EMP has been developed, which will further improve the environmental performance of the project. The EMP assigns roles and responsibilities, provide environmental guidelines and discuss the scope of Environmental Management Plan.

The EIA Report has thoroughly assessed all the potential environmental impacts associated with the project. The environmental impacts identified by the study are manageable. Site



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specific and practically suitable mitigation measures are recommended to mitigate the impacts. The EIA concludes that constructional and operational phase of proposed project will not pose any major adverse environmental impacts on environment if the anticipated impacts are properly mitigated and the Environmental management Plan is properly implemented.





10 Annexures





10.1 Annexure: A: Glossary

- I. Environment: means air, water and land; all layers of the atmosphere; all organic and inorganic matter and living organisms; the ecosystem and ecological relationships; buildings, structures, roads, facilities and works; all social and economic conditions affecting community life; and the inter-relationships between any of the factors mentioned
- II. Effluent: means any material in solid, liquid or gaseous form or combination thereof being discharged from industrial activity or any other source and includes a slurry, suspension or vapour
- III. National Environmental Quality Standards: means the permissible standards for emission of air pollutants and noise and for discharge of effluent and waste
- **IV. Discharge:** means spilling, leaking, pumping, depositing, seeping, releasing, flowing out, pouring, emitting, emptying or dumping
- V. Waste: means any material, substance, or by-product eliminated or discarded as no longer useful or required after the completion of a process
- VI. Sustainability: means such developments that meet the needs of the present generation without compromising the ability of future generations to meet their needs
- VII. Baseline: Conditions prevailing at the time of study or before initiation of any project
- VIII. **Proponent**: the person who intends to carry-out a proposed project.
 - IX. **Ambient:** relating to the immediate surrounding of something
 - X. **Environment budget:** Monitory assets reserve for environmental activity.
 - XI. **pH:** negative log of hydrogen concentration:
- XII. Flora: plant life occurring in particular region or time.
- XIII. Fauna: Animal life occurring in particular region or time.
- XIV. **Base line:** Conditions prevailing at the time of study or before initiation of any project
- XV. **Nuisance:** A person, thing or circumstances causing inconvenience or annoyance.



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10.2 Annexure: B: List of Abbreviation

NOC No Objection Certificates

COD Chemical Oxygen Demand

BOD Biological Oxygen Demand

COD Chemical Oxygen Demand

TSS Total Suspended Solids

TDS Total Dissolved Solids

EMP Environmental Management Plan

PEQS Punjab Environmental Quality Standards

WHO World Health Organization

PEPA Punjab Environmental Protection Act

WAPDA Water and Power Development Authority

NCS National Conservation Strategy

ppm Parts per million

ppb Parts per billion

 Q_s Total sediment discharge (kg/s)

V Flow velocity (m/s)

 G_w Water discharge by weight (kg/s)

 S_o Slope of flow

 C_t Sediment concentration by weight (ppm by weight)

 C_{v} - Sediment concentration by volume (ppm by volume)

D Depth of flow

V Average channel velocity

S Energy slope

B Effective channel width

d Representative particle diameter

ρ Density of water



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$ ho_{s}$	Density of sediment particles
sf	Particle shape factor
d_{i}	Geometric mean diameter of particles in size class i
p_i	Fraction of particle size class i in the bed.
T	Temperature of water





10.3 Annexure: C: References

Guidelines for Preparation and Review of Environmental Report

Labour Laws

Meteorology Department Data (From Website)

National Environmental Policy

Punjab Environmental Quality Standards (Self- Monitoring And Reporting By Rules, 2001)

ISO 45001 for Health and Safety

Pakistan Environmental Protection Act, 1997

Pakistan Environmental Protection Order (PEPO) 1983

The Land Acquisition Act 1894

The Punjab Local Government Ordinance, 2001

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10.4 Annexure: D: Training Schedule

During operational Phase

Trainings	Responsibility	Duration	Timings	Training required for
Fire Fighting	HSE Officer/third party consultant	1 Day	9:00 am to 5:00pm	Staff/Workers
First aid	HSE Officer/third party Consultant	1 Day	9:00 am to 5:00pm	Staff/Workers



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10.5 Annexure: E: Consulted Organizations

10.5.1 Consultation with the Responsible Authority

Findings of the consultations with Responsible Authority/EPA's team are summarized in Table 10-1.

Table 10-1 Views of Responsible Authority

Sr. No.	Name of respondent	Organization	Designation	Views
	EPA Officials			Consider all guidelines of Punjab EPA during preparation of Environmental Impact Assessment Report. Public consultation should be conducted. Baseline study should be conducted. Primary and updated data should be used. As the project is sand extraction/mining from river, proponent has to submit Environmental Impact Assessment Report.



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Consultation with the Environmental Practitioners and other departments

Table 10-2Findings of the consultations with Environmental Practitioners & other departments

Sr. No.	Name of respondent	Organization	Designation	Views
Enviro	nmental expert from	EnviroSafe Soc	ciety	Proponent should strictly follow Environmental Management plan Consider all guidelines of Punjab EPA during preparation of Environmental Impact Assessment. Proponent should plant trees.





10.6 Annexure: F: Consultant

EIA Team

A core team of qualified professionals having relevant experience of conducting environmental and social assessments contributes to preparation of an Environmental Impact Assessment (EIA). The team shown in Table

Team Members

Name	Designation	Qualification	Responsibilities
Mr. Hassan Zahid	Lead Environmental Professional	PhD Researcher Environmental Management	Major responsibilities involve visit of the project area reviewed procedures, guidelines, legal and policy framework and applicable standards, collection of baseline data identification and evaluation of potential significant impacts of the project, developed mitigation measure and EMP preparation of EIA Report, Involve meeting with the client and other stakeholders Over all supervision and technical
			guidance to team and preparation of EIA report.
Mr. Abid Ali	Lead Environmental	M. Phil. Environmental	The responsibilities included collecting the baseline data through literature review, social surveys,
	Professional	Sciences	environmental monitoring and field observations, identification of impacts based on the collected data,
			recommendations for the mitigation of potential adverse impacts, preparation of a comprehensive environmental management and monitoring plan with detailed responsibilities of each activity,
			Identification of Impacts on flora fauna, tree counting, Prepare tree plantation plan and addressing mitigation of impacts and compilation of report.





Mr. Awais Hassan	Lead Environmental Professional	M. Phil. Environmental Sciences	The responsibilities include meeting with the client, site visit, and collection of baseline data, identification of impacts, addressing mitigation of adverse impacts, preparation of environmental management plan and preparation of EIA report as per EPA guidelines
Miss. Ayesha Hameed	Environmental Professional	MS. Environmental Sciences	The responsibilities include assistance in collection of baseline data, identification of impacts, addressing mitigation of adverse impacts, preparation of environmental management plan and help in report writing.
Miss Sumaira Saleem	Environmental Professional	M. Phil. Environmental Sciences	The responsibilities include assistance in field level data collection and report writing.
Miss Rabia Arshad	Environmental Professional	M. Phil. Environmental Sciences	Major responsibilities are providing assistance in arranging meetings with the stakeholders and client, Conduct public consultation meetings, data collection.





10.7 Annexure: G: TORs

TERMS OF REFERENCE (TOR)

Title of Project	Sand extraction with Dredger Machine
Title of Assignment	Preparation of Environmental Impact Assessment(EIA) Report
Proponent	Mr. Hafeez ur Rehman Mirza is the proponent of this project.
Location of Project	Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot.
Procurement Method	Formal Quotation

Introduction:

The proponent intends to extract Sand with Dredger Machine from Block No. River Tawi 1, near river Tawi, Tehsil District Sialkot. The area is on lease for two years.

Objectives of Environmental Impact Assessment (EIA):

The primary purpose of EIA process is to provide proponents and decision makers as well as members of the public, with an understanding of the potential environmental effects of the proposed action, so as to avoid or minimize environmental impacts wherever possible bearing in mind the cost and benefits of using the environmental resources in this particular project. EIA is an important tool for incorporating environmental concerns at the project inception/design stage level. The general objectives of the EIA Study are to provide the following information.

- Baseline Data about the environment condition in the project area.
- Information on potential impacts of the project and the characteristics of the impacts, magnitude and distribution.
- Information on potential mitigation measures to minimize the impacts.
- Preparation of Environmental Management & Monitoring Plan



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 To provide an understanding of the environmental impacts of the project for decision making

Scope of Work:

Scope of work includes all the activities required under EPA Guidelines and national legislation.

- Include the review of legal and institutional framework.
- Describe the project perspective, components and activities.
- Establish baseline condition of effected environment.
- Identify, assess and evaluate key adverse environmental impacts that may result from the activities of the project and address them.
- Identify, assess and recommend impact monitoring programme and compliance auditing programmes and estimate environmental cost.
- Prepare comprehensive Environmental Mitigation & Monitoring Plan (EMMP);
- Report all the findings and conclusion in the form of EIA Report which will lead to conduct the public hearing.

Key Deliverables:

- ➤ 10 Hard Copies of EIA Report shall be filed as per Regulation (8) of Review of IEE / EIA Regulations, 2000
- ➤ 2 Soft Copies of IEE/EIA Report shall be submitted along with report as per Regulation (8) of Review of IEE / EIA Regulations, 2000
- > EIA Report shall be accompanied by;
 - An application, in the form set out in Schedule IV of Review of IEE / EIA Regulations, 2000
 - An undertaking as per Schedule VII of Review of IEE / EIA Regulations, 2000
 - Copy of receipt showing payment of the review fee
- ➤ Reply of Query Letter (will be submitted if EPA require additional information)



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Qualifications:

Personnel involved in the survey and preparation of EIA Report of the said project will have the following qualifications;

- ➤ MS/M Phil Environmental Sciences
- > PhD Environmental Management
- MS. Landscape Engineering Land and water management

Responsibilities of Proponent:

- 1 Responsible to pay all the dues of the consultants as per the agreed terms and conditions.
- 2 According to regulation 7 of Review of IEE and EIA Regulations, 2000, proponent shall pay, at the time of submission of IEE/EIA, a non-refundable review fee to EPA, in accordance with rates specified in schedule III.
- 3 Provide all documents / details required for completion of EIA Report
- 4 Proponent shall be responsible for paying any fines / penalties levied by the EPA Punjab or Environment Tribunal
- 5 Proponent shall be responsible for the validity and correctness of the information provided to the consultants

Client	Consultant



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10.8 Annexure H: Equipment Maintenance Details

EQUIPMENT MAINTENANCE DETAILS:

Date:

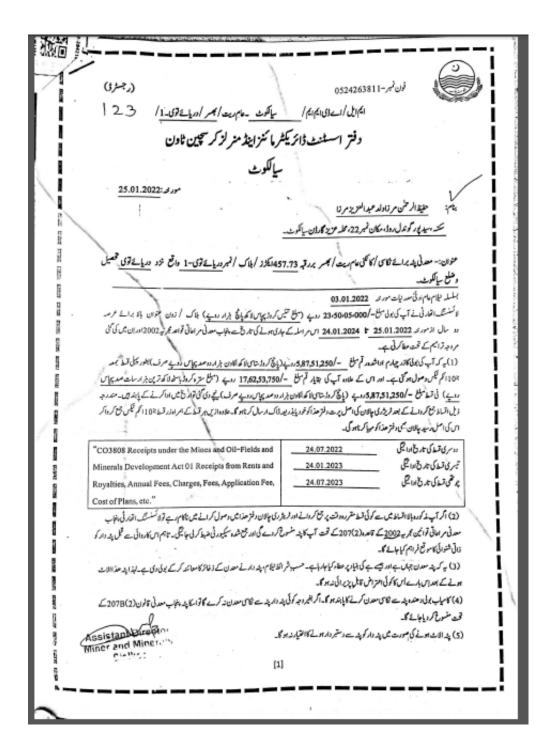
Sr no.	Name of Equipment	Model No.	Last Maintenance Done	Next Maintenance Planned
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02				
03				
04				
05				
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07				
08				
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10				

Signed By:		



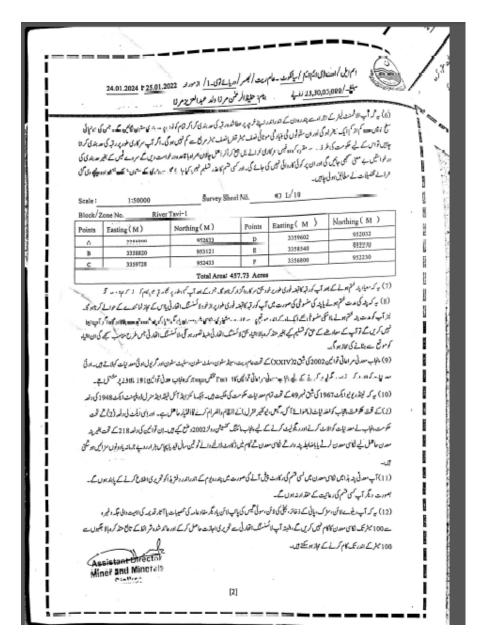


10.9 Annexure I: Lease Documents









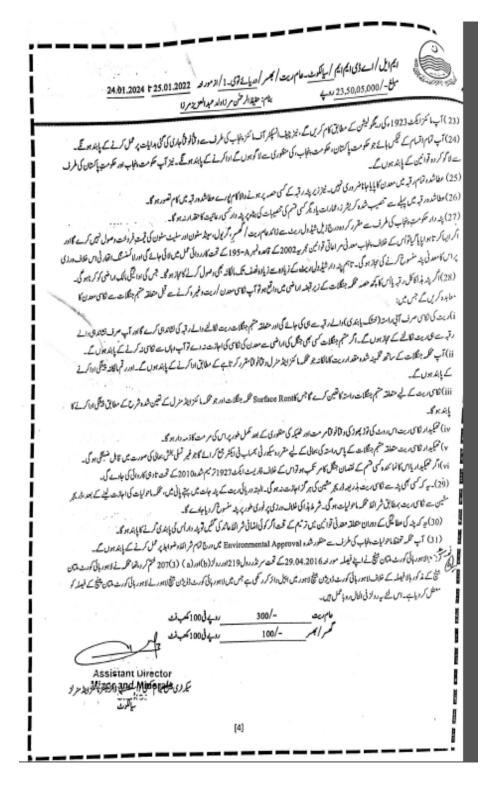


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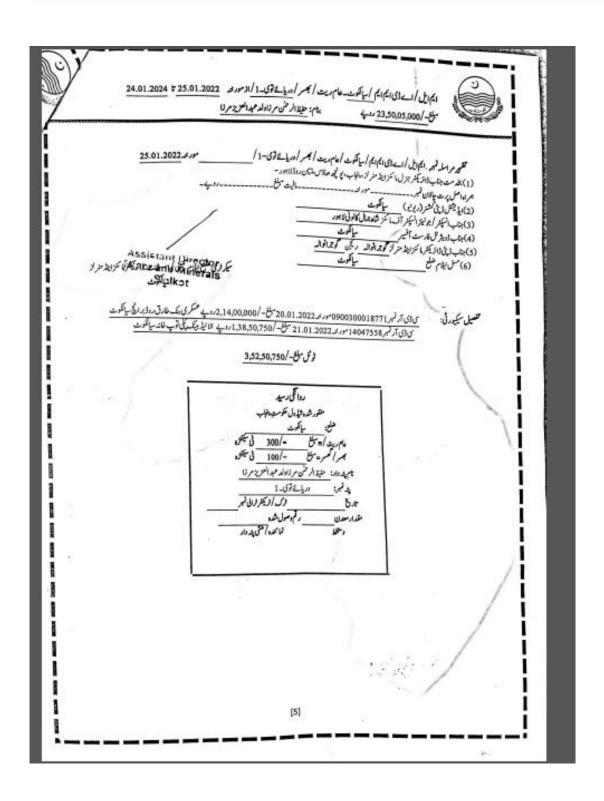


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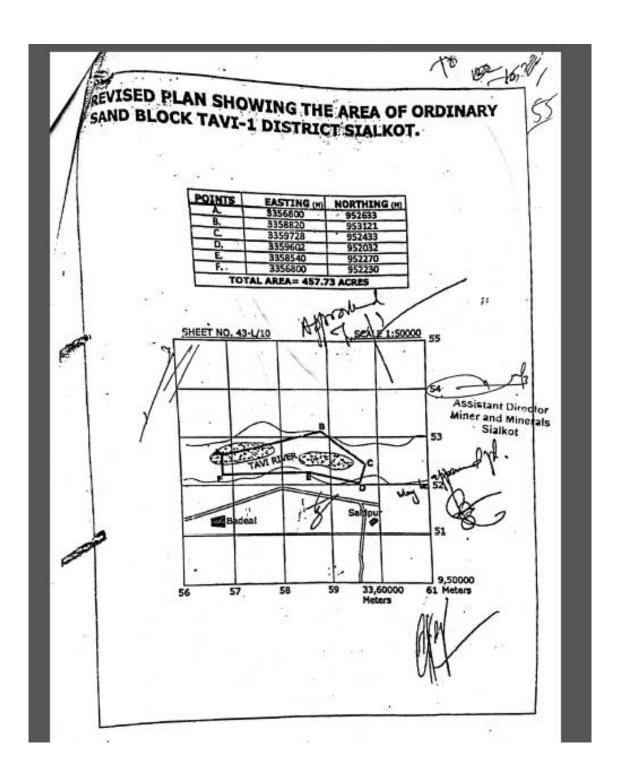


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10.10 Annexure J: Public Consultation Forms





	day / date:
Name & Location of the Po	gied
Sand Extraction with a River Tawi 1, NBay Sial Kot	dredger from Block No. River Tawi, Tehsil District
Name of Person Interviews M. Imrain Khalid	ewed
Remarks This is the bett Extraction Excavator	ter aption of Sand as Compared to
Interviewer	Interviewee M. Turan
	سخ الد





Environmental Impact Assessment (EIA) Report Public Consultation Forms. day / date: Name to Location of Project: Sand Extraction with dredger Machine Jram Block No. River Tawi I near River Tawi, Tehsil District. Sialkot Name of Person Interviewed ا الرائع اعد خان Remarks دوگوں کر میاں کا کرنے کا موقع سالکا ریت تھے اتی کا میں اسمال ہوتی ہے اور بہاں سے ریت تھے ایک کا سے مطعنیں میں ۔ Signature of Person Interviewed Signature of Interviewer





Name & Lanting of the Project	day / date:
Name & Location of the Project	
Sand Extraction with Drea River Tawi 1 Near Rive Sialkot.	dger from Block No. I Tawi, Tehsil Distric
Name	
Tahir Wascem	
M. Arif	
M. Arifo Silal Qayyum	
Remarks	
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> Project will improve Eco	nomic Condition of the areas
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		day / date:
Name	E Location of Pro	jed
Sa Block Tehs	nd Extraction No. River Tar Il District	with dredges Machine from wi 1 near River Taw. Sialkot.
Name	of Pexson Inte	rviewed
Rema	M. Musso	or Ahmed, Sami Ullach
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