BLUE STAR ENERGY (PRIVATE) LIMITED

Lahore: 36, Sector B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel 0092-937-520004, 92 321 4453447 FAX: 0092-937-520574

email amarkhalid@hotmail.com NTN # 2217217 Company Registration No 13370/20040302 Sales Tax Registration # 0504720600164

No : BSEPL/17/NEPRA/LIC/3
Dated : 6th September 2017

To: Mr. Syed Safeer Hussain,
Registrar NEPRA,
NEPRA Tower, Attaturk Avenue (East), Sector G-5/1,
Islamabad.

Subject: Application for Generation License Pursuant To "NEPRA Licensing (Application & Modification Procedure) Regulatic 1999" for 2.8 MW Khokhra Hydro Electric Power Plant by Blue Star Energy (Private) Limited

Dear Sir,

1. It is humbly submitted that Punjab Power Development Board, Government of PUNJAB, vide its letter no. PPDB/435/2017 dated 14th Mar. 2017, has appreciated the efforts made by Blue Star Energy Private Limited towards completion of Feasibility Study of 2.8 MW Khokhra Hydropower Project, district Gujrat, Punjab and directed Blue Star Energy Private Limited to apply for Upfront Tariff for the said project. The Upfront Tariff has been announced by NEPRA for Small Hydro Power Generation Projects upto 25 MW installed capacity on 14th October 2015. In such a case, it is a pre-requisite to apply for Generation License.

2. Pursuant to "NEPRA Licensing (Application & Modification Procedure) Regulation 1999", the Application for Generation License for Khokhra Hydropower Project is submitted herewith in triplicate as enclosure to this letter, for approval of Worthy Authority.

3. The documents required for Generation License for a new Hydel facility as per the "NEPRA Licensing (Application & Modification Procedure) Regulation 1999" are attached parawise.

4. It is intended to sell the electric power to GEPCO under the provisions of Section 8.2.1 of "Policy for Development of Renewable Energy for Power Generation-2006" issued by GOP on 16 Dec 2006.

5. Generation License Application Fee in the form of P.O. no. 02918787 amounting Rs 146,864/= is enclosed.

Best regards

Yours Sincerely,

Blue Star Energy (Pvt) Ltd.

Director,
Amar Khalid.

Salient Features of 2.8 MW Khokhra Hydropower Project

1)	**Location**	Near Khokhra Headworks on Gujrat Branch at RD 255 of UJC
2)	**Name of canal**	Gujrat Branch
3)	**Design discharge Qd**	1433 cusecs (40.6 m^3/sec)
4)	**Design head Hd**	26.74 ft (8.15 meter)
5)	**Construction period**	24 months
6)	**Head race (Brick lined)**	
	Design discharge	1537 cusecs
	Length	304 ft
	Bed width	37 ft
	Side slopes	1.5H : 1V
	Bed slope	1 : 10,000
7)	**Tail race (Brick lined)**	
	Design discharge	1433 cusecs
	Length	1800 ft
	Bed width	60 ft
	Side slopes	1.5H : 1V
	Bed slope	1 : 5,000
8)	**Chillianwala Distributary (Brick lined)**	
	Bed width	9.16 ft
	Side slopes	1.5H : 1V
9)	**Powerhouse**	
	Length	50 ft
	Width	51.25 ft
	Height	37.50 ft
	Type of turbine	Kaplan style
	No of Units	2 Nos

	Installed capacity	(2 x 1.4 MW) = 2.8 MW
	Annual energy	16.488 GWh
	Plant factor	67.0 %
1b)	**Cost of Project** (in million US $)	
	Total Project Cost	**11.815**

GOVERNMENT OF PAKISTAN

CERTIFICATE OF INCORPORATION

(Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)

Company Registration No. 13370/20040302

I hereby certify that "BLUE STAR ENERGY (PRIVATE) LIMITED"

xx xx xx xx

xx xx xx xx

is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by Shares.

Given under my hand at Lahore

this 24th day of MARCH

two thousand and Four.

Fee Rs. =40,200/-

Certified to be True

MAR KHAN

(TAHIR MAHMOOD)

JOINT REGISTRAR OF COMPANIES

NO. JRL/ 19134 DATED: 24.3.04

CERTIFIED TO BE TRUE COPY

ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

11/1/2017

Blue Star Energy

CRO-I

THE COMPANIES ORDINANCE, 1984

--:o:--

(PRIVATE COMPANY LIMITED BY SHARES)

--:o:--

Memorandum of Association

of

BLUE STAR ENERGY (PRIVATE) LIMITED

I. The name of the Company is "**BLUE STAR ENERGY (PRIVATE) LIMITED**".

II. The Registered Office of the Company will be situated in the Province of Punjab, Pakistan.

III. The Sole Object of the Company is :-

1. To set up an undertaking for production of electricity and for its further utilization either for self use or for manufacture of other goods / materials or sale to another party.

2. In order to achieve the above object, the Company is authorised :-

   (a) To market all its products both in and outside Pakistan.

   (b) To import, purchase from local market or fabricate the plant and machinery for the purpose of installation or operation of the unit and for that purpose, purchase land and acquire any other utility, to purchase or import raw materials, chemicals, spares, stores and other articles for use as required by the Company.

   (c) To hire manpower / labour either from inside Pakistan or from abroad under the applicable rules, for making the undertaking operational or for its running.

   (d) To borrow or raise money by means of loans or other legal arrangements from banks, or other financial institutions, or Directors in such manner as the Company may think fit and in particular by issue of debentures, debenture-stock, perpetual or otherwise convertible into shares and to mortgage, or charge the whole or any part of the property, assets of the Company, present or future, by special assignment or to transfer or convey the same absolutely or in trust as may seem expedient and to purchase, redeem or pay off any such securities.

   (e) To open bank accounts of the Company and to draw, accept, make, endorse, discount, execute and issue cheques, promissory notes, bills of exchange, bills of lading or other negotiable or transferable instruments related to the business of the Company.

Certified to be True.

MAR

Star Energy (Pvt) Ltd.

(f) To arrange local and foreign currency loans from scheduled industrial banks and other financial institutions for the purchase and import of machinery, construction of factory, building material and for working capital or for any other purpose of the Company.

(g) To guarantee the performance of contract and obligations of the Company in relation to the payment of any loan, debenture, bonds, obligations or securities issued by or in favour of the Company and to guarantee the payment or return on such investments.

(h) To distribute any of the property of the Company amongst the members in specie or kind at the time of winding up.

(i) To carry out joint venture agreements with other companies or countries.

(j) To cause the Company to be registered or recognised in any foreign country.

(k) To apply for and obtain necessary consents, permissions and licences from any Government, State, Local and other Authorities for enabling the Company to carry on any of its object into effects.

(l) To invest and deal with surplus moneys of the Company not immediately required in such manner as may from time to time be determined.

(m) To do all such other things as may be deemed incidental or conducive to the attainment of the above object.

(n) To guarantee the payment of money unsecured or secured by or payable under or including but not limited to in respect of promissory notes, bonds, debentures, loan finances debenture stock, contracts, mortgage, charges, obligations, instruments and securities of associated companies [redacted] and generally to guarantee or become sureties for the performance of any contracts or obligations of associated companies [redacted].

3. It is declared that notwithstanding anything contained in the foregoing object clause of this Memorandum of Association, nothing contained therein shall be construed as empowering the Company to undertake or to indulge in business of banking company, banking, leasing, investment or insurance business directly or indirectly as restricted under the law or any other unlawful operation.

IV. The liability of the members is limited.

V. "The Authorised Capital of the Company is Rs. 50,000,000 (Rupees fifty million only) divided into 5,000,000 (Five million) ordinary shares of Rs. 10/- (Rupees ten only) each with power to increase or reduce the Capital or the Company and to divide the shares in the Capital for the time being into several classes in accordance with the provisions of the Companies Ordinance 1984 ".

23/7/06

Certified to be true

MAP

Blue Star Energy (Pvt) Ltd.

We, the several persons whose names and addresses are subscribed below, are desirous of being formed into a Company, in pursuance of this Memorandum of Association, and we respectively agree to take the number of shares in the Capital of the Company as set opposite to our respective names.

Name and Surname (Present & Former) In Full (In Block Letters)	Father's Name (In Full)	Nationality with any former Nationality	Occupation	Residential Address (In Full)	Number of shares taken by each subscriber	Signature
1 MISS SIDRA KHALID N.I.C. # 38103-9471400-6	*D/o Brig.* Khalid Parvez Nadeem	Pakistani	Architect	House No. 35, Street No. 19, Cavlary Ground, Shami Road, Lahore - Cantt.	100 One Hundred	
2 MR. AMAR KHALID N.I.C. # 38103-2245072-7	*S/o Brig.* Khalid Parvez Nadeem	Pakistani	Computer Engineer	House No. 35, Street No. 19, Cavlary Ground, Shami Road, Lahore - Cantt.	100 One Hundred	AMAR KHALID
				Total Number of Shares Taken	200 Two Hundred	

CERTIFIED TO BE TRUE COPY

ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

Dated this 24th day of Mar 2004

Witness to the above signatures :

Full Name : MUHAMMAD SAEED

N.I.C. # 35202-2495173-9

Father's
Full Name : MUHAMMAD SHARIF

Signature ....Saeed........

Nationality : Pakistani

Occupation : Private Service

Full Address : 19 - Umer Block,
Allama Iqbal Town,
LAHORE.

Certified to be True.

AMAR KHALID

Blue Star Energy (Pvt) Ltd

THE COMPANIES ORDINANCE, 1984

--:o:--

(PRIVATE COMPANY LIMITED BY SHARES)

--:o:--

Articles of Association of

BLUE STAR ENERGY (PRIVATE) LIMITED

PRELIMINARY

1. Subject as hereinafter provided, the Regulations contained in Table 'A' of the First Schedule to the Companies Ordinance, 1984, (hereinafter referred to as Table 'A') shall apply to the Company so far as those are applicable to Private Companies, with the exception of the Regulations which are modified, altered or added hereunder.

PRIVATE LIMITED COMPANY

2. The Company is a Private Company within the meaning of Clause (28) of Section 2(1) of the Companies Ordinance, 1984 and accordingly :-

(a) No invitation shall be issued to the public to subscribe for any shares, debentures or debenture-stocks of the Company.

(b) The number of members of the Company (exclusive of persons in the employment of the Company) shall be limited to fifty provided that for the purpose of this provision when two or more persons hold one or more shares in the Company jointly they shall for the purposes of this clause be treated as a single member ; and

(c) The right to transfer shares in the Company is restricted in the manner and to the extent hereinafter appearing.

BUSINESS

3. The Company is entitled to commence business from the date of its incorporation.

4. The business of the Company shall include the object enumerated in the Memorandum of Association.

Certified to be True

Blue Star Energy (Pvt) Ltd.

MAR Khan

5. The business of the Company shall be carried out at such place or places in the whole of Pakistan or elsewhere as the Directors may deem proper or advisable from time to time.

CAPITAL

6- "The Authorized Capital of the Company is Rs. 50,000,000 (Rs. Fifty million only) divided into 5,000,000 (Five million) ordinary shares of Rs. 10/- (Rupees ten only) each with power to increase, reduce, consolidate, sub-divide or otherwise re-organize the share capital of the Company".

7. The shares shall be under the control of the Board of Directors who may allot or otherwise dispose of the same to such persons, firms, corporation or corporations on such terms and conditions and at any such time as may be thought fit.

8. The shares in the capital of the Company may be allotted or issued in payment of any property, land, machinery or goods supplied or any services rendered to the Company or promotion or formation of the Company or conduct of its business and any shares so allotted may be issued as fully paid shares.

SHARES, TRANSFER AND TRANSMISSION

9. Every person whose name is entered as a member in the Register of Members shall without payment, be entitled to a certificate under the Common Seal of the Company specifying the shares held by several persons. The Company shall not be bound to issue more than one certificate and delivery of a share certificate to any one of several joint holders shall be sufficient delivery to all.

10. The Directors may decline to register any transfer of share to transferee of whom they do not approve and shall not be bound to show any reasons for exercising their discretion subject to the provisions of Sections 77 and 78 of the Companies Ordinance, 1984.

11. No share can be mortgaged, pledged, sold, hypothecated transferred or disposed off by any member to a non-member without the previous sanction of the Board of Directors.

12. The legal heirs, executors or administrators of a deceased holder shall be the only persons to be recognised by the Directors as having title to the shares. In case of shares registered in the name of two or more holders the survivors and the executors of the deceased shall be the only persons to be recognised by the Company as having any title to the shares.

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Certified to be True

Blue Star Energy (Pvt) Ltd.

GENERAL MEETING

13. The First Annual General Meeting shall be held within 18 months from the date of incorporation of the Company in accordance with the provisions of Section 158 and thereafter once at least in every year and within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding Annual General Meeting as may be determined by Directors. The Directors may, whenever they think fit, call an Extraordinary General Meeting of the shareholders in terms of Section 159 of the Companies Ordinance, 1984.

PROCEEDINGS AT GENERAL MEETING

14. Twenty one days' notice atleast specifying the place, day and hour of the General Meeting and in case of special business the general nature of such business, shall be given to the members in the manner provided in Table "A" but accidental omission to give such notice to or non-receipt of such notice by the member shall not invalidate the proceedings of the General Meeting.

15. The Chief Executive, with the consent of a meeting at which quorum is present and shall if so directed by the meeting may adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place.

QUORUM

16. No business shall be transacted at any General Meeting unless a Quorum of members is present at the time when the meeting proceeds to business. Two members, present in person, representing not less than 25% of the total voting power either on their own account or as proxies, shall form a Quorum for a General Meeting.

VOTES OF MEMBERS

17. At any General Meeting a resolution put to the vote of the General Meeting shall be decided on a show of hands, unless a poll is demanded in accordance with the provisions of Section 167 of the Companies Ordinance, 1984.

18. On a show of hands every member present shall have one vote and on a poll, every member present in person or by proxy shall have one vote in respect of each share held by him.

19. The instrument appointing a proxy and the power of attorney or other authority under which it is signed or notarially certified copy of that power of attorney or authority shall be deposited at the Registered Office of the Company not less than forty eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote and in default, the instrument of proxy will not be treated as valid.

Certified to be True

Blue Star Energy (Pvt) Ltd.

CHAIRMAN

20. The Directors may from time to time appoint one of their members to be the Chairman of the Company for a period not exceeding three years on such terms and conditions as they deem fit. The Chairman shall preside over the meetings of the Board of Directors and members of the Company. In his absence, the Directors may elect one of them to preside over Board's / General Meetings. The questions arising at the meeting of the Directors shall be decided by a majority of votes. In the case of equality of votes, the Chairman or the Director presiding over the meeting, as the case may be, shall have a casting vote.

CHIEF EXECUTIVE

21. The first Chief Executive of the Company will be appointed by the Board of Directors within fifteen days from the date of incorporation of the Company who shall hold office till the first Annual General Meeting.

DIRECTORS

22. Unless otherwise determined, the number of Directors shall not be less than two. The following will be the first Directors of the Company.

1. **MISS SIDRA KHALID**
2. **MR. AMAR KHALID**

23. The election of the Directors shall be held in accordance with the provisions of Section 178 of the Companies Ordinance, 1984.

24. The first Directors including the Chief Executive, shall hold office upto the First Annual General Meeting in accordance with the provisions of the Companies Ordinance, 1984, unless any one of them resigns earlier or becomes disqualified for being Director or otherwise ceases to hold office.

25. A resolution for removing a Director shall not be deemed to have been passed if the number of votes against him is equal to, or less than the number of votes that would have been necessary for the election of Directors at the immediately preceding annual election of Directors in the manner aforesaid but as provided under Section 181 of the Companies Ordinance, 1984.

26. The remuneration of Directors except regularly paid Chief Executive and full time working Directors shall, from time to time, be determined by the Board of Directors but it shall not exceed Rs. 500/- per meeting at which the Directors are present.

Blue Star Energy (Pvt) Ltd. ★

Certified to be True.

AMAR KHALID

27. The Directors may sanction the payment of such additional sums as they may think fit to any Director for any special service he may render to the Company or be thought capable of rendering either by fixed sum or in any other form as may be determined by the Directors subject to the provisions of the Companies Ordinance, 1984.

28. The Director who resides out of station shall also be entitled to be paid such travelling and other expenses for attending the meeting for the Company as may be fixed by the Directors from time to time according to the provisions of the Companies Ordinance, 1984.

29. Any casual vacancy occurring on the Board of Directors shall be filled in by a resolution of the Board of Directors and the person so appointed shall hold office for the remainder of the term of the Directors in whose place he is appointed.

30. No Director shall be disqualified from his office by contracting with the Company either as vendor, purchaser or otherwise nor shall any Director be liable to account for any profit realised from any such contract or arrangement or the fiduciary relation thereby established, but the nature of his interest must be disclosed by him at the first meeting of the Directors after acquisition of his interest.

NOMINEE DIRECTOR

31. In addition to the elected Directors, the Financial Institutions shall be entitled, during the currency of their respective loan(s) to the Company to appoint one person on the Board of Directors of the Company to be called Nominee Director and to recall and/or replace such a person from time to time. Such Nominee Director on the Board of Directors of the Company may not be holders of share(s) in the Capital of the Company and regulations and/or rules pertaining to the election, retirement, qualification and/or disqualification of Directors shall not apply to him.

NOTICES

32. Notices for every meeting of the Board of Directors will be given in writing and there must be given a reasonable time in advance. The nature of the business to be transacted at an intended Board meeting will be specified in the notice.

MANAGEMENT

33. The whole business and affairs of the Company shall, subject to the control and supervision of the Board of Directors, be managed and controlled by the Chief Executive.

Blue Star Energy (Pvt) Ltd.

Certified to be True

34. Subject to the limit fixed by the Directors, the Chief Executive may from time to time raise or borrow any sums of money for and on behalf of the Company from other companies, banks or financial institutions on such terms as may be approved by the Board of Directors from time to time.

35. Without prejudice to the powers conferred by these Articles, the Board of Directors shall have the following powers :-

(a) To take on lease, purchase, erect or otherwise acquire for the Company any assets, stocks, lands, buildings, property, rights or privileges which the Company is authorised to acquire at such price and generally on such terms and conditions as they think fit.

(b) To let, mortgage, sell, exchange or otherwise dispose of absolutely or conditionally all or any part of the assets, stocks, raw materials, properties, privileges and undertaking of the Company upon such terms and conditions and for such consideration as they think fit.

(c) To appoint any person or persons to be attorney or attorneys of the Company for such purposes and with such powers, authorities and discretions and for such period and subject to such conditions as they may, from time to time, think fit.

(d) To enter into, carry out, rescind or vary all financial arrangements with any bank, person, company, firm or corporation or in connection with such arrangements to deposit, pledge or hypothecate property of the Company or the documents representing or relating to the same.

(e) To make and give receipts, release and discharge all moneys payable to the Company and for the claims and demands of the Company.

(f) To compound or allow time to the payment or satisfaction of any debt due to or by the Company and any claim and demands by or against the Company and to refer claims or demands by or against the Company to arbitration and observe and perform the awards.

(g) To institute, prosecute, compromise, withdraw or abandon any legal proceedings by or against the Company or its affairs or otherwise concerning the affairs of the Company.

MAP

Certified to be True.

Blue Star Energy (Pvt) Ltd

(h) To raise and borrow money from time to time for the purposes of the Company, on the mortgage of its property or any part thereof and/or on any bond or debenture payable to bearer otherwise repayable in such a manner and generally upon such terms as they think fit.

(*i*) To open, operate and maintain bank/banks account(s) individually or jointly as the Board may authorise or to any other person on its behalf.

BORROWING POWERS

36. The Directors may from time to time raise, borrow or secure the payment of any sums for the purposes of the Company in such manner and upon such terms and conditions as they think fit and in particular by the issue of debentures, debenture-stock or other securities charged upon all or any part of the property of the Company present or future.

37. Debentures, debenture-stock, or other securities may be issued with any special privileges as to redemption, surrender, allotment of shares, attending and appointment of Directors or other privileges subject to any permission required by law.

THE SEAL

38. The Company shall have a Common Seal and the Directors shall provide for the safe custody of the same. The Seal shall not be applied on any instrument except by the authority of the Board of Directors and in the presence of atleast two Directors who shall sign every instrument to which the Seal shall be affixed in their presence. Such signatures shall be conclusive evidence of the fact that the Seal has been properly affixed.

ACCOUNTS

39. The Directors shall cause to be kept proper books of account as required under Section 230 of the Companies Ordinance, 1984.

40. The books of account shall be kept at the registered office of the Company or at such other place as the Directors shall think fit subject to the provisions of Section 230 of the Companies Ordinance, 1984.

AUDIT

41. Once at least in every year the accounts of the Company shall be audited and correctness of the Balance Sheet shall be ascertained by one or

Blue Star Energy (Pvt) Ltd.

Certified to be True.

more Auditors. The Auditors shall be appointed and their duties regulated in accordance with the provisions of Section 252 to 255 of the Companies Ordinance, 1984.

INDEMNITY

42. In connection with carrying on the business of the Company, the Chief Executive, every Director, or other officers of the Company shall be indemnified by the Company for all losses and expenses occasioned by error of judgement or oversight on his part, unless the same happens through his own dishonesty or wilful act and defaults.

SECRECY

43. No member shall be entitled to visit and inspect the Books of the Company without the permission of the Chief Executive or one of the Directors or to require discovery of any information regarding any detail of the Company's business or any matter which is or may be in the nature of trade secret, or secret process which may relate to the conduct of the Company's business and which in the opinion of the Directors, will not be in the interest of the members of the Company to communicate to the public.

ARBITRATION

44. Whenever any difference arises between the Company on the one hand and the members, their executors, administrators or assignee on the other hand, touching the true intent or construction or the incident or consequence of these present or of the statutes or touching any thing thereafter done, executed, omitted or suffered in pursuance of these presents or otherwise relating to these presents or to any statutes affecting the Company, every such difference shall be referred for the decision of the arbitrator who will be qualified in Islamic law.

45. The cost incidental to any such reference and award shall be at the discretion of the arbitrator or umpire respectively who may determine the amount thereof and direct the same to be shared between the attorney and client or otherwise and may award by whom and in what manner the same shall be borne and paid.

WINDING UP

46. If the Company is wound up whether voluntarily or otherwise the liquidator may, with the sanction of a special resolution, divide amongst the contributories in specie any part of the assets and liabilities of the Company, subject to Section 421 and other provisions of the Companies Ordinance, 1984 as may be applicable.

Blue Star Energy (Pvt) Ltd

Certified to be True.

We, the several persons whose names and addresses are subscribed below, are desirous of being formed into a Company, in pursuance of these Articles of Association, and we respectively agree to take the number of shares in the Capital of the Company as set opposite to our respective names.

Name and Surname (Present & Former) in Full (in Block Letters)	Father's Name (in Full)	Nationality with any former Nationality	Occupation	Residential Address (in Full)	Number of shares taken by each subscriber	Signature
1 MISS SIDRA KHALID N.I.C. # 38403-9471400-6	D/o Brig. Khalid Parvez Nadeem	Pakistani	Architect	House No. 35, Street No. 19, Cavlary Ground, Shami Road, Lahore - Cantt.	100 One Hundred	
2 MR. AMAR KHALID N.I.C. # 38403-2245072-7	S/o Brig. Khalid Parvez Nadeem	Pakistani	Computer Engineer	House No. 35, Street No. 19, Cavlary Ground, Shami Road, Lahore - Cantt.	100 One Hundred	AMAR KHALID
				Total Number of Shares Taken	200 Two Hundred	

CERTIFIED TO BE TRUE COPY
ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE.

Dated this 24th day of March 2017

Witness to the above signatures :

Signature ....

Full Name : MUHAMMAD SAEED

N.I.C. # 35202-2495173-9

Father's
Full Name : MUHAMMAD SHARIF

Nationality : Pakistani

Occupation : Private Service

Full Address : 19 - Umer Block, Allama Iqbal Town, LAHORE.

Blue Star Energy (Pvt) Ltd.

Certified to be True.

AMAR KHALID

"THIRD SCHEDULE"

(See section 156)

FORM A- ANNUAL RETURN OF COMPANY HAVING SHARE CAPITAL

8432/3/
1225

1	Registration No.	0047084
2	Name of the Company	BLUE STAR ENERGY (PVT) LIMITED.

3	Form A made upto (Day /Month / Year)	31-10-2015
4	Date of AGM (Day/Month/Year)	31-10-2015

PART-A

5	Registered office address:	# 37-B, Street No. 1, Askari-10, Lahore Cantt, Lahore.
6	Email Address:	Brig.khalid@gmail.com
7	Office Tel. No.:	042-36501086
8	Office Fax No.:	042-36500086
9	Nature of Business:	Energy Generation

10	Authorized Share Capital			
	Type of Shares	No. of Shares	Amount (Rs.)	Face Value (Rs.)
	Ordinary Shares	5,000,000	50,000,000/-	10/-

11	Paid up Share Capital			
	Type of Shares	No. of Shares	Amount	Issue Price
	Ordinary Shares	4,500,000	45,000,0000/-	10/-

12	Amount of indebtedness on the date upto which form A is made in respect of all			
	Mortgages / Charges			
13	**Particulars of the holding company** N / A			
	Name			
	Registration No.	% Shares Held		
14	**Chief Executive**			
	Name	BIRG. (R) KHALID PERVEZ NADEEM	NIC	38403-6486101-1
	Address	# 37-B, Street No. 1, Askari-10, Lahore Cantt, Lahore.		
15	**Chief Accountant**			
	Name	AMAR KHALID	NIC	38403-2245072-7
	Address	# 37-B, Street No. 1, Askari-10, Lahore Cantt, Lahore.		
16	**Secretary**			
	Name	AMAR KHALID	NIC	38403-2245072-7
	Address	# 37-B, Street No. 1, Askari-10, Lahore Cantt, Lahore.		
17	**Legal Adviser**			
	Name	Pervez & Company		
	Address	11-Sir Ganga Ram Mension, 53-The Mall, Lahore.		
18	**Auditors**			
	Name:	SARWARS Chartered Accountants		
	Address:	Office # 12, 2nd Floor, Lahore Centre, Main Boulevard, Gulberg-III, Lahore.		

Certified to be True.

AMAR KHALID

Blue Star Energy (Pvt) Ltd.

Blue Star Energy (Pvt) Ltd.

19	**List of Directors on the date of Form-A**			
	Name of Director	Address	Nationality	NIC (Passport No. if foreigner)
1.	Birg. (R) Khalid Pervez Nadeem	House # 86, Street 3, Sector A, Army Housing, Lahore	Pakistani	38403-6486101-1
2.	Amar Khalid	-: Do -	Pakistani	38403-2245072-7

PART-B

20. List of members & debenture holders on the date upto which this Form A is made					
Folio	Name	Address	Nation-ality	No. of shares	NIC (Passport No. if foreigner)
	Members				
	Birg. (R) Khalid Pervez Nadeem	Lahore	Pakistani	4499800	38403-6486101-1
	Amar Khalid	Lahore	Pakistani	100	38403-2245072-7
	Sidra Khalid	Lahore	Pakistani	100	38403-9471400-6
	Debenture Holders	NA			

Use separate sheet, if necessary (* As per part D)

21.	Transfer of shares (debentures) since last Form A was made			
	Name of Transferor	Name of Transferee	Number of shares transferred	Date of registration of transfer
	Debenture holders			

Use separate sheet, if necessary

22. I certify that this return and the accompanying statements state the facts correctly and completely as on the date upto which this Form-A is made.

Date	Day	Month	Year		Signature
	31	10	2015	Designation (Please tick)	Chief Executive / Secretary

CERTIFIED TO BE TRUE COPY OF THE DOCUMENT FILED BY THE COMPANY HOWEVER THIS OFFICE ACCEPTS NO RESPONSIBILITY AS TO THE CORRECTNESS OF THE DETAILS GIVEN IN THE DOCUMENT

18/1/2017

ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE.

Blue Star Energy (Pvt) Ltd.

Certified to be True

Blue Star Energy (Pvt) Ltd.

BLUE STAR ENERGY (PRIVATE) LIMITED
Lahore: 36, Sector B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086
Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel 0092-937-520004, 92 321 4453447 FAX: 0092-937-520574
email amarkhalid@hotmail.com NTN # 2217217 Company Registration No 13370/20040302 Sales Tax Registration # 0504720600164

PROFILE OF EXPERIENCE OF APPLICANT

Blue Star Energy Private Limited is the pioneer and a reliable name in the field of renewable energy, which not only obtained Generation License from NEPRA for its 3 MW Hydropower Project in Khyber PakhtunKhwa but has executed first Hydel Power Plant in private sector of Pakistan. Phase I of this has been completed and Phase II is going to be completed after issuance of Hydel Upfront Tariff, which is in the knowledge of worthy Authority.

Not only this, two of its subsidiary companies Blue Star Hydel Private Limited and Blue Star Electric Private Limited have also obtained Generation Licenses for setting up Solar Power Plants in Pind Dadan Khan, District Jehlum, Punjab.

Blue Star Energy Private Limited is now setting up a new 2.8 MW Hydroelectric Power Plant in District Gujrat, Punjab for which it seeks the Generation License.

Being a pioneer, Blue Star Energy Private Limited has all the required experience in setting up and operating Small Hydropower Plants in private sector of Pakistan.

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TYPE, TECHNOLOGY, MODEL, TECHNICAL DETAILS AND DESIGN OF THE FACILITIES PROPOSED TO BE ACQUIRED

TYPE:

KAPLAN.

TECHNOLOGY:

VERTICAL AXIS

MODEL:

DOUBLE REGULATED

TECHNICAL DETAILS:

1.	GENERATION VOLTAGE	:	6300 V (To be stepped up to 11000 Volts through Transformer)
2.	POWER FACTOR	:	0.8 Lagging/1.10 Leading
3.	FREQUENCY	:	50 Hz ±1%
4.	AUTOMATIC GENERATION CONTROL	:	YES
5.	RAMPING RATE	:	100Kw/minute for increasing/decreasing.
6.	CONTROL METERING	:	YES
7.	INSTRUMENTATION	:	ALL INTERNATIONAL STANDARDS.

DESIGN:

1.	Runner Diameter	:	2 meters
2.	Number of Blades	:	4
3.	Length of Shaft	:	Not more than 2 meters
4.	Generator Voltage	:	6,300 Volts
5.	Number of Poles	:	24
6.	Rated Speed	:	250 r/min
7.	Runaway Speed	:	600 r/min

Two turbines of capacity 1.4 MW each shall be installed in the power house in a bypass arrangement constructed parallel to the canal. Water shall enter from the main canal into the headrace through the intake gates. From the headrace it shall flow into the intake structure and then through the spiral case shall enter the turbines. After passing through the turbines, the water shall exit through the draft tube into the Tail race. And then finally from the Tailrace the water shall flow into the main canal again.

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PROSPECTUS

1. BRIEF INTRODUCTION OF THE APPLICANT

1.1. Blue Star Energy (Pvt.) Limited is a Private Limited company which was registered in Pakistan under the Companies Ordinance 1984 to construct small Hydel Power Stations. Its first venture was a 3 MW hydel power station on Machai Branch, Upper Swat Canal at RD 53+000. The company was issued the Generation Licence for this 3 MW project in August 2008. The Generation Licence Number as allotted by National Electric Power Regulatory Authority is SGC/036/2008. The first 1 MW plant has been completed.

Now, Blue Star Energy (Pvt.) Limited is working on another hydel project of 2.8 MW capacity located at RD 0+000 to RD 2+250 of Gujrat Branch Canal in District Gujrat, Punjab. In this application, the Generation License is applied for this project. The project is located in Punjab near village Khokhra and hence named Khokhra Hydropower Project. It is intended to sell the electric power to GEPCO under the provisions of Section 8.2.1 of Policy for Development of Renewable Energy for Power Generation 2006 issued by GOP on 16.12.2006. Punjab Power Development Board, Government of Punjab has authorized Blue Star Energy (Pvt.) Limited to develop the project on BOOT basis.

2. SALIENT FEATURES OF THE FACILITY

2.1. The hydropower project under consideration is planned to be constructed on Gujrat Branch Canal by combining four falls at RD 0+000, RD 0+600, RD 1+350 and RD 2+000 respectively. The design head is 26.7388 ft (8.15 meters) and the design discharge is 1433 cusecs (40.6 cubic meter per second).

2.2. The project is about 40km away both from Kharian City and Jehlum City and lies in the administrative control of District Gujrat in Punjab.

2.3. The plant is designed to be of Chinese Origin, fully automatic, synchronous and run of river plant. The plant shall comprise of 2 x Kaplan Turbines of capacity 1.4 MW each.

2.4. The project will yield both direct and indirect financial benefits. The direct benefits include annual power revenue obtained from the availability of electricity generated by the project over its useful life. The indirect benefits will come in the form of savings of foreign exchange used for importing fuel to be used for operating thermal units.

3. PROPOSED INVESTMENT

3.1. Total cost of this 2.8 MW project is estimated at approx. USD 11.815 Million. The planned debt equity ratio is 75:25.

3.2. The debt part is planned to be obtained through a commercial bank or some other financial institution. However, if possible, the debt equity ratio may be changed from 75:25 to 50:50.

4. SOCIAL AND ENVIRONMENTAL IMPACT OF THE PLANT

4.1. There will be no significant loss of any rare and endangered species.

4.2. There will be no change in sediment pattern due to the construction of the project.

4.3. There is no aesthetic loss caused by the diversion of the canal.

4.4. Excavated material will be mostly used for construction.

4.5. No fish exists in the canal therefore no fish migration is expected.

4.6. The project will not displace any families so there will not be any resettlement issue.

4.7. Safe working condition will be provided by the contractor.

4.8. The contractor will need to be responsible for the management given in the litigation and management section.

4.9. The project has sustainability as it uses renewable resource and as it is a run of river project.

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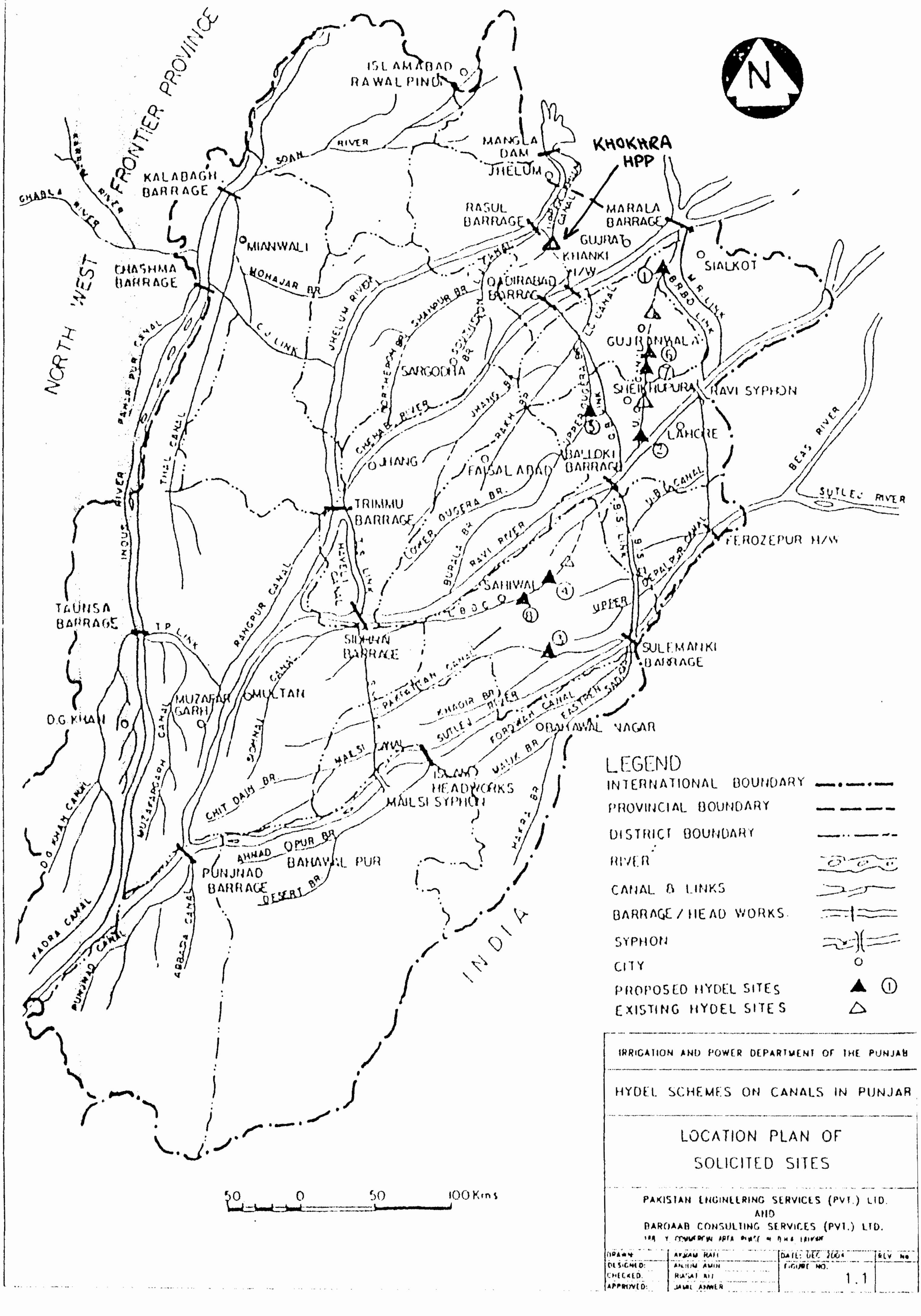
LOCATION (LOCATION MAP, SITE MAP), LAND

The project site is located on the right side of Upper Jhelum Canal at R.D. 254-255/R, near the off take of Gujrat Branch Canal. The site is accessed from the main G.T. road before Sarai Alamgir where UJC crosses the G.T. road. Going along the UJC on the metalled road towards Rasul (Approx. 27 km from main G.T road), then further 5 km from Rasul, the project site is located along the UJC adjacent to Khokhra village.

Upper Jhelum Canal (UJC) is off taking from River Jhelum at Mangle. This canal is also a link Canal being used for transferring of canal supply from River Jhelum to River Chenab at upstream of Khanki Head Works for sustaining the Lower Chenab System. There are two Hydel Power stations, Rasul and Shadiwal, are functioning at R.D. 244+000 and Tail R.D. 420+000 of this canal. The canal has its maximum capacity of 8,500 cusecs.

The project site is well connected to main cities of Punjab from G.T road near Sarai Alamgir. A road off takes from G.T. road along the Upper Jhelum Canal towards Rasool, then a service road on the right bank reaches the project site, where a cross regulator on UJC and head regulator exists at the off take of Gujrat Branch Canal. The road upto Rasul is single lane metalled and from Rasool to project site is single lane service road.



N
KHOKHRA HPP
ISLAMABAD
RAWALPINDI
MANGLA DAM
JHELUM
KALABAGH BARRAGE
RASUL BARRAGE
MARALA BARRAGE
GUJRAT
KHANKI H/W
SIALKOT
MIANWALI
CHASHMA BARRAGE
QADIRABAD BARRAGE
GUJRANWALA
SHEIKHUPURA
RAVI SYPHON
SARGODHA
LAHORE
JHANG
FAISALABAD
BALLOKI BARRAGE
TRIMMU BARRAGE
SUTLEJ RIVER
FEROZEPUR H/W
SAHIWAL
TAUNSA BARRAGE
SIDHNAI BARRAGE
SULEMANKI BARRAGE
D.G KHAN
MUZAFFAR GARH
MULTAN
BAHAWAL NAGAR
ISLAM HEADWORKS
MAILSI SYPHON
PUNJNAD BARRAGE
BAHAWAL PUR
NORTH WEST FRONTIER PROVINCE
INDIA
SOAN RIVER
JHELUM RIVER
CHENAB RIVER
RAVI RIVER
BEAS RIVER
INDUS RIVER
50 0 50 100 Kms
LEGEND
INTERNATIONAL BOUNDARY
PROVINCIAL BOUNDARY
DISTRICT BOUNDARY
RIVER
CANAL & LINKS
BARRAGE / HEAD WORKS
SYPHON
CITY
PROPOSED HYDEL SITES
EXISTING HYDEL SITES
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB
HYDEL SCHEMES ON CANALS IN PUNJAB
LOCATION PLAN OF SOLICITED SITES
PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTING SERVICES (PVT.) LTD.
DRAWN:
DESIGNED:
CHECKED:
APPROVED:
FIGURE NO.
1.1

BLUE STAR ENERGY (PRIVATE) LIMITED

Lahore: 36, Sector B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

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INFORMATION REGARDING PLANT

It will be a Run of River plant.

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INFORMATION REGARDING HEAD

GROSS MAXIMUM HEAD: 33.214 Feet
GROSS MINIMUM HEAD: 24.834 Feet

NET MAXIMUM HEAD: 32.23 Feet
NET MINIMUM HEAD: 23.85 Feet

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TECHNOLOGY

The Technology used shall be 'Vertical Axis.'

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RESETTLEMENT ISSUES

Currently there is no population in the project land which is proposed to be acquired. Hence there will be no resettlement issues.

No. PPDB/ 435 /2017
PUNJAB POWER DEVELOPMENT BOARD
ENERGY DEPARTMENT
Irrigation Secretariat, Old Anarkali, Lahore
(Ph: 042-99213879 Fax: 99213875)
Date: 14 / 03 /**2017**

M/s Blue Star Energy (Private) Limited
37, Sector-B, Askari-10
Lahore Cantt

Subject: **DEVELOPMENT OF 2.8 MW HYDROPOWER PROJECT (HPP) ON GUJRAT BRANCH CANAL AT RD. 0+000 To RD. 2+250, DISTRICT GUJRAT**

PPDB appreciates the efforts made by M/s Blue Star Energy (Pvt.) Limited (the "Sponsor") towards completion of Feasibility Study of the subject cited HPP & its approval by PPDB appointed Panel of Experts (POE) on 1st December 2016. Now, the Sponsor is required to carryout the following activities:

- Approach NEPRA to apply for acceptance of Upfront Tariff in accordance with NEPRA's Upfront Tariff for Small Hydropower Generation Projects, notified by GoP, Ministry of Water & Power on March 28, 2016.
- Approach Irrigation Department for land acquisition process
- Approach GEPCO for issuance of Power Acquisition Request (PAR)

2. It is expected that the above mentioned tasks will be taken up on fast track basis for timely completion of the project. A copy of duly signed & stamped complete set of final updated FSR is being enclosed herewith.

Regards,

SANIYA AWAIS
Managing Director

ENCL: *Complete set of stamped & signed Final Feasibility Study Report*

CC:
1. The Chairman, National Electric Power Regulatory Authority (NEPRA), Islamabad
2. The Chairman PPDB Board / Additional Chief Secretary, Government of the Punjab, Energy Department, Lahore
3. The Secretary, Government of the Punjab, Energy Department, Lahore

Certified to be True

Blue Star Energy (Pvt) Ltd.

GUJRANWALA ELECTRIC POWER COMPANY LIMITED

Ph#055-9200519-26
Fax:055-9200122
www.gepco.com.pk

OFFICE OF CHIEF EXECUTIVE OFFICER, GEPCO LTD.
565-A, MODEL TOWN GEPCO HEADQUARTERS G.T. ROAD GUJRANWALA
(MARKETING & TARIFF SECTION)

No. 17682-83 /MKT Dated: 28/08/2017

Chief Executive Officer, CPPA-G
Enercon Building Sector G-5/2
Islamabad

SUBJECT: GEPCO POWER EVACUATION CERTIFICATE AND CONSENT ENABLING CPPA-G TO PROCURE 2.80 MW POWER FROM M/S BLUE STAR ENERGY LTD, KHOKHRA HYDRO POWER PROJECT

Pursuant to Clause-3(a)(ii)(B&C) of CPPA-G Guidelines/SOP for procurement of Power from renewable resources under technical and legal framework (NEPRA Renewable Energy Guidelines, 2015) issued vide No.CPPA-G/CS/2016/1965 dated May 31, 2016, Power Evacuation Certificate and consent are hereby given enabling CPPA-G to procure Power from project company, i.e. **M/S Blue Star Energy Ltd** subject to Clause 4.5.2 of the Power Procurement Agency Agreement (PPAA) executed between GEPCO and CPPA-G for purchase of power from National Power Pool.

This issues with the approval of Competent Authority.

Certified to be True.

Blue Star Energy (Pvt) Ltd.

(MUHAMMAD HAROON-UR-RASHID)
GENERAL MANAGER (OPERATION)
GEPCO, GUJRANWALA

Copy to:

1. MD Punjab Power Development Board (PPDB), Energy Department 1st Floor, Central Design Builing, Irrigation Secretariat Old Anarkali, Lahore.
2. M/S Blue Star Energy Private Ltd.Lahore:36 Sector B, Askari 10 Lahore Cantt.

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email amarkhalid@hotmail.com NTN # 2217217 Company Registration No 13370/20040302 Sales Tax Registration # 0504720600164

INFRASTRUCTURE DEVELOPMENT

Road Infrastructure:

a. Project site is located bang on already existing 16 feet wide canal road of class 70. Therefore, no additional road is required for accessing the site for delivering the materials and machinery to the site.

b. Internal roads have been planned on the site as per the requirements of delivery of material and machinery as well as for later administration.

Electricity Infrastructure:

GEPCO electricity is available in the area and a 50 kVA dedicated transformer is planned to be installed. A 50 kVA Diesel Generator will work as stand by as well as till the time GEPCO electricity is not available.

Water Infrastructure:

Due to nearby canal, subsoil water is easily accessible. Suitable sized deep well pumps have been planned for delivery of water for human consumption and construction.

Communication:

Area receives good signal strength of all major cellular companies. Although Landline Infrastructure of PTCL exists but is congested. Initially cellular telephones will be used for communication which will be later replaced with Landline when PTCL provides the required Infrastructure.

Internet 3G/4G:

Wireless bandwidth for internet service of all major cellular companies is available in the area. However, it will be replaced with land internet at appropriate time.

Sewage:

Septic tanks have been planned for delivery of sewage water to farmers for irrigation purposes.

EXPECTED LIFE

The expected life of the project is 50 years.

KHOKHRA HYDRO POWER PROJECT
CONSTRUCTION SCHEDULE - 8.2

Sr.#	COMPONENTS	Months																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4.1	Excavation					■	■																								
4.2	R.C.C. Cut-Off Walls							■	■																						
4.3	Foundation Concreting									■	■																				
4.4	Super Structure Including Bridge											■	■	■																	
4.5	Excavation for Joining UJC with Intake including Pitching during closure period of UJC																					■	■								
5.0	HEAD RACE (Power Channel)							■	■	■	■	■	■	■																	
5.1	Excavation							■	■																						
5.2	Embankments including Compaction									■	■																				
5.3	Brick Lining - Bed and Side Slopes											■	■	■																	
6.0	TAIL RACE			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■													
6.1	Excavation			■	■	■	■	■	■	■	■	■	■	■	■																
6.2	Brick Lining															■	■	■													
6.3	Removal of Plug-4																						■								
7.0	CHILLIAN WALA DISTRIBUTARY													■	■	■	■	■	■												
7.1	Excavation													■	■	■	■														
7.2	Brick Lining																	■	■												
7.3	Removal of Plug 2 and 3																						■								

KHOKHRA HYDRO POWER PROJECT
CONSTRUCTION SCHEDULE - 8.2

Sr.#	COMPONENTS	Months 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.0	MOBILIZATION	■	■																												
2.0	POWERHOUSE (Civil Wroks)			■	■	■	■	■	■	■	■	■	■	■	■	■	■														
2.1	Excavation 1st Stage			■	■																										
2.2	Installation of Dewatering System					■																									
2.3	Excavation 2nd Stage						■	■																							
2.4	Concreting Foundation								■	■																					
2.5	Placing of Penstock and Draft Tube										■	■																			
2.6	Concreting upto EL 758.55												■	■																	
2.7	Construction of Superstructure														■	■	■														
3.0	E & M EQUIPMENT										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
3.1	Erection of Main Crane																	■	■												
3.2	Erection of Turbine, Generator and Transformer																		■	■	■	■	■								
3.3	Completion of Transmission System										■	■	■	■	■	■	■	■	■	■	■	■	■								
3.4	Trial Run																							■							
3.5	Removal of defects																								■						
3.6	Commercial Operation																								↓						
4.0	INTAKE STRUCTURE FOR HEADRACE					■	■	■	■	■	■	■	■	■																	

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INFORMATION REGARDING PEAKING/BASE LOAD

Being a Run of River Hydel Power Plant, Khokhra Hydel Power Plant shall remain operational as long as the water is available in the canal.

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PLANT CHARACTERISTICS

1.	GENERATION VOLTAGE	:	6300 V (To be stepped up to 11000 Volts through Transformer)
2.	POWER FACTOR	:	0.8 Lagging/1.10 Leading
3.	FREQUENCY	:	50Hz ±1%
4.	AUTOMATIC GENERATION CONTROL	:	YES
5.	RAMPING RATE	:	100Kw/minute for increasing/decreasing.
6.	CONTROL METERING	:	YES
7.	INSTRUMENTATION	:	ALL INTERNATIONAL STANDARDS.

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TRAINING AND DEVELOPMENT

M/S Blue Star Energy Private Limited are currently operating a 1 MW Hydropower Plant in the province of Khyber PakhtunKhwa. The complete construction, installation and commissioning of this Hydropower Plant was executed by M/S Blue Star Energy Private Limited.

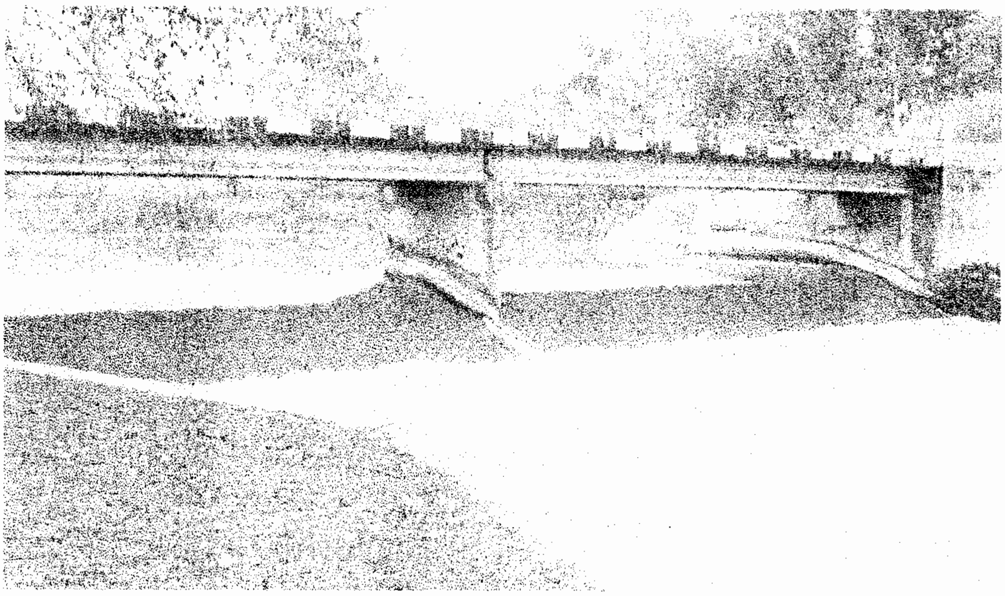
Keeping in view their experience of presently operational 1 MW hydel power plant, M/S Blue Star Energy Private Limited have the requisite training and development capabilities for commissioning and running of the proposed 2.8 MW power plant.

PPI

INTERCONNECTION STUDY

For

2.8 MW Khokhra Hydro Power Project, District Gujrat, Punjab



Final Report

(February 2017)

POWER PLANNERS INTERNATIONAL LTD.

Registered in England & Wales No. 6363482

UK Office:
Sylvester Road,
Sudbury Town, Middlesex,
HA0 3AQ, UK
Phone & Fax:+44-(0)208-9223219

Pakistan Office:
64-F/1, Wapda Town,
Lahore 54770, Pakistan
Phone: +92-42-53.22835;
Fax: +92-42-53.23166

Email: info@powerplannersint.com
www.powerplannersint.com

Executive Summary

- The study objective, approach and methodology have been described and the plant's data received from the client validated.
- The GEPCO system data, as available with PPI for other studies, has been used.
- The interconnection study of Khokhra HPP to evacuate its maximum power of 2.8 MW is envisaged and studied in detail.
- The substations of GEPCO available in the vicinity of Khokhra HPP are Dinga and Helan 132 kV.
- In view of the above mentioned network available in the vicinity of the site of the Khokhra HPP, the proposed interconnection scheme is to connect Khokhra HPP to the nearest Dinga 132/11 kV grid station via 11 kV D/C of Osprey Conductor. The distance, as verified from site visit, was found out to be 11 km.
- Keeping in view the COD of the HPP which is expected to be April 2020, detailed load flow studies have been carried out for the peak load conditions of September 2020 (High Water Season) for all the proposed schemes under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow reveals that proposed schemes are adequate for the evacuation of the maximum power of 2.8 MW of the plant, under normal and contingency conditions shown in Appendix - C.
- The short circuit analysis has been carried out to calculate maximum fault levels at Khokhra-PP 11 kV and other 132 kV substations in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. It was found that there are no violations of exceeding the rating of the equipment due to contribution of fault current from Khokhra HPP.
- The short circuit level at Khokhra-PP 11 kV bus bar is 4.24 kA and 4.71 kA for 3-phase and 1-phase faults respectively. Therefore industry standard switchgear of the short circuit rating of 25 kA may be installed at the 11 kV substation of

Khokhra HPP to accommodate future expansions of generation and transmission in this area.

- The dynamic stability analysis of proposed schemes of interconnection has been carried out. The stability check for the worst case of fault on the 11 kV bus bar of Khokhra HPP substation, followed by the final trip of respective transformer has been performed for fault clearing of 9 cycles (180ms). The system was found to be strong enough to maintain its stability, and recovered with fast damping.

- The proposed schemes of interconnection have no technical constraints or problems under steady state load flow, short circuit currents and dynamic/transient conditions; and are therefore recommended to be adopted.

Report Contents

1 Introduction

1.1 Background

The proposed project is a Hydropower Plant to be located near 132 kV Dinga Grid Station, District Gujrat, located in the concession area of Gujranwala Electric Power Company (GEPCO). The location of Khokhra HPP is shown in Appendix-B. The net output planned to be generated from the site is about 2.8 MW of electrical power. The project is expected to start commercial operation by April 2020. The electricity generated from this plant will be supplied to the grid system of GEPCO through the 132/11 kV grids of GEPCO available in the vicinity of this plant.

1.2 Objectives

The overall objective of the Study is to evolve an interconnection scheme between Khokhra HPP and GEPCO network, for stable and reliable evacuation of 2.8 MW of electrical power generated from this plant, fulfilling N-1 reliability criteria. The specific objectives are:

1. To develop schemes of interconnections of which right of way (ROW) and space at the terminal substations would be available.
2. To determine the performance of interconnection scheme during steady state conditions of system, normal and N-1 contingency, through load-flow analysis.
3. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the substation at Khokhra HPP.
4. To check if the interconnection withstands dynamic stability criteria of post fault recovery with good damping after 3-phase faults on the system.

1.3 Planning Criteria

The planning criteria required to be fulfilled by the proposed interconnection is as follows:

Steady State:

Voltage	± 5 %, Normal Operating Condition
	± 10 %, Contingency Conditions
Frequency	50 Hz, Continuous, ± 1% variation steady state
	49.2 - 50.5 Hz, Short Time
Power Factor	0.8 Lagging; 0.9 Leading

Dynamic/Transient:

The system should revert back to normal conditions, after transients die out, with good damping, without losing synchronism.

- For 132 kV and above, the total normal fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker interruption time to isolate the faulted element, is equal to 100 ms (5 cycles).

2. Assumptions of Data

The detailed electrical parameters of the generators at Khokhra HPP are as follow:

2.1 Khokhra HPP data

Generator data:

Number of Generating Units	= 2
Lump sum Net generating capacity	= 2.8 MW
Power factor	= 0.8 lagging, 0.85 leading
Generating Voltage	= 6.3 kV
Inertia Constant H (turbine + generator)	= 1.24 (MWs/MVA)

2.2 Network data

The surrounding networks available for interconnection to Khokhra Hydro Power Plant are as shown in Sketches 1 and 2 in Appendix-B.

3. Study Approach and Methodology

3.1 Understanding of the Problem

Khokhra HPP 2.8 MW is going to be a hydropower project located near 132 kV Dinga Grid Station, District Gujrat, located in the concession area of Gujranwala Electricity Power Company (GEPCO)

This source of local power generation to be embedded in local distribution network shall provide great relief to the source substations in the vicinity and also help in terms of improving line losses and voltage profile.

The nearest substations of GEPCO, available in the vicinity of Khokhra HPP, are Dinga and Helan 132 kV. The adequacy of this system to absorb and transmit power as per the reliability criteria will be investigated in this study.

3.2 Approach to the problem

The consultant has applied the following approaches to the problem:

- A base case network model has been prepared for the year 2020, which is the commissioning year of Khokhra HPP, comprising all 500kV, 220kV and 132 kV system, envisaging the load forecast, the generation additions and transmission expansions for that year, particularly in GEPCO.
- The month of September has been selected for the study because it is a high water season and it will allow us to judge the maximum impact of the plant on the network in these conditions
- Interconnection schemes without any physical constraints, such as right of way or availability of space in the terminal substations, have been identified.
- Technical system studies for peak load conditions have been performed, to confirm technical feasibility of the interconnection schemes. The schemes have been subjected to standard analysis like load flow and short circuit, and transient stability study to check the strength of the machines and the proposed interconnection scheme under disturbed conditions.

- The relevant equipment for the proposed technically feasible schemes has been determined.
- The most technically feasible scheme of interconnection from the options considered has been recommended.

4. Development of Schemes of Interconnection

4.1 The Existing and Ongoing Network

It was found that the nearest existing GEPCO interconnection facilities at the time of commissioning of Khokhra Hydro Power Project would be:

- Dinga 132 kV Substation
- Helan 132 kV Substation

The existing 132 kV network in the vicinity of these grid station, as well as the power plant, is shown in Sketch-2 in Appendix-B.

4.2 The Scheme of Interconnection of Khokhra HPP

- In view of the above mentioned 132 kV network available in the vicinity of the site of Khokhra HPP, the proposed interconnection scheme is to connect Khokhra HPP to the nearest Dinga 132/11 kV grid station via 11 kV D/C of Osprey Conductor. The distance, as verified from site visit, was found out to be 11 km.

5. Detailed Load Flow Studies

5.1 Base Case 2020, Without Khokhra HPP

A base case has been developed for the peak load of September 2020, which lies in the high water season and will allow us to judge the maximum impact of Khokhra HPP on the GEPCO network during high water conditions, using the network data supplied/authorized by NTDC/GEPCO.

The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-C. The system plotted in this Exhibit comprises of 132 kV network feeding Mandi Bahauddin, Dinga, Helan and its surrounding substations.

The load flow results for the normal case show that the power flows on all the circuits are within their normal rating. We find that there are no capacity constraints in terms of power flow or voltage ratings in the surrounding network available in the vicinity of Khokhra HPP for its connectivity under normal conditions.

The following N-1 contingency tests were run:

Exhibit 0.1	Mangla to Dinga 132 kV Single Circuit Out
Exhibit 0.2	Dinga to Helan 132 kV Single Circuit Out
Exhibit 0.3	Rasul-PP to M.B.Din 132 kV Single Circuit Out
Exhibit 0.4	Shahtaj to M.B.Din 132 kV Single Circuit Out
Exhibit 0.5	Mangla to NBongese 132 kV Single Circuit Out
Exhibit 0.6	Rajar to Kharian 132 kV Single Circuit Out

The load flow results also show that there are no capacity constraints in the area surrounding and the voltage rating of the bus bars remain within their limits.

5.2 Load Flow with Khokhra HPP for September 2020

This proposed scheme of interconnection of Khokhra HPP scheme is to connect Khokhra HPP to the nearest Dinga 132/11 kV grid station via 11 kV D/C of Osprey Conductor. This interconnection scheme has been modeled in the load flow studies. The month of September has been selected because it is a high water season and it will allow us to observe the impact of the project when loadings on the lines are maximum.

The results of load flow with Khokhra HPP interconnected as per proposed scheme are shown in Exhibit 1.0 in Appendix-C. The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % of the nominal.

We find no capacity constraints on adjoining circuits under normal conditions i.e. without any outages of circuits. N-1 contingency analysis has been carried and the plotted results are attached in Appendix – C as follows;

Exhibit 1.1	Khokhra 11/6.3 kV Single Transformer Out
Exhibit 1.2	Khokhra-PP to T2 132 kV Single Circuit Out
Exhibit 1.3	Mangla to Dinga 132 kV Single Circuit Out
Exhibit 1.4	Dinga to Helan 132 kV Single Circuit Out
Exhibit 1.5	Rasul-PP to M.B.Din 132 kV Single Circuit Out
Exhibit 1.6	Shahtaj to M.B.Din 132 kV Single Circuit Out
Exhibit 1.7	Mangla to NBongesc 132 kV Single Circuit Out
Exhibit 1.8	Rajar to Kharian 132 kV Single Circuit Out

N-1 contingency criteria is fulfilled in all the above contingency cases. Also, the bus bar voltages are well within the rated limits in the contingency events. Hence there are no additional constraints introduced in this scheme due to the interconnection of Khokhra HPP.

5.3 Conclusion of Load Flow Analysis

From the analysis discussed above, we conclude that the proposed interconnection scheme of Khokhra HPP with GEPCO is adequate to evacuate the power of Khokhra HPP under normal as well as contingency conditions as shown in Appendix – C.

6. Short Circuit Analysis

6.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analyses in this report for which provision is available in the PSS/E software used for these studies. The maximum fault currents have been calculated with the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence
- Desired voltage magnitude at bus bars set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition.

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2020 i.e. all the generating units have been assumed on bar in fault calculation's simulations.

The assumptions about the generator and the transformers data are the same as mentioned in Ch.2 of this report.

6.2 Fault Current Calculations

6.2.1 September 2020 without Khokhra HPP

In order to assess the short circuit strength of the network of 132 kV without Khokhra HPP for the grid of GEPCO in the vicinity of the site of the plant, fault currents have been calculated for balanced three-phase and unbalanced single-phase short circuit conditions. These levels will not only give us the idea of the fault levels of Dinga 132 kV grid station and other grid stations in the vicinity without Khokhra HPP but also would help us know as to how much the contribution of fault current later on from Khokhra HPP may add to the existing levels.

The short circuit levels have been represented graphically on the bus bars of 132 kV which are shown in the Exhibit 3.0 attached in Appendix-D.

The fault currents in the Exhibit are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault current is shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-D for bus bars of our interest i.e. the substations lying close to Khokhra HPP. The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.1.

Table 6.1

Maximum Short Circuit Levels without Khokhra HPP

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Helan 132 kV	3.87	4.10
Dinga 132 kV	4.37	4.67
M. B. Din 132 kV	3.65	4.20
Rasul-PP 132 kV	3.67	3.63
Shahtaj 132 kV	3.69	4.19
Phalia 132 kV	3.45	3.77
Rasul 132 kV	3.49	3.92
Shahana Lok 132 kV	3.70	4.17
Kharian 132 kV	15.58	13.66
Lalamusa 132 kV	16.40	15.91
Bhimber 132 kV	4.53	3.02
NBongesc 132 kV	21.87	19.69
Rajar 220 kV	10.25	8.08
Mangla 132 kV	34.49	36.74

6.2.2 September 2020 with Khokhra HPP

Fault currents have been calculated for the electrical interconnection of proposed scheme. Fault types applied are three phase and single-phase at the 11 kV bus bar of Khokhra HPP itself and other bus bars of the 132 kV substations in the electrical vicinity of Khokhra HPP. The graphic results are shown in Exhibit 3.1.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the electrical vicinity of Khokhra HPP are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.2.

Table 6.2

Maximum Short Circuit Levels With Khokhra HPP

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Khokhra-PP 11 kV	4.24	4.71
Helan 132 kV	3.91	4.13
Dinga 132 kV	4.43	4.71
M. B. Din 132 kV	3.66	4.21
Rasul-PP 132 kV	3.68	3.63
Shahtaj 132 kV	3.70	4.20
Phalia 132 kV	3.45	3.78
Rasul 132 kV	3.49	3.92
Shahana Lok 132 kV	3.70	4.17
Kharian 132 kV	15.58	13.66
Lalamusa 132 kV	16.41	15.91
Bhimber 132 kV	4.53	3.02
NBongesc 132 kV	21.88	19.69
Rajar 220 kV	10.25	8.08
Mangla 132 kV	34.52	36.77

Comparison of Tables 6.1 and 6.2 show slight difference in short circuit levels for three-phase and single – phase faults due to connection of Khokhra HPP. We find that the resulting fault levels are much the rated short circuit values of the equipment installed on these substations. The short circuit level at Khokhra HPP 11 kV bus bar is 4.38 kA and 4.83 kA for 3-phase and 1-phase faults respectively. Therefore industry standard switchgear of the short circuit rating of 25 kA would be fine to be installed at the 11 kV substation of Khokhra HPP. It would provide a sufficient margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.

6.3 Conclusion of Short Circuit Analysis

The short circuit analysis results show that for the proposed schemes of interconnection of Khokhra HPP, we don't find any problem of violations of short circuit ratings of the already installed equipment on the 132 kV equipment of substations in the vicinity of Khokhra HPP due to fault current contributions from this power house under three-phase faults as well as single phase faults.

The short circuit level at Khokhra HPP 11 kV bus bar is 4.24 kA and 4.71 kA for 3-phase and 1-phase faults respectively. Therefore industry standard switchgear of the short circuit rating of 25 kA would be fine to be installed at the 11 kV substation of Khokhra HPP taking care of any future generation additions in its electrical vicinity.

7. Dynamic Stability Analysis

7.1 Assumptions & Methodology

7.1.1 Dynamic Models

The assumptions about the generator and its parameters are the same as mentioned in Ch. 3 of this report.

We have employed the generic dynamic models available in the PSS/E model library for dynamic modeling of the generator, exciter and the governor as follows:

Generator	GENSAL
Excitation System	EXST1
Speed Governing System	HYGOV

7.1.2 System Conditions

We have used the system conditions of September 2020, which represents the high water season. Most of the hydel generators would be running nearly at their full output.

We have carried out the Dynamic Stability analysis for Khokhra HPP with the proposed interconnection scheme. All the power plants of NTDC from Tarbela to Hub have been dynamically represented in the simulation model.

7.1.3 Presentation of Results

The plotted results of the simulations runs are placed in Appendix-E. Each simulation is run for its first one second for the steady state conditions of the system prior to fault or disturbance. This is to establish the pre fault/disturbance conditions of the network under study were smooth and steady. Post fault recovery has been monitored for nine seconds.

7.1.4 Worst Fault Cases

Three phase faults are considered as the worst disturbances in the system. Normally we apply 3 phase fault on the bus bar of the power plant, followed by tripping of a circuit emanating from that bus, and trip one of the generators of the plant and / or trip one of the inter-bus transformers if there are two voltage levels in the switching station of the plant. For the Khokhra 11 kV bus bar, we applied single phase fault right on the bus bar of Khokhra HPP for 9 cycles (180 ms) followed by trip of respective T/F.

7.3 <u>Dynamic Stability Simulations' Results (Year 2020)</u>

7.3.1 Single-Phase Fault at 11 kV Khokhra-PP: Trip of respective T/F

We applied single-phase fault on Khokhra HPP 11 kV bus bar, cleared fault in 9 cycles (180 ms) followed by the tripping of respective T/F. We monitored different quantities for one second before the fault (pre-fault) and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and discussed as follows:

Fig. 1.1 Bus Voltages

The bus voltages of 6.3 kV bus bar of Khokhra, 11 kV bus bar of Khokhra-PP and 132 kV bus bars of Dinga, Helan, Mangla and Rasul-PP are plotted. The results show recovery of the voltages after clearing of fault.

Fig. 1.2 Frequency

We see the system frequency recovers back to normal quickly after fault clearance.

Fig. 1.3 MW/MVAR Output of Generators of Khokhra HPP

The pre-fault output of generator at Khokhra HPP was 2.8 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 1.4 Speed and mechanical power of Generators at Khokhra HPP

The speed deviation of the generator, after clearing fault, damps down quickly returning to normal speed as of before fault. The transients in mechanical power also damp quickly and settle to a new equilibrium.

Fig. 1.5 MW/MVAR Flow on Khokhra 11/6.3 kV Transformer

Followed by clearing of fault, the trip of the 11/6.3 kV transformer at Khokhra-PP caused the entire output of 2.8 MW to flow through the sole remaining intact 11/6.3 kV transformer at Khokhra. We plotted the flows of MW and MVAR on this intact transformer and observe that the power flows on this circuit attains a steady state level with power swings damping down fast.

Fig. 1.6 Rotor Angles

The rotor angles of the generators of Khokhra HPP 6.3 kV, Shahtaj 11 kV, Rasul Powerhouse (old) 11 kV, Mangla 132 kV, Allai 220kV and Rasul-PP 6.3 kV are plotted relative to machine at Allai 220 kV. The results show that the rotor angle of Khokhra HPP gets back after the first swing and damps down quickly. Similarly the rotor angles of other machines swing a little after the fault and damp fast after clearing of fault. The system is strongly stable and very strong in damping the post fault oscillations.

7.1.2 Three-Phase Fault at 132 kV Dinga: Trip of 132 kV circuit between Mangla and Dinga

We applied three-phase fault on Dinga 132 kV bus bar, cleared fault in 5 cycles (100 ms) followed by the tripping of 132 kV circuit between Mangla and Dinga 132 kV. We monitored different quantities for one second before the fault (pre-fault) and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and discussed as follows:

Fig. 2.1 Bus Voltages

The bus voltages of 6.3 kV bus bar of Khokhra, and 132 kV bus bars of Khokhra-PP, Dinga, Helan, Mangla and Rasul-PP are plotted. The results show recovery of the voltages after clearing of fault.

Fig. 2.2 Frequency

We see the system frequency recovers back to normal quickly after fault clearance.

Fig. 2.3 MW/MVAR Output of Generators of Khokhra HPP

The pre-fault output of generator at Khokhra HPP was 2.8 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 2.4 Speed and mechanical power of Generators at Khokhra HPP

The speed deviation of the generator, after clearing fault, damps down quickly returning to normal speed as of before fault. The transients in mechanical power also damp quickly and settle to a new equilibrium.

Fig. 2.5 MW/MVAR Flow on Dinga to Helan 132 kV circuit

Followed by clearing of fault, the trip of the 132 kV circuit from Dinga to Helan 132 kV circuit caused the power flow to reverse its direction between Dinga and Helan. We plotted the flows of MW and MVAR on one of this intact circuit and see that the power flows on this circuit attains a steady state level with power swings damping down fast.

Fig. 2.6 Rotor Angles

The rotor angles of the generators of Khokhra HPP 6.3 kV, Shahtaj 11 kV, Rasul Powerhouse (old) 11 kV, Mangla 132 kV, Allai 220kV and Rasul-PP 6.3 kV are plotted relative to machine at Allai 220 kV. The results show that the rotor angle of Khokhra HPP gets back after the first swing and damps down quickly. Similarly the rotor angles of other machines swing a little after the fault and damp fast after clearing of fault. The system is strongly stable and very strong in damping the post fault oscillations.

7.3 Conclusion of Dynamic Stability Analysis

The results of dynamic stability show that the system is very strong and stable for the proposed schemes for the severest possible faults at 11 kV bus bar of Khokhra HPP. Therefore there is no problem of dynamic stability for interconnection of Khokhra HPP; it fulfills all the criteria of dynamic stability.

8 Conclusions

- Interconnection study of 2.8 MW Khokhra HPP has been carried out. Keeping in view of the network available in the vicinity of the site of the Khokhra HPP, the proposed interconnection scheme is to connect Khokhra HPP to the nearest Dinga 132/11 kV grid station via 11 kV D/C of Osprey Conductor. The distance, as verified from site visit, was found out to be 11 km.
- Keeping in view the COD of the HPP which is expected to be April 2020, detailed load flow studies have been carried out for the peak load conditions of September 2020 (High Water Season) for all the proposed schemes under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow reveals that proposed schemes are adequate for the evacuation of the maximum power of 2.8 MW of the plant, under normal and contingency conditions shown in Appendix - C.
- The short circuit analysis has been carried out to calculate maximum fault levels at Khokhra-PP 11 kV and other 132 kV substations in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. It was found that there are no violations of exceeding the rating of the equipment due to contribution of fault current from Khokhra HPP.
- The short circuit level at Khokhra-PP 11 kV bus bar is 4.24 kA and 4.71 kA for 3-phase and 1-phase faults respectively. Therefore industry standard switchgear of the short circuit rating of 25 kA may be installed at the 11 kV substation of Khokhra HPP to accommodate future expansions of generation and transmission in this area.
- The dynamic stability analysis of proposed schemes of interconnection has been carried out. The stability check for the worst case of fault on the 11 kV bus bar of Khokhra HPP substation, followed by the final trip of respective transformer has been performed for fault clearing of 9 cycles (180ms). The system was found to be strong enough to maintain its stability, and recovered with fast damping.

- The proposed schemes of interconnection have no technical constraints or problems under steady state load flow, short circuit currents and dynamic/transient onditions; and are therefore recommended to be adopted.

2.8 MW- KHOKHRA HYDRO POWER PROJECT
AT UPPER JEHLUM CANAL
NEAR VILLAGE KHOKHRA, DISTRICT GUJRAT

INITIAL EVIRONMENTAL EXAMINATION
(IEE) REPORT

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Section-1

INTRODUCTION

1 PROJECT HISTORICAL PERSPECTIVE

This report deals with the updated Initial Environmental Examination of the 2.8 MW Khokhra Hydro Power project to be located at Upper Chenab Canal, near village Khokhra, District Gujrat. Previously, the project has obtained the Environmental Approval from the Environment Protection Agency (EPA) vide letter # DD(EIA)/EPA/F-45(IEE)/Cir/2012/266.

National consensus has been developed to plan hydel power projects on canal sites in Punjab and, in pursuance thereof; the Punjab Power Development Board (PPDB) has been created for the promotion of hydel power generation. At different canals and barrages, about 324 potential sites with a total capacity of 5895 MW were identified with medium and small heads.

Out of these, the following 7 projects are already in operation:

Sr. #	Project	Capacity
1	Ghazi Barotha	1,450 MW
2	Rasul	22 MW
3	Shadiwal	14 MW
4	Nandipur	14 MW
5	Chichoki	13 MW
6	Renala	1 MW
7	Chashma	184 MW
Total		**1,698 MW**

There are 8 solicited sites (sites whose feasibility studies are already carried out) with below 50 MW power potential. The sites are tabulated under Table A:

Table – A: Solicited Sites Identified in Punjab (below 50 MW)

Sr. #	Project Name	Location	Capacity MW
1	Head Main Line Upper Chenab Canal	Bambanwala Sialkot RD 133298	6.29
2	Main Line Lower (Upper Chenab Canal)	Deg Fall Sheikhupura RD 283100	6.29
3	Pakpattan Canal Upper	Pakpattan RD 112350	3.26
4	Lower Bari Doab	LBDC Sahiwal RD 285454	2.43
5	Upper Gugera Br.	Upper Gugera Canal Sheikhupura RD 214000	2.34
6	Main line lower UCC	Main line UCC Sheikhupura RD 128000	3.5
7	Main line lower UCC	Main line UCC Sheikhupura RD 164400	3.5
8	Lower Bari Doab	Sahiwal RD 329058	4.56
Total			32.17

These are (1) Kalabagh 3600 MW and (2) Taunsa HPP on Taunsa Barrage with installed capacity of 120 MW. 306 raw sites with power potential below 50 MW have also been identified at different canals and distributaries. The total potential identified on these sites is 350 MW. Out of these 306 raw sites, three raw sites of Gujrat Branch off-taking from UJC at R.D 255.080 have been combined and Khokhra HPP with expected installed capacity of 3 MW has been conceived. This study covers the Khokhra HPP.

Upper Jhelum Canal (UJC) is off taking from River Jhelum at Mangle. This canal is also a link Canal being used for transferring of canal supply from River Jhelum to River Chenab at upstream of Khanki Head Works for sustaining the Lower Chenab System. There are two Hydel Power stations, Rasul and Shadiwal, are functioning at R.D. 244+000 and Tail R.D. 420+000 of this canal. The canal has its maximum capacity of 8,500 cusecs.

1.1 IMPORTANCE & BACKGROUND OF PROJECT

The on-going power supply shortage in the country besides the high fuel costs and low quality oil are causing a significant loss of production resulting in negative economic impact. The use of water potential as source of energy production is on high priority of government. The use of hydel potential may provide cost component energy units. Therefore, as a responsible corporate citizen company, the Government has focused on energy efficiency using best available resource. The proponent's environment friendly initiatives has already recognized by many local and international organizations. Therefore, private investor through Punjab Power Development Board (PPDB) is planning to set up 2.8 MW Khokhra Hydro Power Project in, District Gujrat.

1.2 OBJECTIVES OF THE PROJECT

The main object of the proposed project is to generate cleaner, economical and reliable energy from available renewable natural resources which will not only provide a better source of energy but also cause a compensatory role in reducing the shortage of energy demand.

1.3 PURPOSE OF REPORT

Updated Initial Environmental Examination (**IEE**) report is being submitted to the Environmental Protection Agency (**EPA**), Government of the Punjab, Lahore in compliance with the legal requirement for Punjab Environment Protection Act-2012 (amended act), Section-12 for obtaining the Environmental Approval (**EA**)/No Objection Certificate (**NOC**) before commencement of the project work at the proposed project site. The other relevant regulations and guidelines considered while preparing this IEE report include:

1. Policy and procedures for filing, review and approval of environmental assessments.
2. Guidelines for the preparation and review of environmental reports.
3. Guidelines for public participation.
4. Guidelines for sensitive and critical areas.

5. Detailed sectoral guidelines.

Different environmental aspects like social, physical, biological and other related features of the project both during construction and its regular occupancy are highlighted in this IEE report. Measures necessary to be adopted to mitigate negative environmental impacts on any part of the environment around are also described. All the important information is also provided as described under present format used to help decision makers, EPA Punjab in the present case, before issuing the desired Environmental Approval (EA).

1.4 IDENTIFICATION OF PROJECT PROPONENT

Mr. Amar Khalid

Chief Executive Officer

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Lahore.

1.5 CONSULTANTS PREPARING ENVIRONMENTAL REPORT

Integrated Environment Consultants

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1.6 NEED OF THE EIA STUDY

Government of Pakistan in the year 2000 has adopted the regulations for the Review of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA), under these review regulations, the Environmental Protection Agency (EPA) stipulated relevant procedures for the proponents to be compliance with environmental quality requirements for the preparation of environmental assessment studies (either IEE or EIA). These environmental studies are planning instruments that aim to contribute to design phases of the development as well as functions as management tools to minimize potential negative impacts and maximize benefits during construction and operational phases of a project. To be effective in this role the IEE or EIA needs to form an integral part of the project design process. In this way the environmental implications of various design alternatives can be evaluated and the cost benefits of different trade-offs assessed. The result is the potentially negative impacts can often be avoided and almost always reduced, without compromising the real cost of the project. Conversely, positive environmental outcomes associated with the project can be enhanced.

1.7 OBJECTIVE OF THE REPORT

Objectives to conduct this IEE are as following:

i. A legal binding in accordance to Punjab Environmental Protection Act-2012 (amended Act).

ii. To identify the potential environmental issues pertaining to the proposed site.

iii. To evaluate the ability of the site in view of social acceptance and environmental soundness.

iv. To provide the maximum information to the proponent and other stakeholders about the existing environmental conditions and the implications of the proposed project.

v. Collection of available data, reports, drawings and other relevant information about area of proposed project.

vi. Review of applicable existing environmental legislation and national environmental quality standards (NEQS).

vii. Propose mitigation measures to eliminate or to reduce the negative impacts to an acceptable level.

viii. Development of well resourced environmental management and monitoring plans to identify mitigation strategies targeted towards avoidance, minimization and rehabilitation of the impacts.

1.8 EXTENT OF THE STUDY

In compliance with PEPA-2012 (amended act) requirements, an IEE report has been prepared by M/S Integrated Environment Consultants, Lahore. This document covers all environmental impacts, due to installation of the 2.8 MW co-gen power project, in and around the project area comprising the physical, ecological and socio-economic aspects together with identification of the potential positive and negative impacts. Any developmental activities outside the project area, the transmission lines for dispatch of electricity and establishment of the other factories outside the project vicinity have not been covered under this IEE study.

1.9 METHODOLOGY

The methodology adopted to carry out the IEE study of the proposed project was as follow:

a) Orientation
b) Planning of Data Collection
c) Data Collection
d) Site Reconnaissance
e) Analysis of Maps
f) Literature Review
g) Desk Top Research
h) Stakeholders Consultations
i) Field Studies
j) Laboratory Analysis
k) Evaluation of Impacts and their analysis
l) Categorization of impacts based on their potential environmental significance and prescription of preventive / mitigation measures

In addition to the evaluation and review of the available records, data and the facts for the previous project, detailed discussions were held with the concerned members of the project management as well as other project stakeholders. Notes and proposals for measures to be taken to mitigate and compensate for any detrimental environmental impacts are contained in the Environmental Management Plan (EMP) as well as a Monitoring Plan, including all parameters that need to be measured, and the frequency of monitoring actions.

A comprehensive qualitative and quantitative methodology was adopted to conduct this study inter-alia in due compliance with the IEE requirements. The study included collection of both primary and secondary data regarding environmental status and other relevant factors. This IEE report has been accomplished after carrying out thorough visit to the proposed site and detailed investigation to identify the following Environmental areas of concern:

1) To achieve the desired environmental compliance standards; as per the national environmental regulatory requirements; as applicable to the project.
2) Plans and activities to prevent/mitigate any potential impacts and the gaps that could probably remain after implementation.
3) Any other points/steps to be taken which could be beneficial to mitigate environmental adverse impacts that may accrue both during construction and regular operation of the project.

A view of methodology for environmental assessment is given in table 1.1:

Table 1.1: Environmental and Social Assessment Process

Screening and Scoping	Reconnaissance and initial site visit and consultations, identification of environmental and social issues & applicable safeguard environment policy, categorization and working out an action plan.	carried out during the present IEE	Project Management (PM) Consultants
Impact Assessment	Identification of potential environmental and social impacts through site visits, stakeholders	during the present IEE	PM Consultants

	consultations, review of drawings, alternatives etc		
Impact categorization	The significant potential impacts were tabulated and mitigation/preventive measures were prescribed	during the present IEE	PM Consultants
EMP Preparation	Stakeholders/Women consultation	carried out during/prepared as part of the present IEE	PM Consultants
	EMP		
Final EMP	Final version of EMP produced	included in the present IEE	PM Consultants

1.10 SCOPE OF THE STUDY

The purpose of this IEE study is identification of key environmental and social issues which will likely arise during construction and operation of the power plant along with the assessment of the significant negative impacts and mitigation measures to be adopted for their minimization.

The ultimate goal of this IEE report, among others, is also to produce an Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMtP) for the construction and operation stages of 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 IEE report ensures compliance to all national and local regulations enforced in Pakistan, especially Punjab for such report. While taking into consideration the corporate standards, it was further sought to ensure that the project under reference of this IEE report, is to be developed in a manner that is socially responsible and reflects sound environmental management practices.

This IEE report also discusses the legal and administrative framework within which the IEE has been prepared. A brief project description is included in the IEE 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 construction 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.

1.11 PERSONS PERFORMING THE STUDY (TEAM MEMBERS)

The proponent has assigned the task of preparing IEE report to M/S **Integrated Environment Consultants, Lahore**. The IEE study of the proposed project has been conducted according to Environmental Assessment Procedures, 1997, Review of IEE and EIA Regulation 2000 as prescribed by the Federal Environmental Protection Agency (Pak EPA), Government of Pakistan. The study team of M/S **Integrated Environment Consultants** which completed the IEE report consists of experts as mentioned in table 1.2.

Table 1.2: Members Completed IEE Process

Mr. Ahtasham Raza	M.Phil (Env. Sciences) GC University, Lahore Ph.D Scholar, (Env. Sciences) University of the Punjab, Pakistan	Project Incharge
Mr. M. A. Nouman	M.Sc Environmental Sciences. M.Phil Environmental Sciences University of the Punjab, Lahore	Team Leader
Mr. Asher Azad	M.Sc Chemistry GC University, Lahore	Monitoring Incharge
Mr. Zaheer Bhati	M.Sc Chemistry GC University, Lahore	Monitoring incharge
Mr. Mubroor Hassan	M.Sc Chemistry M.Phil Environmental Sciences	Monitoring Engineer
Mr. Hamaza Ahmad	B.Sc. Civil Engineering (UET) M.Sc. Env. Engineering (UET)	Geo Technical Engineer
Mr. M.A. Sheraz	M.A Sociology University of the Punjab, Lahore	Sociologist
Ms. Hina Gillani	M.Sc. Environmental Sciences	Environmentalist
Mr. Adnan Sharif	B.S Environmental Sciences	Environmentalist

*Only the main roles of the team members are given. However, their role was not restricted to these, rather it also includes many other studies in their respective fields in the context of this IEE studies.

1.12 PROJECT CLASSIFICATION

The project envisages the installation of 2.8-MW hyrdro (run of the canal) power project at village Khokhra, District Gujrat. In accordance with the

Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000, SRO # 339 (1)/2000, the project falls in Schedule –I, Part-A 'Energy' Serial 1 'Hydroelectric power generation less than 50 MW; therefore, requires the Initial Environmental Examination (IEE) study for sustainable development and to submit in provincial Environmental Protection Agency (EPA), for issuance of Environmental Approval (EA).

1.13 BRIEF DESCRIPTION OF NATURE, SIZE AND LOCATION OF PROJECT

1.13.1 Location and Access to Site

The project site is located on the right side of Upper Jhelum Canal at R.D. 254-255/R, near the off take of Gujrat Branch Canal. The site is accessed from the main G.T. road before Sarai Alamgir where Upper Jehlum Canal (UJC) crossing, from the road to Rasul on right bank (Approx. 27 km from main G.T road), then further 5 km from Rasul to Khokhra village.

UJC is off taking from River Jhelum at Mangle. This canal is also a link Canal being used for transferring of canal supply from River Jhelum to River Chenab at upstream of Khanki Head Works for sustaining the Lower Chenab System. There are two Hydel Power stations, Rasul and Shadiwal, are functioning at R.D. 244+000 and Tail R.D. 420+000 of this canal. The canal has its maximum capacity of 8,500 cusecs.

The project site is well connected to main cities of Punjab from G.T road near Sarai Alamgir. A road off takes from G.T. road along the Upper Jhelum Canal towards Rasool, then a service road on the right bank reaches the project site, where a cross regulator on UJC and head regulator exists at the off take of Gujrat Branch Canal. The road upto Rasul is single lane metalled and from Rasool to project site is single lane service road.

1.13.2 Nature & Size of the Project

2.8 MW Khokhra Hydro Power project is run of the canal scheme. About 2-acre of land will be required for proposed power plant. Sufficient additional vacant space owned by the irrigation department is available to install necessary plant & machinery required for proposed project. Layout of various sections for all the plant & machinery has been worked out in order to utilize the land very economically.

1.13.3 Upper Jhelum Canal (UJC)

Upper Jhelum Canal was commissioned in 1915, primarily as a feeder canal to supplement supplies at Khanki Head Works on Chenab River. Prior to commissioning of Mangla Dam in 1967, the natural flows of Jhelum River were drawn by UJC through head works at Mangla. Presently the UJC is being regulated from a regulator just downstream of Old Bong Escape.

The present maximum discharge of UJC U/S of Khokhra Head Works is 8500 Cusecs, while safe out-falling discharge upstream of Khanki Head Works is about 4100 Cusecs. There are two Hydel Power Station i.e. Rasul at RD 240-000 and Shadiwal Hydel Power Station at RD 420.000 of UJC

1.13.4 Gujrat Branch Canal

Gujrat Branch canal off taken from right bank of UJC at R.D 255+080.The design discharge during Kharif is 1537 Cusecs and during Rabi it is 1295 Cusecs. The natural surface level of the head reach is steep as such there are three falls at R.D 0+600 R.D 1+350 and R.D 2+000, in addition to a drop of 7.94 ft at head regulator of Canal. The total drop as measured on 19-09-2004 is 30.13 ft.

Chillianwala distributary off taken from right side of Gujrat branch at R.D 1+000.The design discharge of the distributary is 104 Cusecs. During planning of scheme the Chillianwala distributary shall be supplied the required discharge through head race of the scheme. Therefore the maximum discharge available for power generation during Kharif is 1537-104 = 1433 Cusecs and during Rabi it is 1295-104 = 1191 Cusecs.

1.14 THE REPORT STRUCTURE

This IEE document is structured as follow:

Section – 1:

Introduction: Containing general information about the project and process of carrying out the study.

Section – 2:

National Environmental Policy, Legal And Administrative Framework: Describes the national policy, laws and regulations governing this IEE.

Section – 3:

The Project Description: Describes an overall detail of the works to be done pertaining to the proposed project.

Section –4:

The Description of the Environment: Gives information on Physical, Biological and Social conditions collected through survey of the Project Area.

Section – 5:

Environmental Impacts Due To Project & Mitigation Measures: Identifies various environmental impacts and their preventive actions. This makes the basis of the Environment Management Plan.

Section – 6:

Environment Management Plan (EMP): Contains comprehensive prescriptions regarding environmental impacts and their mitigation measures. This also includes institutional arrangements and Environmental Management & Monitoring Plan.

Section – 7:

Stakeholders Consultations: Explains the process of public consultation and disclosure of the project in related stakeholder. It makes this document a legal public document.

Chapter – 8:

Emergency Response Plan & Evacuation/Exit Plan: Explains about the arrangements to avoid any natural or anthropogenic emergency.

Chapter – 9:

Conclusion and Recommendation: Concludes the IEE report with some practical recommendation.

Section - 2
NATIONAL ENVIRONMENTAL POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 GENERAL

This section deals with the policy and legal framework which apply for protection, conservation, restoration, rehabilitation and also related to sustainable development in context of project implementation and its operation. The Project is expected to comply with all the legislations related to the environmental aspects as regards of Pakistan.

2.2 NATIONAL POLICY FRAMEWORK

Following elements of national policy framework are considered the most relevant to this project:

2.2.1 National Conservation Strategy

The Pakistan National Conservation Strategy (NCS), which was approved by the federal cabinet in March 1992, is the principal policy document on environmental issues in the country (EUAD/IUCN, 1992).

The NCS outlines 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,
- restoration of rangelands,
- increasing energy efficiency,
- conserving biodiversity,
- supporting forestry and plantations, and
- the preservation of the cultural heritage.

2.2.2 National Environment Policy 2005

The national environmental policy 2005 aims to protect conserve and restore the environment in order to improve quality of the life of citizens through sustainable development and resource conservation.

The main objectives of the policy are;

- Conservation, restoration and efficient management of the natural resources.
- Integration of the environmental considerations in policy making and planning process.
- Capacity building of government agencies and other stakeholders at all levels for the better environmental management.
- Meeting international obligations effectively in line with the national aspirations.
- Creation of a demand for environment through mass awareness and community mobilization.

2.2.3 The National Forest Policy 2001 of Pakistan

This policy covers the Renewable Natural Resources (RNR) of Pakistan i.e. Forests, Watersheds, Rangelands, Wildlife, Biodiversity and their habitats. The policy seeks to launch a process for eliminating the fundamental causes of the depletion of RNR through the active participation of all the concerned agencies and stakeholders, to realize the sustainable development of the resources. It is an umbrella policy providing guidelines to the Federal Government, Provincial Governments and territories for the management of their RNR. In consonance with it, the Provincial and District Governments may devise their own policies in accordance with their circumstances.

The goal of this policy is to foster the sustainable development of RNR of Pakistan, for the maintenance and rehabilitation of its environment and the enhancement of the sustainable livelihoods of its rural masses especially women, children and other deprived groups.

The elements of the policy are as follow:

- Population planning in critical eco-systems.

- Providing substitutes to firewood in the wooded mountains.
- Reducing the impact of socio-economic causes.
- Reducing poverty, poverty of opportunity, and powerlessness.
- Reducing political interference in the Forestry and Wildlife Departments.
- Renovating and invigorating the institutions of RNR.
- Supporting Local Governments in the sustainable development of their RNR.
- Policies for fragile natural Eco-systems.
- Riverain forests.
- Irrigated Plantations.
- Preservation of relict and unique forests.
- Wildlife.
- Rangelands and desert eco-systems.
- Planting of trees and fodders on farmlands.

2.3 PUNJAB ENVIRONMENTAL PROTECTION ACT (PEPA), 2012 AND ADMINISTRATIVE FRAMEWORK

2.3.1 General

PEPA 2012 (amended act) is a fairly comprehensive legislation and provides legislative framework for protection, conservation, rehabilitation and improvement of the environment. It contains concrete action plans and programs for the prevention of pollution and promotes sustainable development.

The salient features of the law are:

- No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Provincial Environmental Protection Agency (EPA) an EIA, and has obtained a No Objection Certificate (NOC)/Environmental Approval (EA).
- Establishment and Formation of the Punjab Environmental Protection Council.
- Powers and Functions of the Provincial Environmental Protection Agency.
- Prohibition of certain discharges or emissions.

- National Environmental Quality Standards (NEQS) for wastewater, air emissions and noise.
- This act also empowers Provincial EPA to issue notices and to enforce them for the protection of the environment and resource conservation.

For the effective implementation of the provisions of PEPA 2012, EPA headed by a Director General has been constituted.

The capability of regulatory institutions for environmental management largely achieves the success of environmental assessment for ensuring that development projects are environmentally sound and sustainable. For decision-making and policy formulation in the environmental and conservation issues, the institutional framework is described in following paragraphs.

2.4 PAKISTAN ENVIRONMENTAL PROTECTION AGENCY REGULATIONS, 2000 FOR REVIEW OF INITIAL ENVIRONMENTAL EXAMINATION (IEE)/ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Under Section 12 (and subsequent amendment) of the 2012 amended Act, a project falling under any category specified in Schedule I or II requires the proponent to file an IEE or EIA, as the case may be, with the provincial agency. Within ten working days of the IEE or EIA having been submitted, the provincial agency will confirm that the documents submitted are complete for the purpose of review. During this time, should the provincial agency requires the proponent to submit any additional information; the IEE or EIA will be returned to the proponent for revision, clearly listing those aspects that need further discussion. Subsequently, the provincial agency shall make every effort to complete an IEE review within 45 days and an EIA review within 90 days of filing of the complete information of report.

After the successful review, the EPA will issue the NOC/EA according to the rules and regulations as prescribed in Regulation 2000. During the project execution the proponents are required to comply with the recommendations of the IEE/EIA and also the conditions of the NOC/EA set forth by the relevant EPA, in present case, EPA, Lahore, Punjab. During the construction or post EIA monitoring and reporting is mandatory according to clause 19 of Regulation-2000. These Regulations requires proponent of all projects to submit environmental monitoring reports during and on completion of construction, and regular operation of the project. Any additional requirements of the report as desired by the EPA are also necessary for the proponent, however, the format and contents of such reports are not specified in the law.

2.5 PAKISTAN ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURES

These guidelines are descriptive documents describing the format and content of IEE/EIA reports to be submitted to Provincial EPA for obtaining NOC. Following are the major areas, which are covered by these guidelines:

- The Environmental Assessment report formation (scoping, type and category of project, description of project, alternatives, site selection, baseline data).
- Assessing impacts (identification, analysis and significance).
- Mitigation and impact management and preparing an environmental management plan.
- Reporting (format, main features, shortcomings, other forms of presentation).
- Review and decision making (role, steps, remedial options, checks and balances).
- Monitoring and auditing (systematic follow up, effective data management).
- Project Management (inter-disciplinary teams, programming and budgeting).

2.6 GUIDELINES FOR PUBLIC CONSULTATION

The Federal EPA provides these guidelines to deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.

These guidelines cover:

- Consultation, involvement and participation of stakeholders
- Effective public consultation (planning, stages of EIA/IEE where consultation is appropriate)

- Facilitation involvement (including the poor, women and Non-Governmental Organizations (NGOs)

2.7 NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS), 2000

The NEQS 2000 specify the following standards:

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers).
- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources.
- Maximum allowable concentration of pollutants (two parameters) in gaseous emissions from vehicle exhaust.
- Maximum allowable noise levels from vehicles.

These standards apply to the gaseous emissions and liquid effluents. Standards for ambient air quality have not been prescribed as yet.

2.7.1 National Ambient Air Quality Standards (NAAQSs)

The Ministry of Environment, Government of Pakistan vide its Notification, Islamabad, the 18th October, 2010 under S.R.O. 102 (1)/2010 established standards which provide the maximum allowable limits, in the ambient air, of Sulphur Dioxide (SO_2), Oxides of Nitrogen as (NOx) and as (NO), Suspended Particulate Matter-(SPM), Respirable Particulate Matter-PM_{10}, Respirable Particulate Matter-$PM_{2.5}$, Lead and Carbon Monoxide (CO).

Table 2.1: National Environmental Quality Standards Ambient Air

[redacted]			
Sulfur Dioxide (SO_2)	Annual Average*	80 µg/m^3	Ultraviolet Fluorescence
	24 hours**	120 µg/m^3	

[redacted]			
Oxides of Nitrogen as (NO)	Annual Average*	40 µg/m³	Gas Phase Chemiluminescence
	24 hours**	40 µg/m³	
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µg/m³	Gas Phase Chemiluminescence
	24 hours**	80 µg/m³	
Ozone (O_3)	1 hour	130 µg/m³	Non dispersive UV absorption
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m³	High Volume Sampling, (Average flow rate not less than 1.1m³/minute)
	24 hours**	500 µg/m³	
Respirable Particulate Matter. PM_{10}	Annual Average*	120 µg/m³	βRay absorption
	24 hours**	150 µg/m³	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	15 µg/m³	βRay absorption
	24 hours**	35 µg/m³	
		15 µg/m³	

[redacted]			
Lead (Pb)	Annual Average*	1.0 µg/m^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m^3	
Carbon Monoxide (CO)	8 hour	5 µg/m^3	Non Dispersive Infra Red (NDIR)
	1 hour	10 µg/m^3	

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

2.7.2 National Drinking Water Quality Standards (NDWS)

The Ministry of Climate Change, Government of Pakistan vide its Notification, Islamabad, the 18th October, 2010 under S.R.O. 102(1)/2010 established standards for Drinking Water Quality. The major quality parameters fixed depend upon Bacterial, Physical and Chemical ones.

Table 2.2: National Standards for Drinking Water Quality

[redacted]	
All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml samples
Treated water entering the distribution system (E.Coli or thermotolerant Coliform and total Coliform bacteria)	Must not be detectable in any 100 ml samples

Treated water in the distribution system (E.Coli or thermo tolerant coliform and total Coliform bacteria)	Must not be detectable in any 100 ml samples In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12- month period.
Physical	
Color	Non objectionable/Acceptable
Taste	Non objectionable/Acceptable
Odor	Non objectionable/Accept able
Turbidity	< 5 NTU
Total hardness as $CaCO_3$	< 500 mg/l
TDS	< 1000
pH	6.5 – 8.5
Chemical	
Essential Inorganic	mg/Litre
Aluminum (Al)	≤0.2
Antimony (Sb)	≤0.005 (P)
Arsenic (As)	≤0.05 (P)
Barium (Ba)	0.7
Boron (B)	0.3

Cadmium (Cd)	0.01
Chloride (Cl)	<250
Chromium (Cr)	≤0.05
Copper (Cu)	2
Toxic Inorganic Cyanide (Cn)	**mg/Litre** ≤0.05
Fluoride (F)*	≤1.5
Lead (Pb)	≤0.05
Manganese (Mn)	≤0.5
Mercury (Hg)	≤0.001
Nickel (Ni)	≤0.02
Nitrate (NO_3)*	≤50
Nitrite (NO_2)*	≤3 (P)
Selenium (Se)	0.01 (P)
Residual chlorine	0.2-0.5 at consumer end; 0.5-1.5 at source
Zinc (Zn)	5.0
Organic	
Pesticides mg/l	PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may

[redacted]	
	be consulted.
Phenolic compound (as phenols) mg/l	WHO standards: ≤0.002
Polynuclear Aromatic hydrocarbon(as PAH) g/L	WHO standards: ≤0.01v(by GC/MS method)
Radioactive	
Alpha Emitters bq/L or pCi	0.1
Beta Emitters	1

2.7.2 National Environmental Quality Standards - Noise

The Ministry of Climate Change, Government of Pakistan vide its Notification, Islamabad, and the 18th October, 2010 under S.R.O. 102(1) /2010 established standards for Noise. These standards are based on Category/zone i.e. Residential area, Commercial area, Industrial area and Silence zone. The limiting values for day and night have also been fixed for all categories/zones.

Table 2.3: National Environmental Quality Standards - Noise

[redacted]		
Residential area	55	45
Commercial area	65	55
Industrial area	75	65
Silence zone	50	45

Limit in dB (A) Leq*

Notes:

1. Day time hours: 6:00 a.m. to 10:00 p.m.

2. Night time hours: 10:00 p.m. to 6:00 a.m.

3. Silence zone::Zones that is declared as such by the competent authority. An area comprising not less than 100 m around the hospitals, educational institutions, and courts.

4. Mixed categories of areas may be declared as one of the four above-listed categories by the competent authority.

* dB(A) Leq: Time weighted average of the level of sound in decibels on Scale A which is relatable to human hearing.

2.8 NATIONAL RESETTLEMENT POLICY AND ORDINANCE

As referred above, at present the only legislation relating to land acquisition and compensation is the Land Acquisition Act (LAA) of 1894. Experience with large-scale infrastructure development projects implemented by institutions such as WAPDA has demonstrated the need for a cohesive national policy for resettlement. Following a national consultative process, a national resettlement policy and a related ordinance were drafted known as Draft Resettlement Policy, 2002 which still has to be approved by the government. The salient applicable features of the Draft Resettlement Policy are given below:

- The Pak-EPA will be responsible for both environment-related as well as resettlement-related matters.
- The responsibilities for implementation at a provincial level are to be delegated to the concerned provincial EPAs with overall control of the provincial Planning and Development (P&D) Departments.
- All categories of 'loss' arising from development projects that entail resettlement, need to be addressed; these include not only loss of land, built-up property, other infrastructure, and crops and trees, but also loss of income, job opportunities, and access to natural resources, etc.

- Vulnerable groups whose issues need to be addressed in particular include: women, children, destitute persons, tribal communities, squatters, those with usurper rights, and landless groups.
- There should be a special emphasis on consultation with affected groups when preparing a Resettlement Action Plan.

2.9 OTHER ENVIRONMENT RELATED STATUTES

This section outlines the other statutes apart from Pakistan Environmental Protection Act, 1997, which are relevant to the project.

2.9.1 The Land Acquisition Act (LAA), 1894

At this point, the only legislation relating to land acquisition and compensation is the LAA of 1894. The LAA is, however, 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 consider the rehabilitation and resettlement of disrupted populations and the restoration of their livelihoods.

The Project will involve acquisition of about 500 Acres of land owned by the Cholistan Development Authority and some portion leased by the local farmers. The land will be acquired under the LAA 1894. In the Act there are provisions for normal acquisition of land under Section 6 (4) or emergency acquisition under Section 17 (4).

2.9.2 Pakistan Explosives Act, 1884

Under the Explosives Act, the project contractors are bound by regulations on handling, transportation and using explosives during quarrying, blasting, and other purposes.

2.9.3 The Forest Act, 1927

The Forest Act empowers provincial governments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and toping of trees, branches in reserved or protected areas.

2.9.4 Pakistan Penal Code, 1860

The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the context of environment, the Penal Code empowers the local authorities to control noise, noxious emissions and disposal of effluents. The NEQS enforced by the EPAs supersede the application of this legislation on industries and municipalities.

2.9.5 Provincial Wildlife Act, 1974

In addition to empowering the provincial wildlife departments to establish game reserves, parks, and wildlife sanctuaries, this Act regulates the hunting and disturbance of wildlife.

2.10 INTERNATIONAL AND NATIONAL NON-GOVERNMENTAL ORGANIZATIONS

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, have been formulated in consultation with these leading NGOs, who have also been involved in drafting new legislation on conservation.

2.11 PROVINCIAL LOCAL GOVERNMENT ORDINANCES, 2001

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.

2.12 PUNJAB INDUSTRIAL RELATIONS BILL 2010

In December 2010 Punjab Assembly passed new legislation that will govern the formation of trade unions, relations between industries and their workers, and the process for the settlement of labour disputes.

2.13 INDUSTRIAL RELATIONS ORDINANCE 2011 PROMULGATION

The Government has promulgated Industrial Relations Ordinance 2011. The Ordinance has been approved by the President on the Advice of the Prime Minister. The Government has promulgated Industrial Relations Ordinance, 2011 in view of the current legal vacuum created due to deletion of the concurrent Legislative List through the 18th Constitutional Amendment. The Industrial Relations has also been transferred to the Provinces which have promulgated provincial laws to regulate industrial relations. However, there is no law in place to deal with Industrial Relations in the Islamabad Capital Territory or in respect of national level trade federations and for resolutions of trans-provincial industrial issues. The Parliament has yet to promulgate the Ordinance as law.

2.14 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY ACT 1997

The NEPRA Act was approved by Parliament and signed into law in December 1997. It seeks to create an autonomous, independent regulatory authority, which will be solely responsible for the power sector. It will be responsible for the oversight of the power sector and will exercise control through its power to license power generation, transmission and distribution. It will regulate tariffs for all these activities. It will perform its functions through transparent processes to be enshrined in rules that are being framed in a transparent manner through appropriate rules.

2.15 LAND USE

The project site is situated in the area where in surroundings the industrial activities are lacking. The land is agricultural in nature and the productive for wheat and rice etc.

Section-3

DESCRIPTION OF THE PROJECT

3. GENERAL

This section deals with project components, which are the part of installation of 2.8-MW Hydel power project and its related construction activities for execution of this project. It also describes the category of the project, availability of construction materials, type of vegetation in the project area, construction time and cost of the project, construction and operation equipments etc. The information presented in this section is based on project site survey, preliminary design report, and the information provided by the client.

3.1 TYPE AND CATEGORY OF THE PROJECT

Acute shortage of energy in the country besides the high fuel costs and use of low quality oil is causing a significant loss of production resulting in negative economic impact. Thus, use of hydel (water) potential from available natural resource may provide cost component energy units. The use of water potential both in canal as well rivers as source of energy production is on high priority of government to overcome this energy shortage. Therefore, 2.8 MW Khokhra Hydro power is envisaged at Upper Jehlum Canal, District Gujrat. The purpose of the project is to provide the reliable energy with affordable cost. In accordance with the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000, SRO # 339 (1)/2000, the project falls in Schedule –1, Part-A 'Energy' Serial 1 'Hydroelectric power generation less than 50 MW' therefore, requires the 'Initial Environmental Examination' (IEE) study for sustainable development and to submit in provincial Environmental Protection Agency (EPA), for issuance of Environmental Approval (EA).

3.2 OBJECTIVE OF THE PROJECT

The main objective of the proposed project is to generate cleaner, economical and reliable energy from available fuel which will not only provide a better alternate source of energy but also provide a relief to overcome acute shortage of energy and save millions of dollars which is being wasted to import expensive oil being used as fuel for producing electricity. By using a cleaner technology and fuel it will also reduce environmental hazards caused by burning of fossil fuel for producing electricity.

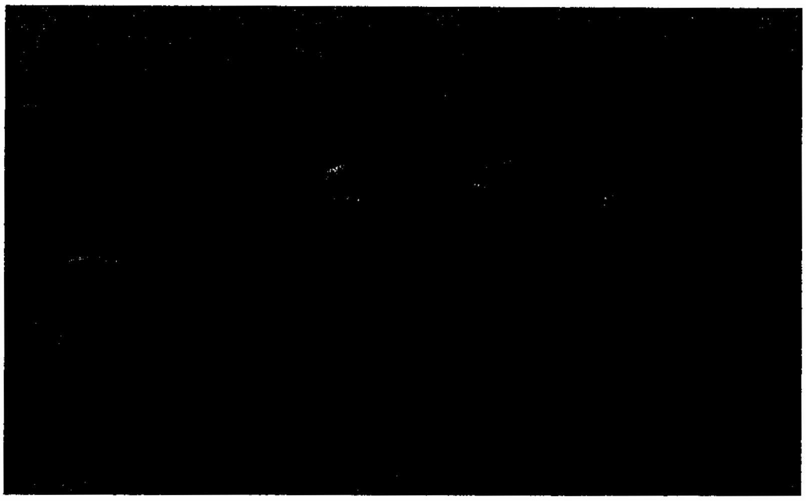

Figure 3.1: A View of Project Site During Survey

3.3 LAND USE ON THE SITE

Currently the proposed land for installation of power project is barren land owned by the private farmers and irrigation department.

3.4 VEGETATION FEATURES OF THE SITE

The project site and its vicinity have some sort of shrubs with no significant importance. The land is barren and non-cultivated except some part of land which is far away from the proposed project site.

3.5 SCHEDULE OF IMPLEMENTATION

It is planned that the following schedule of project implementation will be adhered to. This is subject to the conditions that everything goes according to planning and no serious bottlenecks are encountered.

The implementation stages of the project activity include:

1st Stage

The stage–1 comprises the onsite contouring studies and soil investigations.

2nd Stage

The stage –2 comprises Finalization of EPC and the following task:

- **I-** Laying of foundations excavation and commencement of erection work.
- **II-** Start of civil, electrical and mechanical work.
- **III-** Development of basic infrastructure.
- **Iv-** Fitting of instrumentation.

3rd Stage

The stage –3 comprises the following task:

- **v-** Plant Equipment erection completion.
- **vI-** Completion of the basic infrastructures water supply system, electricity supply etc.

4th Stage

The stage –3 comprises the Tests & Commissioning.

5th Stage

The Last stage will be commencement of regular production (December 2018).

3.6 DESCRIPTION OF THE PROJECT (PROCESS FLOW CHART/STEPS)

Project is installation of 2.8 MW hyrdo power plant. Briefly the power plant will have a power channel off-taking from right bank of UJC upstream of the existing Khokhra Head Regulator. For this purpose an intake structure will be built on the right bank of UJC for the power channel. After working the turbines in the power house, water will be discharged into the tall race just downstream of third fall on the Gujrat Branch Canal. The existing outlet of Chillianwala Distributary, now off-taking at RD 14+000 of Gujrat Branch, will be shifted upstream to receive its flow directly from the power channel. Salient features of the layout are described below.

I) Power Output

Flow Rate

Maintaining the requisite flow in the Gujrat Branch Canal is the controlling factor in the operation of the power house. This depends upon the water availability in UJC and the downstream crop requirements in the two major cropping seasons of Kharif and Rabi.

Kharif Season

Discharge	1433 cusecs
Net Head	29.7 ft.
Power	3.1 MW

Rabi Season

Discharge	1191 cusecs
Net Head	29.7 ft.
Power 2.59 MW	

The power house building would be located 500 ft. from the right bank of the UJC, and 500 ft. on right side of Gujrat Branch Canal.

II) Intake Structure

Intake structure, 50 ft. wide and with a maximum depth of 8 ft. will allow main flow of UJC directly into the power channel. It will be located 500 ft. upstream of existing Khokhra Head Regulator.

III) Power Channel

Power channel 304 ft. long and at a slope of 1 in 10,000 is trapezoidal in shape with a bed width 37 ft. and side slopes of 1 ½ to 1.

Iv) Bridge

A bridge on intake structure will be built for smooth flow of traffic on right bank of UJC.

v) Penstocks

The water from the power channel will be guided through two penstocks into two turbines of the power house. Each penstock, made of steel, will be 10 ft. diameter and 50 ft. long.

vi) **Powerhouse**

The building for power house 50 ft. x 75 ft. will be constructed at a distance of about 500 ft. from UJC. A sluice will make it possible to close the entrance of water to the penstock. In front of every penstock a trash rack will be installed to prevent large particles to enter the penstock. Depending upon the head flow and speed considerations, the number and type of turbines have been selected for the powerhouse. Two turbines, S-Koplan type, each 1.6 MW capacity along with hydro-generators will be installed in the power house.

vii) **Tail Race**

Tail race will be a channel 1600 ft. long. Immediately below the powerhouse the tail race will have 20 ft. R.C.C. transition with rest of its remaining length being brick-lined. It will convey turbines outflow back into Gujrat Branch Canal just downstream of the third fall at its RD 2+000.

viii) **Feeder Channel**

The alignment of power channel will necessitate shifting of intake of Chillianwala Distributary from its present location on Gujrat Branch. This will be done by constructing a feeder channel off-taking from power channel upstream of power house and re-joining the existing alignment of the Distributary, some 800 ft. downstream of its present location.

ix) **Accessibility**

Infrastructure in terms of road for accessibility of site of power station from National Highway already exists along the right bank of UJC. However, the canal road needs to be repaired/metalled at some spots. Within the bounds of the site itself, a short length of metalled road would be needed for accessibility and regular inspection of various components constituting the project complex.

3.7 HYDRO-MECHANICAL EQUIPMENT

This section gives general information and guidelines used for the feasibility design of the hydro-mechanical equipment of Khokhra power station. The equipment which will be required comprises of:

- Mechanical equipment, comprising:
  - Turbines and Governors
  - Powerhouse Bridge Crane
  - Cooling and Dewatering Systems
  - Auxiliary Equipment
  - Draft Tube Gates
- Hydraulic Steel Structures, comprising:
  - Power Intake Gates complete with hoisting gantry and Trashracks
  - Penstocks

3.7.1 Turbines

Types and Rating of Turbines

Types of Turbines

Net head and the installed capacity of Khokhra power station characterized this scheme as a low head (Less than 65ft) small hydro (Less than 30MW) hydropower development which is practically the operational zone of the Kaplan turbines, may be Kaplan Vertical, Kaplan Bulb/Pit turbines and Kaplan Tubular (S or inclined), however, their specific turbine selection is dependent on some parameters which are separately discussed for each turbine as hereunder:

Kaplan Vertical

Kaplan vertical qualify for Khokhra power station, however, economically these are not best suited for this scheme due to the following reasons:

- Require deep setting of turbine centerline by 15ft below the maximum tailrace level of El.756.8 due to their higher specific speed above 716 (rpm).
- Excavation upto El. 725 would be required for draft tube foundation, which means a total excavation of 54ft (approx.) from the natural soil level of El. 780.7
- An adequate drainage system would be required to keep the power station area dry during the course of construction.
- Due to deep setting of the turbine, the tailrace area has to be deeply excavated.
- A permanent drainage and dewatering system with heavy duty pumps have to be installed within the power station.
- Synchronous generator having unit speed of 273rpm has to be coupled directly with the turbine, which will not only extensively increase the cost of the E&M equipment but also increase the sub-structure and superstructure concrete volume by considerable quantity.
- The power station area and its height would be increased considerably due to larger generator parameters
- The bridge crane capacity due to increased rotor weight will increase.

Kaplan Bulb

Kaplan bulb is usually considered feasible for heads upto 20ft, however very specific and known manufacturers world around do have the capability to provide Kaplan bulb turbines over 20ft. The bulb type generating set has successful record of operation and development world-wide. However, this type of turbine is not considered suitable for Khokhra power station due to the following reasons:

- The turbine requires negative setting of its centerline below the tailrace level of El.756.8
- Excavation upto EL 743 would be required for penstock, bulb, draft tube and tailrace.
- The area of the power station and the substructure and superstructure concrete quantities will increase due to larger size of the bulb unit and the power station construction would be fairly complex.
- The generator being located within the bulb would be directly driven with the rotor overhung on the single shaft. It is not common practice to install step up gearing in a totally enclosed bulb turbine.
- A permanent drainage and dewatering system with heavy duty pumps have to be installed within the power station.
- Synchronous generator having unit speed of 273rpm has to be coupled directly with the turbine, which will extensively increase the cost of the E&M equipment.
- The bridge crane capacity due to increased rotor weight will be increased.
- A complete closed loop cooling water system with provision of cooling tower and standby make up pumps for water supply from well would be required for generator surface coolers.
- Erection and maintenance of turbine and generator is very complex.

Kaplan Pit

Kaplan pit is also considered feasible for heads upto 20ft, however some of the manufacturers world around like bulb, do have the capability to provide Kaplan pit turbines over 20ft. Although Pit turbine facilitate use of speed increasing gear to step-up turbine speed from 273 rpm to generator speed of 1000rpm and economize the generator cost, however, there is a least improvement of power (kW) due to introduction of the speed increasing gear. The pit turbine setting is similar to the bulb turbine and requires similar substructures and superstructures with the exception of reduced generator parameters and its cost.

Kaplan 'S' Type

Kaplan 'S' type also qualify for Khokhra power station. This tubular type of turbine is often referred to as an 'S' type because of the S-shaped waterway from inlet to outlet, the tubular turbine of the Kaplan or fixed propeller type being located centrally within the waterway.

From the turbine, the shaft extends through the casing to drive the generator either directly or via a speed-increasing gear.

According to the geometry, the shaft arrangement can be horizontal or inclined upwards from turbine to generator. The S-shaped waterway suits relatively high heads as of Khokhra power station. This type of turbine has some positive merits over the other classes of Kaplan as discussed hereunder:

- Require positive setting of the turbine centerline above the tailrace level of El.756.8.
- Excavation of power station (draft tube only) and tailrace would be required upto El.744.0, which will considerably reduce the excavation, substructure and superstructure costs.
- A very low capacity pump(s) would be required for draft tube dewatering only, whereas, other surface drainages will be directly disposed off to tailrace.
- A speed increasing gear introduced to step-up the turbine speed from 214.3 rpm to generator speed of 1000 rpm, will competitively reduce the generator parameters and thereby the E&M equipment costs and power station substructure and superstructure costs extensively.
- A turbine efficiency of 92% is considered for installed capacity with

runner diameter of 72.6 inches(1844mm), however, if some priority is given to the turbine efficiency, an efficiency upto 93.8% is possible with a runner diameter of 78.74 inches(2000mm).

- Access to the generator and turbine for maintenance is very easy.

Ratings of Turbines

Ideally a single Kaplan 'S' turbine is more suitable from economics point of view under discharge variation from 1195ft^3/s to 1437ft^3/s, however, a reliable and flexible operation of the power station with one bigger unit cannot be ensured due to the following reasons:

- In case of fault and during the time of annual maintenance, the complete power station has to be shutdown, which will result in failure of power supply for indefinite period to the intended irrigation lift schemes;

- In the light of foregoing reasons, two units each of 1.6MW are suggested for Khokhra power station.

Recommendation

Besides the merits and demerits discussed hereinabove Gulliver Small Turbines Selection Chart(1991) provides an excellent reference for the selection of small turbines on the basis of net head, capacity and n/ns ratio. The speed to specific speed(n/ns) ratio of Kaplan vertical, Kaplan bulb Kaplan pit and Kaplan 'S' comes out 0.39 and 0.38 respectively which is very close, however, the same chart guides for selection of the former turbines for unit capacity ≥5MW. Another reference from (Raabe 1985) advises a maximum head of 20ft for former turbines having a range of specific speed 570-920. Additionally, our own computer programme under default condition ignore the use of Kaplan vertical, bulb and pit turbines under lower specific speed of 555.7 and selects Kaplan 'S' turbine.

In the light of above discussion and references, we consider that Kaplan 'S' machine incorporating a speed increasing gear has marginally greater advantages. These include:-

- Smaller bulb diameter which reduces the size of the power station;
- No need to dewater the machine for maintenance work on the generator and turbine;
- The use of speed increasing gears allow optimum generator speed to be selected;
- The physical size of the generator is smaller;
- There is little difference in overall efficiency because the reduction in efficiency caused by using speed increasing gears is compensated for by a greater generator efficiency;
- Overall, a Kaplan S machine could be up to 20% percent cheaper than a Kaplan vertical and bulb machine and 15% than a pit turbine according to our experience besides the civil construction costs.

For these reasons, we recommend that two(2) Kaplan 'S' type machines each of 1.6MW incorporating speed increasing gears be adopted for the Khokhra power station.

3.7.2 Turbines and Governors

Basic Data

Kaplan 'S' turbines as selected for Khokhra power station will operate under the following conditions of discharge, head and tailrace level:

Discharge

Rated Discharge/unit	718.5ft.^{3}/s
Minimum Discharge	597.5ft.^{3}/s

Headrace and Tailrace Levels

UJC/Power Channel(FSL) level	El.787.07

Tailrace Level

The tailrace level will fluctuate between EL756.8 and 754.5 for full turbines discharges of 1437ft^3/s in kharif and 1195ft^3/s in Rabi seasons respectively.

Turbine Setting

The turbines of Khokhra power station are set at +5.4ft above the tailrace level of El.756.8.

Head Loss and Rated Head

The maximum gross head with two units operation for this power station would be 30.27ft, whereas, the waterways head loss is assumed as 1% of the gross head. Therefore, the rated net head will be 29.97ft.

Synchronous Speed

The turbine speed is selected as 214.3rpm and will be stepped up to generator synchronous speed of 1000rpm through a speed increasing gears may be of epicycle design.

Efficiency

The turbine full gate and gear efficiencies will be 92% and 98% respectively.

The characteristics of the selected Kaplan 'S' turbines for Khokhra power station are summarised hereunder:

Characteristics of the selected Turbines

Rated Net head	29.97ft
Rated Discharge/unit	718.5ft^3/s
Rated turbine output	1.58 MW
Turbine speed	214.3 rpm
Generator speed	1000 rpm
Specific speed	555.7

Runaway speed	545 rpm
Runner diameter	72.6 inches
Number of runner blades	4
Runner weight	4318lbs
inlet diameter	120 inches
Hydraulic thrust	9526 lbs
Number of units	2
Generator Inertia Wr^2	0.01×10^6 lb $ft.^2$
Installed capacity	2.8 MW
Average Energy Production	23.54 GWh

Materials

The materials standards as are normally used for turbine parts are mentioned hereunder:

Item No.	Part	Material Designation
1	Runner	Cr13Ni4Mo
2	Draft tube liner	A283GrC
3	Discharge ring	A283GrC
4	Spiral Case	A516Gr70
5	Stay Ring	A516Gr70
6	Shaft	A668classD
7	Guide vanes	Cr13 Ni4 Mo
8	Regulating ring	A283GrC
9	Links	A668classD

Item No.	Part	Material Designation
10	Servomotor cylinder	G485-275
11	Servomotor piston	A283GrC
12	Guide bearing pad	G485-275
13	Guide bearing white metal	B23-83
14	Rotating wearing rings	S41500 ASTM
15	Governor accumulator	A515Gr70

3.7.3 Turbine Governors

Digital governors with PID characteristics and based on programmable logic controller (PLC) are proposed for both the units. The digital governors will be suitable for network (grid) and isolated operation and will have the following function and properties:

- Automatic frequency and speed (signal from PT and shaft gear) control
- Automatic load control
- Headrace level measurement and control
- Tailrace level measurement
- Manual and auto mode
- Turbine start and stop sequence
- Permanent speed droop adjustable between 0-10%
- Black start operation

The Contractor shall supply all instruments, cabling etc. for the measurement of the above quantities/values.

3.7.4 Hydraulic Power Packs

The hydraulic power packs suitable for parallel operation (grid and isolated loads) are proposed for the hydraulic control of the Kaplan 'S' turbines which work under the command of the digital governors. The hydraulic power packs will comprise of all instruments such as pilot valve, actuators, distribution valves, two (2) pumps of gear or screw type with motors, sump tank with oil capacity not less than 30 litres, filter, oil level indicator, pressure switches, alarms and indications and any other instruments as would be necessary for safe operation of the turbines in the parallel mode as briefly described hereinabove.

3.7.5 POWERHOUSE BRIDGE CRANES

A 10 ton mechanically operated bridge crane with separate wheel drives for longitudinal travel of the bridge and cross travel of trolley, is proposed considering rotor weight of 7 ton. The crane will consist of traveling rails for full length of the power station with all embedded anchors, sole plates, cleats etc. The crane shall be designed in accordance with the CMAA or FEM standards.

3.7.6 COOLING AND DEWATERING SYSTEMS

Cooling Water System

It is intended that the turbine and the generator bearings will be of the self lubricated type having operational life over 100,000 hours, however, if required the shaft seal or the glands will be supplied filtered water from duplex filters with raw water intake from a well source. Similarly, cooling of the generator windings for such small capacity is not foreseen at this stage of the feasibility study, however, provision of a small generator surface cooler if required will be considered during the detail design stage evaluating the manufacturer experience.

Dewatering System

The dewatering of the penstocks and bulbs will be carried out through crack opening of guide vanes upto the tailrace level of El.756.8 and to cater for the remaining water column in the draft tubes, a mobile centrifugal pump having a capacity of 40GPM and capable of discharging against head of 15ft is proposed. This mobile pump can be temporarily positioned on the downstream draft tube deck and suction line dropped in the inspection manhole of the draft tube for dewatering as required.

3.7.7 Auxiliary Equipment

Maintenance Tools

Adequate number of maintenance tools to facilitate repair or renewal of components which do not need specialized skill or experience are proposed which consist of the following:

- All types of keys, spanners, gauges, screw drivers, vernier caliper, micrometer etc.
- Different size of hydraulic jacks, hoses, slings etc.
- Small pedestal and portable drilling machine with tools
- A small welding plant.
- Small electrical tools, air driven tools and a small capacity mobile compressor.

Fire Fighting Equipment

In general, 6 kg hand held and 25 kg mobile fire extinguishers shall be placed at central location in the power station and at the intake.

3.7.8 Draft Tube Gate

For annual operation and maintenance of the turbine and generator, there seems no reason to close the draft tube exist, being the tailrace water level well below the turbine and generator centreline. However, for inspection of the draft concrete part, one draft tube gate of size 16ftx15ft is proposed for the closure of draft exist. The gate will be designed for downstream tailrace level of El756.8 and in accordance with the relevant DIN or ASTM standards considering the dead, hydrostatic, dynamic, friction, wind and seismic loads. Structural steel gates are usually proposed for such utility, however, possibility of using wood stoplogs in place of steel gate, will also be checked to economize the project overall investment cost during the detail design period.

3.7.9 Hydraulic Steel Structures

3.7.9.1 Power Intake Gates

The power intakes of the Khokhra power station comprises of trashrack, stoplogs and vertical fixed wheel gates and rope hoisting system. All these hydraulic structures as shown in Figure ---- will be designed according to data as mentioned in the following table:

Description	Full Supply Level (FSL)	Bed Level (BL)	Designed Head
Power Intake gates	El. 787.07	El. 772.82	14.25≈15 ft
Stoplogs	El. 787.07		
Trashrack	El. 787.07	El. 775.59	11.55 ft

3.7.9.2 Fixed Wheel Gates

The power intake will be supplied with two vertical fixed wheel gates complete with rope hoists fixed on concrete gantry each for one penstock; automatically controlled through the digital governor of each turbine and manually from the Unit Local Control Panel(ULCP) and Local Control Panel(LCP) at the power intake gates control room.

The power intake fixed wheel gates will be of size 14.25ft x 16.86ft and designed in accordance with the relevant DIN or ASTM standards considering upstream water level, the dead, hydrostatic, dynamic, friction, wind and seismic loads.

3.7.9.3 Trashracks

Two trashracks are proposed at the off take point of UJC to avoid entrance of debris and trash into the power channel. The trashrack main dimension and design will be as stipulated in the following table:

Number of trashracks	2
Free opening between the bars, approx.	135 mm
Trashrack inclination	14 °
Net width	22 ft
Height	15.9 ft
Design water velocity	≤4 ft./s

3.7.9.4 Stoplogs

Two wooden stoplogs is proposed at the off take point of UJC to seal the power channel for inspection.

3.7.9.5 Penstocks

Two 10ft. diameter, 55ft. long steel penstock encased in concrete are planned to feed the water to two turbines. Each penstock has an internal operating pressure of 13psi which could increase to atmospheric pressure of 14.7psi even under the load rejection condition. Under such circumstances large steel penstock are designed to provide rigidity required during fabrication and handling. It is therefore planned to adopt a thickness of 3/8 inches for each penstock and fabricate them from flat rolled carbon steel plates 5LA as prepared by Pakistan Steel which have minimum yield point strength of 30000psi.

3.7.9.6 Design Standards

The penstocks will be designed as per USBR Engineering Manual No. 3, AISI steel Plate Engineering Data- Volume 3&4 and ASCE Engineering Practice No. 79.

3.7.9.7 Power Station layout

The total length and width of the power station including the loading bay and control building has been determined as 75ft. long and 50ft. wide. The power station is placed at elevation El.758.55t. The Resident Engineer, operation and maintenance staff offices and store are planned on ground floor of the control building.

3.8 Electrical Equipment

3.8.1 Generator Data / Scope

Installation and commissioning of the two horizontal type, self excited brush less synchronous generators, for direct coupling to turbines, complete with excitation equipment.

3.8.1.1 Main Data of Generator

No. of generators	2
Rated output	1.6 Mw
Rated power factor	0.85
Rated voltage	11 KV
Power frequency	50 Hz
Rated speed	1000 rpm
Efficiency	96%
Ambient temperature	40°C
Cooling	Water / Air heat exchangers
Degree of protection	IP 44
Insulation class Generator	F

3.8.1.2 Excitation System

The excitation system will have brush less excitation system formed by an integrated exciter having its own stator and rotor and rotating rectifier with all its necessary protections. The supply includes but not limited to the following:

- AC / DC circuit breaker, cubicle mounted
- AC / DC converter with controlled thyristors / diodes

- De – excitation circuit
- Over voltage protection
- Electronic automatic voltage regulator (AVR).

3.8.2 Switchgears

General

This section covers the scope of MV, LV switchgears and associated auxiliaries. It covers all the aspects of supply, installation, erection and commissioning of the equipment to be installed at various locations is listed as per drawing.

AC auxiliaries electrical power supply shall be distributed on 400 V AC auxiliary supply system to the various locations of the power plant as per drawing. Stand by diesel generator set shall automatically supply if AC power tripped out. On restoration of AC power, the diesel generator shall be synchronized before shutting down.

The E&M Contractor shall supply all internal wiring terminated in interconnection cubicles.

The single line diagram and the layout drawings showing the location and arrangements of the switchgear are included in Drawings.

Engineering

All equipment shall be designed according to the relevant IEC standards.

Switchgear connected to the generator terminals shall be rated according to the highest actual generator voltage.

The E&M Contractor shall perform short circuit calculations for the systems as basis for final determination of equipment ratings and selection of protection devices.

The E&M Contractor shall perform transient over voltage analysis as basis for selection of surge arresters. All design calculations shall be subject to approval by the Engineer.

MV Switchgears

For MV equipment shall comprise, metal-enclosed cubicle assemblies including all apparatus and requisite accessories, clamps and connections, earthing devices, internal wiring and terminals, base frames and fixing materials, circuit breakers, disconnectors, busbars, conductors, insulators and bushings.

Equipment Specification

11 kV Switchgear

The switchgear shall be of the metal-enclosed type, and be equipped with a top mounted pressure relief channel.

Rated voltage:	12 kV
Breaking medium:	SF_6 or vacuum

Each cubicle shall be equipped with an instrument compartment including mimic diagram, indicators, control switches, instrumentation, transducers and protection relays.

If protection relays are equipped with display showing electrical measurements as phase currents, line voltages, kW and kVAr, and also measuring transducer function, electrical instruments and transducers shall be omitted.

The compartment includes following equipment:

- Mimic diagram
- Control switches and position indicators for circuit breaker, and earth switch.
- Three-phase earthing switch.
- Terminations for the cables.
- Instrument) flush mounted A-meters.
- 1 (one) flush mounted V-meter

- 1 (one) voltmeter selector switch, 6 positions, for selecting phase-phase and phase-earth voltages.
- Transducer input 0-6 A, output 4-20 m A.
- Transducer input 0-132 V A.C., output 4-20 mA.
- Sync check equipment.

If the protection relay is equipped with display showing electrical measurements, and also is including transducer function, instruments and transducers shall be omitted.

Relays shall be equipped with two independent adjustable current settings for instantaneous and delayed tripping. The time delay setting shall be independent of the current setting.

Cable system for distribution of control voltage and auxiliary voltage, connectors, fuses, terminals etc.

Arc relay connected to arc detectors inside the cubicle.

Busbar, Measurement and Earthing Cubicle

- One cubicle with the following equipment:
- (One) three-phase busbar module
- 3 -(three) single-phase voltage transformers for three-phase connection-.

  Ratio: $\frac{11000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{3} V$

- 1 (one) load resistor connected to the voltage transformer open delta winding.
- 1 (one) three-phase earthing switch.
- Instrument compartment including the following equipment:
  - Mimic diagram
  - Control switch and position indicator for earth switch 3. 3 (three)

flush mounted V-meters

- 1 (one) voltmeter selector switch, 2 positions, for selecting phase-phase and phase earth voltages
- 3 (three) transducers

▶ Cable system for distribution of control voltage and auxiliary voltage, connectors, fuses, terminals etc.

▶ Arc relay connected to arc detectors inside the cubicle.

3.9 CONSTRUCTION ASPECTS & OPERATIONAL ARRANGEMENTS

3.9.1 Construction Materials

Comparatively reasonable quantities of buildings and other facility construction materials will be required for construction of the proposed facility. The materials mainly required are listed below:

- Coarse and fine aggregate for concrete works
- Sandy gravel for backfilling, embankment raising, etc.
- Cement
- Steel
- Bitumen
- Electric Equipments
- Lights
- Other materials etc.

3.9.2 Construction Camps

The establishment of the construction camp will be done near the UJC. Location of the camp will be selected in a way that there will not be any disturbance to the nearest community and it is also close to the site of work or within the project site. Camp will be properly fenced and guarded. This site camp will be constructed mainly for construction staff and to accommodate Contractor's machinery. The area of the camp will be kept sufficiently large to accommodate parking areas for machinery, construction materials and workshops.

3.9.3 Work Force and Work Machinery

The details of the construction staff has been shown below in **Table 3.1**. The labour will work in one shift of eight (8) hours. The construction machinery which will be utilized for construction is shown in **Table 3.2.**

Table 3.1: List of Construction Staff

1	Engineer	5
2	Construction Manager	1
3	Planning Engineer	3
4	Material Engineer	3
5	Site Engineer	2
6	Supervisor	5
7	Foreman	15
8	Skilled Worker	210
9	Semi Skilled Worker	550
10	Machinery Operator	16
11	Admin.	2

Table 3.2: List of Construction Machinery to be used for Construction

1	Excavator	5
2	Dumper & Loader	15

[redacted]		
3	Tractor & Trolley	4
4	Water Bowser	5
5	Lift/Crane	2
6	Generator	10
7	Concrete Pump	5
8	Water Pump	3
9	Welding Plant	5
10	Concrete Mixing Plant	1

At operation stage, the project proponent will be involved for operation and maintenance of the proposed facility.

3.10 GOVERNMENT APPROVALS AND LEASES REQUIRED BY PROJECT

The project is in feasibility stage, the drawings are under process of completion and approval of project feasibility and tariff determination is under process. The environmental approval according to the Section 12 of Punjab Environmental Protection Act-2012 is the mandatory requirement of the project. All the other approvals pertaining to the project are under process from various departments.

Section - 4
DESCRIPTION OF ENVIRONMENT

4.1 INTRODUCTION

The project area lies in the District Gujrat. Gujrat is situated on the bank of Chenab River, situated about 120 kilometres (75 mi) north of Lahore, the capital city of Punjab province, and 150 kilometres (93 mi) from Islamabad, the capital of Pakistan. The existing environment in and around the project area has been studied with respect to the physical, biological and socio-economic resources.

4.2 Physical Environment

The physical environment includes topography, geology and soils, seismology, climate, surface water, groundwater, ambient air quality and noise levels.

4.2.1 Geography

Gujrat is an ancient city of Pakistan located between two famous rivers, Jhelum River and Chenab River. Because of its proximity to the rivers, the land is good for cultivation of rice and sugarcane as main crops. It is bounded to the northeast by Jammu and Kashmir, to the northwest by the Jhelum River, to the east and southeast by the Chenab River, separating it from the districts of Gujranwala and Sialkot; and to the west by Mandi Bahauddin District.

4.2.2 Regional Geology

The Project area lies in "Chaj Doab" and soil deposits at the project site belong to Chung Fun formation. These alluvial deposits comprise earthy brown to brown silt, clay and sand. The beds are largely hard, laminated and sandy with inter beds of clay and layers or lenses of sand.

The Project Area does not have any valuable minerals. Although, scientific/in depth, investigations haven't been carried out, yet the surveys conducted have failed to discover any minerals worth the name till to- date. However, the soil is highly fertile and Gujrat is also known for its clay, with which the locals have long produced quality pottery.

4.2.3 Soil

The soil in the project area is cohesion less and is of alluvial type deposited by Ravi Chenab. Various soil layers below the ground level includes: silt, silty clay, silty sand, poorly graded sand with silt, lean clay etc.

The soil is different in character and generally inclined to be dry. However, it is rich in potential plant nutrients. Rainfall is low and groundwater is saline and brackish at the shallow depth and irrigation is largely dependent on the canals. Tube wells have also been sunk at the greater depths in the Project Area where fresh water is available.

4.2.4 Climate

Seasonal climatic conditions must be considered for the design and execution of Project. The climate including air, temperature, precipitation, humidity and evaporation is an influencing factor, affecting the construction of Unit and other engineering structures. However, to determine the overall effect of the climatic stresses, daily and seasonal temperature changes, site altitude, direct solar radiation, and precipitation must be considered.

The city has a moderate climate. During the peak of summer, the daytime temperature shoots up to 45 °C (113 °F), but the hot spells are relatively short due to the proximity of the Azad Kashmir Mountains. During the winter, the minimum temperature may fall below 2 °C (36 °F). The average rainfall at Gujrat is 67 centimeters (26 in).

The Project Area receives rains in all the seasons but monsoon rain is pronounced and constitutes a definite rainy season between the month of July and September. The average rainfall is about 629 millimeters per year. Table 4.1 summarizes month-wise temperature, precipitation, and relative humidity.

Table 4.1 Average Monthly Temperature, Precipitation and Relative Humidity

Month	Mean Temperature		Precipitation (mm)	Relative Humidity (%)
	Maximum	Minimum		
January	19.8	5.9	23.0	64.6
February	22.0	8.9	28.5	57.6
March	27.1	14.0	41.2	51.1
April	33.9	19.6	19.7	37.9
May	38.6	23.7	22.4	31.9
June	40.4	27.3	36.3	39.8
July	36.1	26.8	202.1	63.3
August	35.0	26.4	163.9	68.8
September	35.0	24.4	61.1	59.6
October	32.9	18.2	12.4	53.2
November	27.4	11.6	4.2	61.4
December	21.6	6.8	13.9	67.8
Annual	**30.8**	**17.8**	**628.7**	**54.7**

4.2.5 Seismology

The Project Area is located in Seismic Zone 2B according to building code map of Pakistan (moderate limit of high damage). Zone 2B represents peak ground acceleration (PGA) from 0.16 to 0.24g.

4.2.6 Land Use

The project area is a part of commercial and industrial activities along the G.T. Road and the commercial activities are increasing rapidly in this area. Few agricultural activities were also observed around the project area.

4.2.7 Air Quality

Ambient air monitoring was done at project site in for Carbon monoxide (CO), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) and Particulate Matter (PM). The measurement was done for 8 hours and the results are depicted as average concentration of 8 hours which revealed the concentration were in compliance with the NEQS for ambient air.

4.2.8 Surface Water

One surface water source in the Project Area includes River Chenab and passes on the east of the project area. The waters of the Chenab start from snow melt from the Bara Lacha Pass, 32°44′N 77°26′E, in the Himachal Pradesh. Chenab River is the only River which flows through the district Gujrat. The total length of the Chenab is approximately 960 kilo metres.

4.2.9 Ground Water

The Project Area is a part of Chaj Doab (area between Ravi Chenab and River Jehlum). The chemical quality of groundwater is:

- Generally fresh in the area along the rivers: and
- Brackish/ saline in the central parts of the Doabs

During the last century, a weir controlled irrigation system was superimposed on these areas. Seepage from the canal system and irrigated fields has formed shallow fresh groundwater lenses/layers on top of the saline groundwater zone. Thick clay lenses at varying depth in the area, divide the aquifer in different parts and these impervious clay lenses act as barrier between the shallow poor groundwater quality and deep fresh groundwater quality in the area. One of the reasons of poor groundwater quality at shallow depth in the area is water logging in the past. Whereas, different impervious thick clay layers at depth up to 400 ft separate the shallow aquifer from the fresh groundwater aquifer at depth. Therefore, the groundwater quality in the project area improves with depth. Ground water analysis was also conducted and the monitoring results have been given in following table.

Table 4.2: Groundwater Analysis of Project Area

Sr. No.	Parameters	Unit	Year 2016		
			Test Result	WHO Guidelines	NEQS
A. Chemical Parameters					
1	pH	-	7.5	6.5 -8.5	6.5-8.5
2	Total Dissolved Solids (TDS)	mg/l	240	1000	<1000
3	Chloride (Cl)	mg/l	38	250	<250
4	Hardness	mg/l	70	500	<500
5	Nitrates (NO_3)	mg/l	0.24	50	≤50
6	Sodium	mg/l	10	200	-
7	Fluoride (F)	mg/l	0.19	1.5	≤1.5
8	Arsenic (As)	mg/l	N.D	0.01	≤0.05
9	Lead (pb)	mg/l	N.D	0.01	≤0.05
10	Mercury	mg/l	N.D	0.001	≤0.001
11	Iron (Fe)	mg/l	N.D	0.3	-
B. Microbiological Parameters					
1	Total Colony Count	cfu/ml	Nill	<500 cfu/ml	-
2	Total Coliforms	No./ml	Nill	0/100 ml	0/100 ml
3	Faecal Coliforms	No./ml	Nill	0/100 ml	0/100 ml

The above table shows that all the chemical parameters are well within prescribed limits, also microbiological parameters (Total colony count and Total Coliforms) are well within the permissible limits of WHO and NEQS.

4.3 Industrial Activities

Gujrat is also known for its clay, with which the locals have long produced quality pottery. The city also produces fine furniture. Over the last few decades, Gujrat has also attained a name in the manufacture and export of electric fans including GFC fan, Pak fan, Royal fan and metro fan. Gujrat is also home to one of the two largest shoe manufacturing companies in Pakistan, namely Service Industries, which runs a large shoe factory in the city.

There are about 1,059 cottage-level and small- to large-scale industrial units operating in the district. Rice production and export is another major product of Gujrat. There are many other factories engaged in manufacturing of electrical goods, electric motors and rice cleaning mills. Most are cottage industries, providing employment to a large number of people and accounting, in aggregate, for more than 90 percent of the domestic market.

4.4 Biological Environment

4.4.1 Flora

Tree species found in the Project Area include Shisham (Dalbergia Sisoo), Alustonia, Neem (Azaddrachta Indica), Keekar (Acacia Nilotica), Bottle Palm and Rubber Plant (Ficus Elastica). However, no fruit trees are found in the Project Area except those planted in nearby villages such as mango (Mangifera Indica Anacardiaceae), guava (Psidium Guajava) and jaman (Syzyziam Jambulenum). However, the execution of the project does not involve cutting of the trees.

4.4.2 Fauna

Most of the fauna in the Project Area include pets, dogs, cats, squirrels, lizards and nestling birds such as maina, sparrow, quail, parrot, pigeon, crow etc.

4.5 Socio Economics

4.5.1 Population

The project area was surveyed for villages in and around the project site. The project site falls in Tehsil Kharian of Gujrat District. The human settlements on the right bank are more numerous than on the left because of the reserved forest there; Rabbi forest on low hills has sheesham and tahli trees along the UJC left bank. Table below lists names of human settlements likely to interact or be impacted by the project showing populations of respective settlements. Ten villages belonging to three Patwar Circles (PC) of Panjan Shahana, Khori and Amra Kalan are on the right bank of UJC while eleven villages belonging to

Parwar Circle Randheer in the Pabbi Reserve Forest are on the left bank of UJC. The present (2004) total population of these villages is 34,423.

Sr. #	Village Name	Area (Acres)	Population	
			1993 Census	Projected 2004
Amra Kalan PC			**8,934**	**10,310**
1	Amra Kolan	3,284	6,274	7,240
2	Amra Khurd	808	1,725	1,991
3	Bajarwala	446	935	1,079
Khori PC			**8,366**	**9,654**
1	Khori	2,186	3,073	3,546
2	Noor Jamal	1,112	2,835	3,273
3	Rajoo Bhand	2,180	2,457	2,835
Panjan Shahana PC			**4,802**	**5,541**
1	Budhowal	1,154	872	1,006
2	Khokhra	1,195	1,494	1,724
3	Panjan Shahana	2,858	2,007	2,316
4	Rajoo	1,272	429	495
Randheer PC			**7,726**	**8,918**
1	Bido	1,004	578	667
2	Chak Miana	203	383	442
3	Chimber	527	879	1,019
4	Dik Gujran	404	686	792
5	Dinga Khurd	474	725	837

Sr. #	Village Name	Area (Acres)	Population	
			1993 Census	Projected 2004
6	Hasan Karim	206	315	364
7	Iswal	191	516	596
8	Rai Chand	224	303	350
9	Randheer	1,960	2,685	3,099
10	Sango	236	392	452
11	Thalla	288	264	305

PC* Patwar Circle

People

The main tribes among the people in the project region largely located is Tehsil Kharian of District Gujrat, are Jat, Gujar, Arain and Awan, Many of the villages are named after their founders or notable personalities. The people are generally religious-minded. The staple food is wheat and rice,

4.5.2 Social Sector Parameters

The human population in and around the project area lives in 21 villages on both sides of UJC. According to National Population Census 1998, these villages are grouped in four Patwar Circles (PC's) as indicated in above. Some of the important social sector parameters relating to the populations of these PC's are listed in Table below:

Socio-economic Parameters of Human Settlements (Patwar Circles) in the Vicinity of Khokhra Hydel Power Station

Name of Human Settlement	Population	No. of Houses	Family Size	Literacy Ratio % 10+	Housing Facilities	
					Potable Water	Electricity
Panjan Shahana PC*	4802	801	6	45.4	41	682
Khori PC*	8366	1391	6	38.0	61	1241
Randheer PC*	7726	1096	7	42.2	161	1029
Amra Kalan PC*	8,934	1,280	7	46.6	24	1,123

PC* Patwar Circle

Education

Overall Literacy Ratio for age group 10 years and above is 43.1%. The literacy ratio in female population is lower than in male population. Gujrat District had 1,991 education institutions in 1998 including schools and degree colleges, including very famous Zamidara College in Gujrat City.

Health Facilities

According to 1998 Census Report there were 167 health units in Gujrat District. These health institutions included hospitals (11 nos.), dispensaries, RHC's, BHU's and MCH Centres.

4.5.3 Economy

Agriculture is, by far, the dominant sector of economy in the region. Industrial activity has been expanding over the last three decades. The largest group of active population belongs to elementary occupations, like small time shopkeepers and other similar avocations. This group is followed by skilled agricultural workers, technicians, crafts and related trades.

Agriculture

Agriculture is by far, the dominant profession of the people. Canal irrigation followed by tubewells and rainfed irrigation in that order is practiced. Rabi crops are sown following the heavy rains in July, August and September. The winter rains are important for maturing of Rabi crops. Cultivation in the district is not of high order and people are not as good cultivators as elsewhere. The method of cultivation depends largely on the pressure on the soil. In the eastern part of the district holdings are small. It is common for fields especially those dependent on rains to be cultivated for two harvests in succession and then left fallow for two harvests. A field which has grown wheat or cotton must be left fallow for at least six months. But sowing of Kharif crop is generally done after the first monsoon rain although cotton is sown in April. The millets and pulses are reaped in November while cotton picking lasts until the end of December and sugarcane remains on the ground till March. The Kharif crops require ample rain which should come in September. Wheat and gram are sown in October, but if the rain is late they can be sown in December. Rabi crops need rain in January and February. Harvesting of wheat is done in April, but gram and barley are cut earlier. Green wheat for fodder is cut as needed. The principal crops are wheat and rice which are by far the most important crops in the districts followed by barley, gram, massor, bajra, jowar, maize, cotton, rice, sugarcane, oil seeds, tobacco and miscellaneous cereals like Mash, Kangni, etc.

Industry

Over the last five decades Gujrat District has developed significantly in industrial sector. It is now the biggest centre of production for electrical goods, table ware, china ware and other pottery goods.

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Section-5

ENVIRONMENTAL IMPACTS DUE TO PROJECT & MITIGATION MEASURES

5.1 METHODOLOGY FOR ANTICIPATING ENVIRONMENTAL IMPACTS

Baseline data and conditions form the basis for evaluation of the environmental impacts of the proposed baggase fired cogeneration power project.

A tabulated evaluation procedure has been used for purpose of presentation. The severity of the impact is presented on point scale. The evaluation scale, that is used for the IEE Study is given below:

Scale: Extent of Impact

▲▲▲ = High
▲▲ = Medium
▲ = Low
O = No impact
▼▼ = locally favorable
▼ = regionally favorable.

For evaluation rating, the National Environmental Quality Standards (NEQS) and National Ambient Air Quality Standards (NAAQS)-Pakistan, are used as guidelines. Various parameters of extent of environmental impacts are described below:

Table 5.1 Evaluation of Impacts

High (▲▲▲)	National Standards are exceeded.
Medium (▲▲)	Between National Standards.
Low (▲)	National Standards are met.

5.2 ENVIRONMENTAL IMPACTS ASSESSMENT DURING CONSTRUCTION PHASE

Construction Phase Impacts

The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction.

5 2.1 Land

The land area required for the construction of the intake structure, power channel, power house and tail race channel amounts to about 5 acres. This includes about 3 acres already in the possession and ownership ot the government by way of ROW for UJC and Gujrat Branch Canal. The remaining 2 acres at Rs.1 ½ lac per acre would have to be acquired from the owners. The land to be acquired is agricultural land.

5.2.2 Soils

The soil-related issues include slope stability, and effects on agricultural soils due to fugitive dust created through excavation activities at site and spoil areas. The quantities of excavation and fill material have been calculated and the construction of project has been planned in such a way that all the excavated material will be utilized filling of low lying areas and stabilization of slopes along the power channel and other structures. Therefore, construction of this project will neither involve bringing in of fill material from outside the project site area nor will there be any need for disposal of material outside project site area. The contract documents will also include specific clauses to impose environment protection practices on the part of the contractor.

5.2.3 Biological Environment

Biological environment of the area will have a negligible impact due to construction activity because all the effects will be limited to the proposed site area.

5.2.4 Safety Hazards

Safety hazards are associated with the operation of construction machinery, equipment and tools, transportation, blasting, land cutting and slides, fires etc. The causes of safety hazards are usually complex involving human errors, operational faults of machinery and unforeseen incidences. The majority of the causes are controllable with efficient management, staff training, machinery maintenance and other preventive measures. Accident prevention is essentially an engineering and administrative problem and rests mainly on strict compliance with established safety rules and regulations. The equipment will include drag line, dozers, dumpers, excavators etc. Proper management and utilization will minimize the hazards during construction.

5.2.5 Public Health

Health hazards arise through many sources. The source of concern during construction is dust. The sanitation of the construction camp and work place will have to be proper. The workers will be provided with proper protection materials. In addition to the preventive and precautionary measures, construction camp will have a dispensary equipped with first-aid material, dressing material etc.

5.2.6 Noise Pollution

Noise pollution due to operation and movement of construction equipment may be significant depending upon the intensity of noise produced. Precautionary measures for the construction workers e.g. protective ear muffs will be provided where needed.

5.2.7 Resettlement

No human settlements would be overtaken as a result of project construction, therefore, no resettlement issues of any kind exist in this case.

5.2.8 Construction Phase Benefits

The project construction will enhance employment opportunities for the local people. This will be a welcome development in the project area.

5.3 Operational Phase Impacts

The effects of the Khokhra Hydel Power Station during its operational phase are mostly beneficial. Besides the generation of electrical energy proposed to be used for lift irrigation, the project will benefit by way of employment opportunities created as a result of the project both during construction and over the operational life of the project. A discussion of project impacts on land resources, water resources, biological resources and socio-economic environment follows.

5.3.1 Land Resources

The land resources of the project area will be directly affected in terms of overtaking of land areas for installation of project components. These components include power channel and its intake, feeder channel for Chillianwala Distributary, penstocks, power house complex, tail race and a small length of road and a bridge for accessibility within the project site. An area of about 70 acres of land will be required for these project components. Large part of this land area is under private ownership. All of this privately owned land is cultivated farm land. Some of this land is government property falling within the right of way (ROW) of UJC and Gujrat Branch Canal.

There are no human habitations on this land area. No resettlement issues exist as no population displacement is foreseen due to the project.

5.3.2 Intake Structure

The intake structure to be constructed for allowing UJC water to flow directly into the power channel at 500 ft. upstream of Khokhra Head Regulator, will have no effect on environment except for overtaking of land area,

5.3.3 Power Channel, Tail Race Channel and Feeder Channel

The body of water created in the form of power channel, tail race channel and feeder channel for Chillianwala Distributary will have no effect on environment except for overtaking of land area. Similarly the bridge on power channel and a short length of road will not affect the environment.

5.3.4 Power House

Besides power channel and tail race channel, major land area (about 20 kanals) will be taken up by the power house building which will be located at RD 254+508 of UJC and 500 ft. away from its right bank. The area required for power house building will result in a land use change. The operation of the turbines and generators in the power house will raise noise level at project site. It will not be significant in terms of environmental pollution. The NEQS level for noise is 85 dBA and it is not likely to be exceeded during power house operation.

5.3.5 Effect on Irrigation

As stated earlier there is no effect on existing irrigation system. The intake of Chillianwala Distributary has been shifted for supply of water from Power Channel in place of the present intake at Gujrat Branch. The farmland currently commanded by the distributary remains unchanged.

5.3.6 Effect on Water Quality

None of the villages within the project area has a proper sewerage and drainage system. The local population has use of out-house facilities or open field for defecation. The situation, therefore, shows that there is almost no pollution from village waste waters into any of water bodies like UJC or Gujrat Branch. This project will not change the already existing water quality in anyway.

5.3.7 Effect on Flora

There is reserve forest in Pabbi hills on the left bank of UJC at the project site. This forest will remain un-affected by the project operation. It will not be disrupted. Steps have been taken during project planning to preserve six banyan trees (*Ficus bengalensis*) growing in close proximity to the project site.

5.3.8 Effect on Fauna

The construction of the project will pose a minor hazard to reptiles, in case they are inhabiting the site. These will, however, survive by shifting to nearby vegetation or land areas.

5.3.9 Social and Cultural Resources – Overall Effects of the Project

Generally the negative effects of the project on the local population will be insignificant. However, there will be positive effects of the project on those who live and work in the surrounding villages. The contribution such a project will make to the energy sector should be a welcome development in the sustainable use of natural resources. The project will have substantial social, occupational and economic effects on the local population. In one degree or another, socio-economic effects will occur in the construction phase, the early operational phase and in the longer term period of the project. Some effects will be evident immediately, some will take time to alter current social and economic conditions, while still others are probably as yet unforeseen.

The project region is not in any way thickly populated area. The infrastructure facilities are not developed. However, the completion of the project may promote more rapid population growth and new work opportunities.

5.3.10 Cultural Resources

There are no cultural resources like shrines or archaeological sites which will be affected directly or indirectly by the project components.

5.3.11 Resettlement

There will be no danger of any human habitations or dwellings having to be taken over or done away with for the project. As a result, no resettlement issues are involved.

5.4 MITIGATION MEASURES

The purpose of a mitigation programme and monitoring plan is to manage environmental effects in a manner that minimizes adverse impacts, maximizes secondary benefits and ensures monitoring of parameters that directly affect the environment in terms of land resources, biological resources and socio-economic aspects for remedial action. This is achieved through modification of project incorporating changes in its planning, design, construction or operation.

It is generally acknowledged that some environmental effects are difficult to identify and evaluate prior to project construction or operation. Even effects that have been mitigated may be misjudged, or the success of the mitigation measure may not be upto expectations. Thus, a general environmental monitoring programme should always be considered, as a back-up to environmental assessment and mitigation.

6.4.2 Resettlement

As there are no human settlements at the project site. As such no resettlement problems/issues requiring mitigation are involved.

6.4.3 Spoil Disposal

The major components of the project requiring excavation are power channel, powerhouse complex, tailrace channel feeder channel. All of this earthwork is proposed to be spread on the land area lying between the Gujrat Branch and power channel / tail race channel. This will involve excavation of about 5 million cu.ft. of earthwork.

6.4.4 Construction Materials

The main considerations will be to utilize the local materials available in the surrounding area of the proposed project site. Coarse aggregate (gravel or crushed stone) and fine aggregate (medium to coarse sand) will be obtained from the deposits from banks of rivers Jhelum, Kohan and Bunha flowing in the region. There are 8 stone crushers already working in the Malot area. Cement and reinforcement steel is readily available in local market.

6.4.5 Cultural Properties

Cultural properties include shrines, graveyards, archaeological monuments and historical buildings. However, there are no cultural properties threatened by the construction of the project and as such no preservation and salvage measures are called for.

6.4.6 Employment

The construction period of the project will provide the region with important benefits, particularly in employment on a priority basis to local population. It should also be key part of the monitoring programme. It provides the means to create a positive interest in the project, helping to counter any opposition that may emerge. An important part of this commitment will be to hire local people for its permanent cadre to help staff in the operating and maintenance for the project. This would include jobs for malis, chowkidars, drivers and office assistants as well as openings for skilled and professional cadres.

5.4.7 Public Safety and Convenience

The aspects of public safety and convenience during construction have been discussed earlier with regard to protection of the site, protection from injuries, control of dust fumes and noise. The aspects of public health have also been discussed where emphasis has been laid on adopting efficient management and engineering practices by contractors and supervisory engineers to minimize the construction related hazards. Specific clauses would be included in the contract documents to impose requirements related to public safety and convenience.

5.5 Monitoring Programme

The monitoring programme is always a basis of information in identifying environmental and socio-economic impacts for use in informed decision-making. During the study socio-environmental issues as well as mitigation measures during planning phase have been identified. Some area, however, will require monitoring during construction and operation of the project. It, therefore, becomes necessary to include a monitoring programme as part of the project. The land resources would require monitoring. In particular landscaping of the area to be used for spoil disposal would require monitoring during project construction and project operation phase. Water resources monitoring will include both surface water and ground water. This will involve both quantitative and qualitative aspects of water resources.

Development projects bring social change in their wake. Much of this is beneficial, particularly that which promotes economic and social development. But there is always another side to development: of wage earners, families, or skill groups left behind by new methods of production, of micro-economics destroyed by new technologies, or the disintegration of village communities by population growth and a capitalizing economy. Some of this can be foreseen in a general way. Much of it would occur, even in the project area, whether or not Project is built. It seems clear that longer a project is in place, the more difficult it becomes to separate the social effects of that project from the wider processes of social change already at work in a region. Monitoring of social impacts may therefore be of value for similar project in future.

IMPACT CHARACTERIZATION CONSTRUCTION PHASE

- **D:** Direct; **ID:** Indirect; **CN:** Certain; **LK**: Likely; **LT**: Long Term; **ST**: Short Term; **PO**: Possibly; **MN:** Minor; **MJ**: Major; **MT**:

Impact	Nature	Duration	Geo-Extent	Reversibility	Likelihood	Consequence Severity/Utility
Physical Impact	ID	ST	LO	RE	LK	MN
Air Quality	D	ST	LO	RE	LK	MN
Ground Water	ID	ST	LO	RR	PO	MO
Water consumption and water availability	D	ST	LA	RE	PO	MN
Biological	ID	ST	LO	RE	LK	MN
Natural Vegetation	ID	ST	LO	RE	LK	MN
Wildlife	ID	ST	LO	RE	LK	MN
Social and Socio economic Impacts	D	LT+	LA	IR	PO	MJ
Traffic Congestion	D/ID	ST	LO	RE	PO	MN
Noise and Vibration	D	ST	LO	RE	CE	MO
Safety Hazards	D	ST/LT	LO	RE/IR	CE	MU
Employment	D	LT	LO/LA	RE/IR	CE	MU
Infrastructure	D/ID	LT	LO/LA	RE/IR	CE	MO
Public Health and Nuisance	D	ST/LT	LO	RE/IR	LK	MN

Medium Term; **MO**: Moderate; LO: Local; **LA:** Large; **SV**: Severe; **RE**: Reversible; **IR**: Irreversible.

❖ IMPACT CHARACTERIZATION OPERATIONAL PHASE

❖ **D:** Direct; **ID:** Indirect; **CN:** Certain; **LK:** Likely; **LT:** Long Term; **ST:** Short Term; **PO:** Possibly; **MN:** Minor; **MJ:** Major; **MT:**

Impact	Nature	Duration	Geo-Extent	Reversibility	Likelihood	Consequence Severity/Utility
Physical Impact	D	ST	LA	RE	LK	MN
Air Quality	ID	ST	LO	RE	PO	MN
Ground Water	ID	ST	LO	RR	PO	MO
Water consumption and water availability	D	ST	LA	RE	PO	MO
Biological	ID	ST	LO	RE	LK	MN
Natural Vegetation	ID	ST	LO	RE	LK	MN
Wildlife	ID	ST	LO	RE	LK	MN
Social and Socio economic Impacts	D	LT+	LA	IR	PO	MJ
Traffic Congestion	ID	ST	LO	RE	PO	MN
Noise and Vibration	D	ST	LO	RE	CE	MO
Safety Hazards	D	ST/LT	LO	RE/IR	CE	MU
Employment	D	LT+	LO/LA	RE/IR	CE	MU
Infrastructure	ID	LT	LO/LA	RE/IR	CE	MO
Public Health and Nuisance	ID	ST/LT	LO	RE/IR	LK	MN

Medium Term; **MO**: Moderate; LO: Local; **LA:** Large; **SV**: Severe; **RE**: Reversible; **IR**: Irreversible.

Section-6

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

This EMP describes the mitigation and management measures to address the environmental issues during construction, its regular operation phases of the proposed project.

6.1 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN

The objectives of the EMP are as follow:

a) To outline functions and responsibilities of responsible persons.
b) To state standards and guidelines, which are required to be achieved in term of environmental legislation.
c) To outline mitigation measures and environmental specifications which are required to be implementation for all phase of the project in order to minimize the extent of environmental impacts and to manage environmental impact associated with the proposed project.
d) To prevent long term or permanent environmental degradation.
e) To identify training requirement at various levels.

6.2 SCOPE OF ENVIRONMENTAL MANAGEMENT PLAN

The EMP provides mitigation and management measures for the following phases of the project:

6.2.1 Construction Phase

This section of EMP provides management principles for the construction phase of the project. Environmental actions, procedures and responsibilities as required within the construction phase are specified. These specifications will form part of the contract documentation and therefore, the contractor will be required to comply with the specifications to the satisfaction of the project Manager and Environmental Control Officer, in terms of the construction contract.

6.2.2 Operation and Mitigation Phase

This section of EMP provides management principles for the operation and maintenance phase of the project. Environmental actions, procedure and responsibilities are required from proponent within the operation and maintenance phase are satisfied.

TABLE 6.1: ENVIRONMENTAL MANAGEMENT PLAN FOR 2.8 MW KHOKHRA HYDRO POWER PROJECT

Pre-Construction Phase						
1.	Legislation, permits and agreements	• Full compliance with all relevant National & Local Legislation	• In all instances, Proponent, service providers, contractors and consultants require to remain in compliance with relevant local and national legislation.	Once at Design Stage and prior to moving onto site by proponent.	Proponent, Contractor/ Engineers, Consultants	Project Proponent
2.	Land Acquisition, Loss of private land, agriculture field, trees, residential/ commercial structures	• Site preparation/ clearance and proper landscaping without any kind of grievance for construction of proposed thermal	• Develop an appropriate "land acquisition & Resettlement Action Plan" • Land acquisition must be conducted in	Prior to start construction by Proponent.	Contractor and Design Engineers & Supervision Consultants	Project Proponent

[redacted]

		power plant	compliance with relevant laws and legislation • The cost related to relocation will be given to the relocated residents • Ensure maximum possible employment to local residents			
3.	Planning & Design	• High degree of structural competence, reliability, safety and ease	• The design specification will be followed to withstand local standards regarding noise and vibration and use of familiar and culturally relevant materials	• At Design Stage by proponent with coordination of Design Engineers	Design Engineers & Supervision Consultants	Project Proponent

			wherever consistent with functional needs • Project performance must be enhanced by incorporating innovative and sustainable design strategies.			
4.	Local Conflicts of interest among residents, workers, government officers & local politician	• Settle down each of conflict arise to best possible extent	• Ensure consideration of affected people's emotions • Provide maximum project benefits to local affected person (e.g. employment)	Prior to start construction by contractor with coordination of proponent	Contractors and Design Engineers & Supervision Consultants	Project Proponent
5.	Misdistribution of Benefits and Compensation among	• Equal and fair distribution of benefits and compensation	• Implement the same mitigation as outlined in the "Local conflict of	Prior to commence construction activity by contractor with	Contractors and Design Engineers & Supervision	Project Proponent

[redacted]

	residents, workers, government officers and others.		interest"	coordination of proponent	Consultants	
6.	Access to Site may result in damage to existing roads due to heavy machinery/ equipments mobilizatior	• Ascertain existing conditions of road for safe access to site for transportation of construction equipments and materials	• Access to site will be via existing roads. The Contractor will need to ascertain the existing condition of the roads and repair major damage to avoid delays in transporting construction materials • All roads for construction access must be planned and approved by the Engineer and	Contractor with coordination of Engineer and Consultant	Design Engineers & Supervision Consultants	Project Proponent

			Consultant • No trees, shrubs or groundcover may be removed or vegetation stripped without the prior permission of Engineer/ Consultant • The Local Traffic Police Department shall be involved in the planning stages of the road closure and detour and shall be available on site for the monitoring of traffic in the early stages of the operations during			

			road closure • The Local Traffic Department must be informed at least a week in advance if the traffic in the area will be affected			
7.	Setting up of Construction Camps	• Availability of environmentally sound construction camp facilities	• Choice of site for the Contractor's camp requires the Engineer's permission and must take into account location of local residents, businesses and existing land uses, if any. • If the Contractor	Contractor with coordination of proponent	Design Engineers & Supervision Consultant	Project Proponent

			chooses to locate the camp site on private land, he must get prior permission from both the Engineer and the landowner • Cut and fill must be avoided where possible during the set up of the construction camp • Camp must be properly fenced and secured • The Contractor shall make adequate provision for temporary toilets for			

			the use of their employees. Such facilities, which shall comply with local authority regulations, shall be maintained in a clean and hygienic condition. Their use shall be strictly enforced • Bins and/ or skips shall be provided at convenient intervals for disposal of waste within the construction camp • Bins shall have liner bags for efficient			

[redacted]						
			control and safe disposal of waste • Recycling and the provision of separate waste receptacles for different types of waste shall be encouraged.			
Construction Phase						
1.	**Air Quality** • Dust resulting from construction work • Use of heavy machinery can generate exhaust and dust emissions	– Compliance with prescribed NEQs to control air pollution	– Necessary measures like sprinkling of water on regular basis especially during dry climatic conditions should be taken to limit pollution from	During Construction Phase by Contractor with coordination of Proponent staff	Engineers & Supervision Consultants	Proponent/ EPA

	– Dispersion of particles from stockpiles during high velocity wind – Smoke from burning of waste materials or burning of firewood in the labor camp		dust and other windblown materials. – Covering or use of wind sheets around the stockpiles to avoid air pollution through dispersion – Periodic maintenance and management of all the construction machinery and vehicles – Cutting and burning shrubs for fuel will be prohibited. Instead gas cylinders should be			

[redacted]						
			used in the labor camp for cooking purposes. Similarly waste burning will not be allowed.			
2.	**Water Quality** • Run-off water from construction area – Drainage of wastewater on ground can contaminate the soil and groundwater. – Inappropriate disposal of waste. – Open sewerage water disposal on	– Control of groundwater or surface water pollution from construction activities	– Use of spill prevention trays and impermeable sheets to avoid contamination of the groundwater/surface water – Furthermore, septic tanks will need to be constructed which will be cemented to prevent the groundwater	During Construction Phase by Contractor with coordination of Proponent staff	Engineers & Supervision Consultants	Proponent/ EPA

	land can contaminate ground water and cause generation of mosquitoes and various other insects in the area. • Leakage of oil and chemical materials from construction activity		contamination – Proper disposal of waste material on dumping sites to avoid leachate generation and contamination of groundwater/surface water – Prohibit illegal dumping of waste – The contractor will repair / replace / compensate for any damages caused by the Construction activities to the drinking water			

[redacted]						
			source/s.			
3.	**Waste** • Construction waste from construction activities • Domestic waste from workers camp • Hazardous waste such as dry batteries, chemicals etc.	– Proper & safe handling and disposal of construction related waste – Compliance with applicable waste management rules for hazardous and non-hazardous waste disposal – Implementation of waste management plan	– Ensure prevention of inappropriate disposal of waste material – Conduct separate collection of construction and domestic waste to promote recycling and re-use – Dispose non-recyclable and hazardous waste material properly according to waste management rules – Proper disposal of	During Construction Phase by Contractor with coordination of Proponent staff	Engineers & Supervision Consultant	Proponent/ EPA

			waste on agreed site as per agreed method. The area to be leveled and contoured after disposing excess material. No waste or debris will be thrown in the nearest canal water or other water bodies – Contractor will prepare waste management plan related to construction activities; get its			

			approval from site engineer and ensure its full implementation			
4.	**Noise** • Noise caused by construction machinery and vehicles used for mobilization of construction equipment and workers	– Compliance with prescribed NEQs to control Noise pollution	– The contractor will strictly follow the NEQS for ambient noise – Control noise throug h con-trol of working hours and selection of less noisy equipment. – Prohibit use of pressure horns – Provision of acoustic enclosures (hood and shrouds)	During Construction Phase by Contractor with coordination of Proponent staff	Supervision Consultant	Proponent/ EPA

			on generator – Proper maintenance of vehicles and construction equipment. – Minimize/avoid unnecessary use of pneumatic drills and other noisy machinery – The personal protective equipment (PPE) will be provided to the construction workers and its usage will be made mandatory			
5.	Materials	– Safe and secure	– Stockpiles shall not	Contractor with	Engineer &	Proponent/

	Management	environment for construction workers	be situated such that they obstruct natural water pathways – Stockpiles shall not exceed 2m in height unless permitted by Concerned Engineer on site – If stockpiles are exposed to windy conditions or heavy rain, they shall be covered either depending on the duration of the project. Stockpiles may further be protected by the	coordination of proponent and Engineer	Supervision Consultant	EPA

			construction of low brick walls around their bases – All substances required for vehicle/ machinery maintenance and repair must be stored in sealed containers until they can be disposed of / removed from the site – Hazardous substances / materials are to be transported in sealed containers or			

			bags – Spraying of insecticide shall not take place under windy conditions			
6.	**Biological Resources** – Removal of vegetation covers by cutting of trees, crops, herbs and shrubs – Fauna including birds and animals will be affected during excavation, movement of labor and carriage of	– Obligation to respect wildlife, Forest and Fisheries Laws. – Conserve biodiversity and its terrestrial as well as aquatic habitat	– Re-plantation of maximum number of trees. – Staff and workers should be instructed not to damage nearby vegetation of the surrounding area. – Open fires should be prohibited in the area to avoid the hazard of fire and	Contractor with coordination of proponent staff	Design Engineer & Supervision Consultant	Proponent/ EPA

	goods and machinery		impact on nearby flora and fauna. – Contractor staff should be given clear instructions that they should not hunt any birds/ animal in the project area/ site – Barriers/ fencing/ or boundary wall should be installed at project site to protect movement of animals at the project site during constructions. – Proper disposal of			

			organic waste (if any) generated during the construction stage to avoid rodents and other insects' generation.			
7.	Staff Conduct	– Timely completion of project activities	– The Contractor must monitor the performance of construction workers to ensure that point relayed during their induction have been properly understood and being followed	Contractor	Design Engineer & Supervision Consultant	Proponent/ EPA
8.	Leakages/ spills/ Paints/ Used oil	– Compliance with standards set forth	– Contractor will apply strict rules on his			

		by "Guide Lines for Oil Spill Waste Minimization and Management" issued by International Petroleum Industry Environmental Conservation Associate	workers and labor to ensure that no spill or leakages are caused – All fuels, oils and bitumen will be stored appropriately, with concrete padding and bunding for containment in case of leakage – Proper maintenance of vehicles and machinery – Chemical waste will be disposed off in approved disposal			

			site. – All fuel tanks, chemicals including paints, pesticides or other hazardous substances will be properly marked to highlight their content – PPE will be enforced to use during the handling and application of chemicals – Used oil/ oil rags will be disposed through approved recyclable waste vendors			

			– The contractor will employ the general criteria for oil and leakage at construction sites, as per standards			
9.	Workers Health & Safety	– Prevention of any possibility of work site accident /impact on worker's health	– Provision of Personal Protective Equipment to the workers – Provision of first aid box at work site to cope with emergency situation – Safety training to the workers – Safe driving training to the drivers	Contractor	Engineer & Supervision Consultant	Proponent/ EPA

			– Adequate safety signs on site – Provide training regarding proper handling and use of chemicals/ paints – Install fire extinguishers at fire handling places – Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads – Any loss of public/ private property will be compensated by			

			the contractor – Regular checks should be carried out to ensure a contractor's is following safe working procedures and practices.			
10.	Socio-economic Impacts	– Prevention of conflicts among locals and make the project socially acceptable – Empowerment of locals to possible extent – Increase in employment and	– Contractor's activities and movement of staff to be restricted to designated construction areas – The conduct of the construction staff when dealing with the public or other	Contractor with coordination of proponent staff	Supervision Engineer	Proponent/ EPA

		business opportunities for locals	stakeholders shall be in a manner that is polite and courteous all the time – Lighting on the construction site shall be pointed downwards and away from oncoming traffic. – The site must be kept clean to minimize the visual impact of site – Machinery and vehicles are to be kept in good working			

			order for the duration of the project to minimize noise nuisance to neighbors – Noisy activities must be restricted to the times given in the Project Specification or General Conditions of contract – The Contractor are responsible for ongoing communication with those people that are interested in /			

			affected by the projects – Employ local residents as much as possible – Promote communication between external workers and local people (e.g. join local events).			
11.	Clearance of site from extra / surplus material and construction equipment	– Restoration of site to a similar condition prior to the commencement of the work or to a condition agreed with the project	– Timely removal of waste from the site to avoid congestion at work place. – Construction waste should be collected and disposed	Contractor	Supervision Engineers	Proponent/ EPA

		management and landscaping of the site	separately from other waste. – Care will be taken during handling and disposal of waste. – Contaminated soil (if generated) due to accidental spills will be removed and transported to suitable site for disposal. – Avoid mixing of hazardous waste with non-hazardous waste. – Safe transportation of construction			

[redacted]

			equipment from the site. – The contractor must ensures that all structure, equipment, materials and facilities used or created on site for/or during construction activities are removed. – Empty/available space will be covered with grassy lawns. – Use of native vegetation as a part of landscape.			

			Ornamental plant species like roses, jasmine, and seasonal flowers can be used in proposed landscaping, which is a common practice in this part.			
Operational Phase						
3.	**Waste** – Sludge from wastewater treatment and waste oil from equipment etc. – Sewage and	– Compliance with waste management rules – Management of waste, especially hazardous waste – Prevention of inappropriate waste	❖ **Waste management** – Implementation of waste management program consisting of reduce, reuse and re-cycling of materials – Systematic	EHS officer of Project Proponent	Environment Consultant hired by Project Proponent	Project Proponent/ EPA

[redacted]						
	garbage from workers	disposal	collection and protected storage of waste – Waste disposal at appropriate and designated site – Hazardous waste must be treated under related regulation – Prohibition of dumping of any contaminating material			
4.	**Noise & Vibration** – Noise and vibration from turbines, etc.	– Compliance with prescribed NEQs to control Noise pollution	– Installation of low noise/ low vibration type equipment – Proper maintenance	EHS officer of Project Proponent	Environment Consultant hired by Project Proponent	Project Proponent/ EPA

	– Noise from vehicles used for mobilization of equipment		of equipments – Adequate basis of equipment to reduce the vibration – Provision of PPEs to workers like ear muffles – Ensure use of PPEs by workers			
6.	**Work environment (including work safety)** – Labor accidents due to handling heavy loads; working at heights; electric shocks – Diseases caused	– Prevention measures against labor accidents and health problems	❖ **Labor accidents** – Prepare a manual for labor accident prevention including safety education and training – Provide workers with appropriate	EHS officer of Project Proponent	Environment Consultant hired by Project Proponent	Project Proponent/ EPA

	by any pollutants, and noise from the operation of the power plant		protective equipment – Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads – Keep lifting devices well maintained and perform maintenance checks as appropriate – Use equipment that protects			

[redacted]						
			against electric shock ❖ **Fire Hazards** – Installing fire extinguishers in fire handling places –			

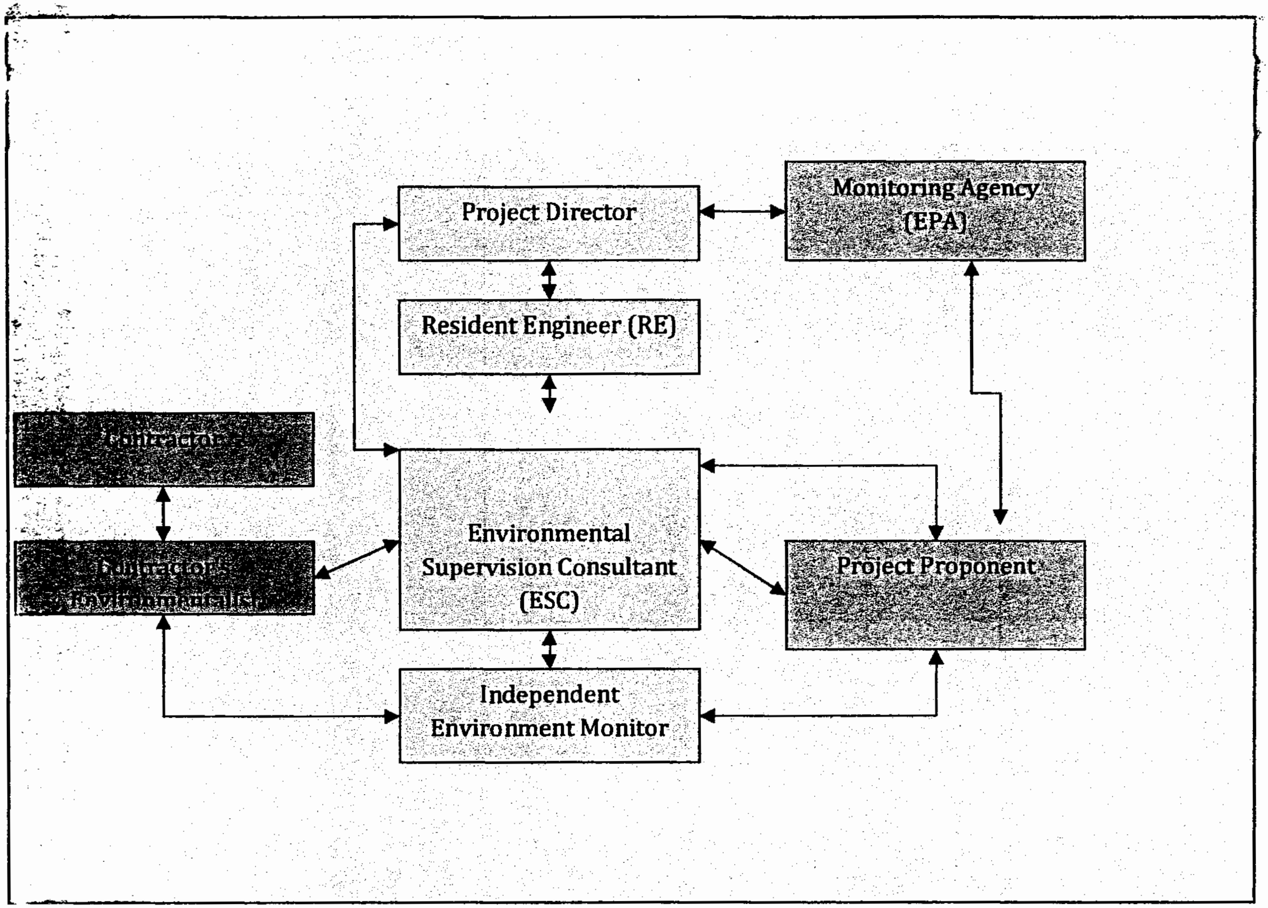


Figure 6.1: ORGANOGRAM FOR IMPLEMENTATION OF EMP

6.3 ENVIRONMENTAL MONITORING PROGRAM

It will be in the fitness of the things to operate this project under the Environmental Management Plan (EMP). The EMP will ensure that even all type of pollutants from project is within the prescribed limiting values of the NEQS. Thus, the environment and human health around the project will be safeguarded.

Regular monitoring of all the significant environmental issues is essential to check the compliance status of EMP.

The main objective of the monitoring will be;

- To verify the results of the environmental study with respects to the proposed project.
- To estimate the trends of concentrated values of the issues, which have been identified as critical and then planning the mitigating measures.
- To assess the efficiency of pollution control mechanism.
- To ensure that any additional parameters, other than those identified in the IEE report, do not turn critical after the commissioning of proposed project.

Table 6.2- Recommended Activities of Environmental Monitoring

Water Quality	▪ Ground Water ▪ Surface Water	Discrete grab sampling and laboratory testing of water samples.	▪ Sampling and laboratory testing should be done on monthly basis during the construction and annually during the operational

			stage. ▪ Discharges from the construction sites should be tested for temperature, pH and turbidity. ▪ Treated effluent discharges from the worker's camp to be tested for pH, TSS and BOD_5.
Dust Emissions	▪ Tracks along the roads during construction period.	Ambient Particulate Matter Monitoring.	▪ Sampling and laboratory testing should be done on monthly basis during the construction and through annual basis during the operational

			stage.
Noise Levels	▪ Camp sites, ▪ Selected locations along the project access.	Noise meter	▪ Monthly during the construction and operational stage.
Stack emission	Silencers of heavy machinery, trucks and other vehicles.	Emissions monitoring system. Monitoring of ambient air quality.	▪ Monthly monitoring of air pollution parameters including PM_{10}, NO_X, SO_X, CO, Hydrocarbons during the construction period
Ecological Environment			
Cutting of trees	In all Project Area during the construction stage and operation stage.	Periodic visits at site to ensure that only those trees should be cut, which are demarcated	▪ Weekly during routine monitoring and reported on monthly basis during the construction

		for cutting.	period, and once in a year monitoring and reporting during the operation period.
Socio-Cultural Environment			
Inconvenience to community	All around the Project Area	Consultations with community to get feedback about inconvenience due to the construction activities to perform their daily routine chores.	• Monthly monitoring and reporting during the construction period.

6.4 ENVIRONMENT MANAGEMENT COST

The total cost for the environmental management is estimated as 2.5 million Pak Rupees. The estimations are as followings;

Table 6.3 Environmental Management Cost

(i) Tree Plantation (local species)	1500	700,000.0
(ii) Health and Safety Measures and Provision of PPEs	L.S.	500,000.0
(iii) Air and Water Quality & Noise Monitoring	L.S.	800,000.0
(iv) Environmental Trainings	L.S	500,000.0
Total Environmental Management and Monitoring Cost		**2,500,000.0**

6.5 TRAINING NEEDS

In order to effectively operate the EMP all the staff to be engaged in this activity should be trained extensively. All the environment management staff to be engaged for operating plant, monitoring and testing should be duly trained. Laboratory chemist should be trained in all operations of laboratory testing of the effluents and other relevant materials/samples. He should be trained in applying analytical methods/techniques of testing, data processing, interpretation and reporting. He should know the local laws, rules and regulations as applicable to the testing of effluents.

The designated HSE Officer will be charged with an ongoing program of environmental training. This will include:

- General promotion of environmental awareness;
- Specific training for staff working in sensitive areas;
- Updating staff on changes to environmental standards; and
- Reporting to staff on the station's environmental performance.

The person to monitor gaseous emissions, PM and noise levels should be extensively trained to handle his job capably. Training program should include use of monitoring instruments, data generation, processing, interpretation, recording and presentation.

6.6 MONITORING & EVALUATION (INSTITUTIONAL ARRANGEMENT)

Project Director will be responsible for Monitoring and Evaluation, but Environment consultant (of the proponent) will responsible to monitor EMP implementation in the field and reporting to the Project Director. The Project Director will integrate monitoring reports in the main monthly reports of the project. The Environment Specialist of Supervision Consultant will carry out a final evaluation at the end of the Project. In addition, for external monitoring, proponent is to engage an independent agency (an NGO, an academic institute or an individual consultant) to conduct 3rd party validation of EMP implementation. District Office of the EPA at Gujrat will monitor the overall activity at the site.

6.7 SOCIAL MANAGEMENT PLAN

6.6.1 Recommendations and Mitigation Measures

Based on the initial benchmark study the recommendations are made:

- The management of the Project can capitalize on the positive attitude of the people of area towards proposed Project by offering them maximum employment opportunities at the construction stage and stage of operational phase of the power plant.
- Insufficient and inadequate socio-economic structure of the community of the area also provides ample opportunities to project management to win sympathies of local people in their favor, by introducing meaningful and manageable plan of community development.
- Aggressive and comprehensive plantation plan can also lessen fear of local people towards environmental issues.
- Plant management can explore direct or indirect chances of female employment opportunities. Such efforts can be fruitful to minimize negative social impacts.

- Sustainable development approach through conservation of natural resources would be the best strategy to compensate negative socio-environmental impacts.
- Plant management should offer technical training opportunities to the local youth, if possible, to remove relative sense of deprivation.

Section-7

PROJECT SOCIAL SOUNDNESS

Stakeholder consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability. Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision-making. Stakeholder consultation was therefore conducted in the project area not only to satisfy the legal requirements of the IEE process in Punjab province but also to improve and enhance the social and environmental design of the project.

7.1 OBJECTIVES OF STAKEHOLDERS CONSULTATION

The process of public participation and consultation was endorsed in the United Nations Conference on the Environment and Development (UNCED) in 1992 through one of the key documents of the conference named as Agenda 21.

Agenda 21 is a comprehensive strategy for global action on sustainable development and deals with issues regarding human interaction with the environment. It emphasizes the role of public participation in environmental decision-making for the achievement of sustainable development.

A study was carried out with the broad objective to evaluate the impact of the project on the local population through public consultation process. The specific impact assessment aims were:

- Promote better understanding of the project, its objective, and its likely impact
- Identify and address concerns of all interested and affected parties of project area.

- Provide a means to identify and resolve issues before plans are finalized and potentially costly delays development commences, thus avoiding public anger and resentment.
- Encourage transparency and inculcate trust among various stakeholders to promote cooperation and partnership with the communities and local leadership.

7.2 PUNJAB ENVIRONMENTAL PROTECTION ACT 2012 (AMENDED ACT)

Public consultation is mandated under Punjab's environmental law. The Provincial Agency, under Regulation 6 of the IEE-EIA Regulations 2000 has issued a set of guidelines of general applicability and sectoral guidelines indicating specific assessment requirements. This includes Guidelines for Public Consultation, 1997 (the 'Guidelines'), that are summarized below:

a) Objectives of Public Involvement

To inform stakeholders about the proposed project, to provide an opportunity for those otherwise unrepresented to present their views and values, providing better transparency and accountability in decision making, creating a sense of ownership with the stakeholders.

b) Stakeholders

People who may be directly or indirectly affected by the proposed project will clearly be the focus of public involvement. Those who are directly affected may be project beneficiaries, those likely to be adversely affected, or other stakeholders. The identification of those indirectly affected is more difficult, and to some extent it will be a subjective judgment. For this reason it is good practice to have a very wide definition of who should be involved and to include any person or group who thinks that they have an interest. Sometimes it may be necessary to consult with a representative from a particular interest group. In such cases the choice of representative should be left to the group itself. Consultation should include not only those likely to be affected, positively or negatively, by the outcome of proposed project, but should also include those who can affect the outcome of a proposal.

c) Mechanism

Provide sufficient relevant information in a form that is easily understood by non-experts (without being simplistic or insulting), allow sufficient time for stakeholders to read, discuss, consider the information and its implications and to present their views, responses should be provided to issues and problems raised or comments made by stakeholders, selection of venues and timings of events should encourage maximum attendance.

d) Timing and Frequency

Planning for the public consultation program needs to begin at a very early stage; ideally it should commence at the screening stage of the proposal and continue throughout the IEE process. In particular for present project the consultation was carried for six consecutive days.

e) Consultation Tools

Some specific consultation tools that can be used for conducting consultations include; focus group meetings, needs assessment, semi-structured interviews; community meetings and workshops.

f) Important Considerations

The development of a public involvement program would typically involve consideration of the following issues;

- objectives of the proposal and the study;
- identification of stakeholders;
- identification of appropriate techniques to consult with the stakeholders
- identification of approaches to ensure feedback to involved stakeholders;
- mechanisms to ensure stakeholders consideration are taken into account.

7.3 CONSULTATION PROCESS

Primary stakeholders were consulted during informal and formal meetings held in the project area. The consultation process was carried out in the Punjabi and Urdu languages. During these meetings a simple, non-technical, description of the project was given, with an overview of the project's likely human and environmental impact. This was followed by an open discussion allowing participants to voice their concerns and opinions. In addition to providing communities with information on the proposed project, their feedback was documented during the primary stakeholder consultation. The issues and suggestions raised were recorded in field notes for analysis, and interpretation.

By reaching out to a wider segment of the population and using various communication tools such as participatory needs assessment, community consultation meetings, focus group discussions, in-depth interviews, and participatory rural appraisal; present IEE involved the community in active decision-making. This process will continue even after this IEE has been submitted, as well as during future IEEs in which similar tools will be used to create consensus among stakeholders on specific environmental and social issues.

In the Secondary stakeholder consultations were more formal as they involved government representatives and local welfare organizations, NGO's consulted during face-to-face meetings and through telephonic conversations. They were briefed on the IEE process, the project design, and the potential negative and positive impact of the project on the area's environment and communities. It was important not to raise community expectations unnecessarily or unrealistically during the stakeholder consultation meetings in order to avoid undue conflict with community's leaders or local administrators. The issues recorded in the consultation process were examined, validated, and addressed in the IEE report.

7.3.1 Points Discussed

Following points were discussed during the public consultations:

- Project components, its activities and impacts.
- Needs, priorities and reactions of the affected population regarding the proposed Project.
- Grievances redress procedures.
- Entitlement checklist development for the affectees of the Project.
- Evaluation criteria of the buildings.

- Basis for determining the rates of the land, houses, and other infrastructures.
- Compensation framework for the Project affectees.
- Compensation criteria to be followed for the payment to the affectees.
- Role of the affectees in implementation of the project.

7.4 STAKEHOLDER CONSULTATION TECHNIQUE

In recognition of the diversity of views within any community, it is very important to obtain a clear understanding of the different stakeholders and to analyze their capacity and willingness to be involved in some or all of the project and its planning process. It is important to be aware of how different power relations can distort participation. It is also important to examine how community skills, resources, and 'local knowledge' can be applied to improve project design and implementation. All of this can be achieved by careful use of the various tools of Stakeholder Consultation. Therefore, the following participatory techniques were employed during stakeholder consultations:

- Informal meetings with communities.
- Focus Groups with participants in communities.

In the consultation process for IEE, following key stakeholders were consulted:

- Local communities,
- Men
- Women and
- Community's elders attended meetings.

Meetings with stakeholders consisted of community consultation meetings, focus group discussions, and in-depth interviews with men and limited focus-group discussions with women.

7.4.1 Government Representatives

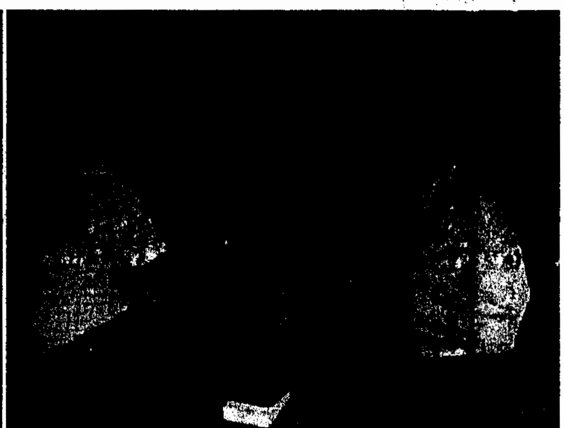
The consultations were carried out with the local government officials and officials of the following departments:

- Forestry

- Fisheries
- Irrigation
- Wild Life

The officials of Wildlife and Forest department perceived that the employment opportunities and business development would be the positive impacts on the community and people during the construction phase of the proposed project. Among the perceived negative impacts during construction phase of the project include especially road blockage, dust emissions, noise and nuisance due to heavy traffic. All officials of project study area were in favor of the project. They expect many positive, conducive and constructive impacts on socio-economic life of local community regarding jobs, business opportunity and social structure development. They were in opinion that project would improve area development through development of existing infrastructure etc. The project will also raise their level of awareness, initiate cultural diffusion, activate social mobility and bring social change regarding various aspects of their life.

The officials from Fisheries and Irrigation departments appreciated the proposed activity. They also expressed that the jobs and business opportunities for the local community will be increased due to project activities and that the infrastructure will developed that automatically lead to the development of the project area. They also expressed the concern that most of the unskilled and skill jobs should be provided for the local communities.



Consultation with the Government Officials

7.4.2 Stakeholder Concerns and Recommendations

The findings of the Community consultations are given as followed. All these have been addressed in various sections of the IEE and the mitigation plans have been incorporated into the EMP.

The summary of the various stakeholder consultations is given below.

- The people foresee positive impacts like employment opportunities, business, development of the area etc.
- Study findings depict that the people of the study area perceive overall positive impacts as a result of power plant sitting. Therefore, their attitude towards the project establishment is quite positive.
- As far as the Environmental Assessment is concerned, positive social impacts are dominant over hardly conceived any negative social impacts observed during the study.
- The people have high expectations and hope from the project activity and its management.
- They correlate their positive attitude towards the project with many socio-economic opportunities and benefits.
- The people believe that the project in the area will open up vast employment opportunities which in turn follow a chain of indirect socio-economic benefits.
- They also perceive accelerated economic activity due to the business opportunities likely to emerge in the area. Directly or indirectly, hundreds of the local people will get employment and business from the project e.g, shopkeepers, traders, suppliers, contractors, transporters, technicians, etc.
- People foresee many socio-cultural and psychological positive impacts on their lives and the community.
- They feel that the project and its related activities will provide a strong base for social change.

- They reckon that invasion of the people and technology in the area will improve the quality of life of the people. It will also improve the level of general awareness of the people about different aspects of life.

From the above facts one can conclude that many positive economic and social impacts will appear in the quality of the lives of the people of the Study Area due to proposed power project. These positive impacts include improvement in female status, employment and business opportunities, infrastructure development, reducing rural urban migration, generating income resources and improving quality of life.

7.5 PROCEDURE FOR REDRESS OF GRIEVANCES

Suggested procedures to be adopted for the redressal of the grievances are given below:

- Project affectee will submit his/her application to the Field Implementation Unit for consideration. Within 15 days of the receipt of the complaint, action will be taken up for redressal of the grievance. Wherever policy matters are involved, the case will be referred to the appropriate authority or committee appointed by the Project to decide the matter.
- In case some response on the complaint is not received within 15 days of the receipt of the complaint, the complainant may also send a reminder to within 15 days notice to take legal remedial measures.
- In case the matter has been decided but the complainant is not satisfied, he/she may go to the court of law.
- In case of such eventualities, all affected persons should be exempted from legal and administrative fees made/paid/incurred pursuant to the grievance redressal procedures.
- All complaints received in writing or written when received verbally will be properly recorded and documented.

7.6 PROPOSED MECHANISM FOR GRIEVANCE REDRESS

Under the Project the following will be established or appointed to ensure timely and effective handling of grievances:

- A Public Complaints Unit (PCU), which will be responsible to receive, log, and resolve complaints; and,
- A Grievance Redress Committee (GRC), responsible to oversee the functioning of the PCU as well as the final non-judicial authority on resolving grievances that cannot be resolved by PCU;
- Grievance Focal Points (GFPs) having educated people from each community that can be approached by the community members for their grievances against the Project. The GFPs will be provided training by the Project in facilitating grievance redress.

Details of the proposed mechanism are given below.

7.6.1 PCU – Function and Structure

PCU will be set up as part of the environment, health and safety department of the Project. A senior official with experience in community and public liaison will lead the unit. Two assistants, one male and one female will be responsible for coordinating correspondence and preparing documentation work and will assist the senior official. The senior official will be responsible to review all documentation. The PCU will be responsible to receive, log, and resolve grievances. Given that the female community members have restricted mobility outside of their homes, the female PCU staff will be required to undertake visits to the local communities. The frequency of visits will depend on the nature and magnitude of activity in an area and the frequency of grievances.

7.6.2 GRC – Function and Structure

The GRC will function as an independent body that will regulate PCU and the grievance redress process. It will comprise of:

- Officials of environment, health and safety of the proposed Project.
- Senior engineer that is responsible to oversee the contractors.
- Two literate representatives from the communities residing near the project site;
- A representative of the local government. In case the local government elections take place, this could be the Naib-Nazim or

Nazim (the district governor). If not, this would be the District Coordinating Officer (DCO) or an appointed representative;

- Senior member from the local civil society with experience in community relations;
- A female member from the local civil society.
- The GRC will meet once every three months to review the performance of the PCU; the frequency can be changed depending on the nature and frequency of grievances received. The performance will be gauged in terms of the effectiveness and the timeliness with which grievances were managed. In case there are any unresolved or pending issues, the GRC will deliberate on mechanisms to resolve those and come up with solutions acceptable to everyone,

7.6.3 Grievance Focal Points

The GFPs will be literate people from each community that will facilitate their community members in reporting grievances from the Project. The GFPs will be provided training by the Project in facilitating grievance redress. Each community will have a male and female GFP appointed for this purpose.

7.6.4 Procedure of Filing and Resolving Grievances

Grievances will be logged and resolved in the following steps:

Step 1: Receive and Acknowledge Complaint

Once the PCU receives a complaint, which could be the complainant giving it in person, via letter or email, through phone call, or through a GFP, an acknowledgement of receipt of the complaint has to be sent within two working days to the complainant. The complainant will be issued a unique complaint tracking number for their and PCU's record.

Step 2: Investigation

PCU will work to understand the cause of the grievance for which the PCU may need to contact the complainant again and obtain details. The PCU will be required to complete preliminary investigations within five working days of receiving the complaint and send a response to the complainant documenting the results of their investigations and what the PCU plans to do ahead.

Step 3: Resolution through PCU

Once the PCU have investigated a grievance, it will share with the complainant the proposed course of action to resolve the complaint, should PCU believe any to be necessary. If the complainant considers the grievance to be satisfactorily resolved, the PCU will log the complaint as resolved in their records. In case the grievance remains unresolved it will be reassessed and GRC will have further dialogue with the complainant to discuss if there are any further steps, which may be taken to reach a mutually agreed resolution to the problem.

For minor grievances, Steps 1, 2 and 3 or Steps 2 and 3 can be merged.

Step 4: Resolution through GRC

In case the PCU is unable to resolve the issue, the matter will be referred to GRC. All complaints that could not be resolved within four weeks will by default be referred to GRC. However, the complainant or the PCU can convene the GRC at any point in time, depending on the nature and urgency of the issue.

7.6.5 Operating Principles for PCU

The PCU will operate on the principles of transparency, approachability and accountability. To achieve these, the PCU will be required to:

- Be equipped to handle grievances in the local languages;
- Be equipped to work through all possible modes of communication, such as, emails, surface mail and face-to-face meetings at project site or requiring visits;
- Employ female staff, preferably from the nearby communities, to oversee complaints and issues of the female community members.
- Maintain a log of all grievances, with record of the date and time of the complaint logged and stakeholder information, such as, name, designation and contact details;

- Provide opportunity to the stakeholder to revert with their comments on the proposed plan of action;
- Keep the stakeholder informed of the progress in grievance resolution;
- Obtain stakeholder consent on the mechanism proposed to redress the grievance and document consent; and,
- Maintain confidentiality of the stakeholder, if requested so,

7.6.6 Stages of Grievances

Once a grievance is logged with the PCU, it could acquire the following stages:

Stage 1: it is resolved by the PCU or if not PCU, by the GRC;

Stage 2: If the stakeholders are still not satisfied, they can go through local judicial proceedings.

7.6.7 Awareness

The stakeholders will be informed of the establishment of the PCU, GRC and GFPs through a short and intensive awareness campaign. Under the awareness campaign, the proponent will share:

- Objective, function and the responsibilities of the PCU, GRC and GFPs;
- Means of accessing the PCU and the mechanics of registering a grievance at the PCU,
- GRC and GFPs;
- Operating principles of the PCU, GRC and GFPs; and,
- Contact details.
- Additional awareness campaigns may be organized, if necessary

7.7 COMMUNITY CONCERNS

Project Approval

The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were considered a good gesture and appreciated, especially by the men and women. This project will provide employments to the local as well as non local poor community in its construction as well as in operational stages.

Resettlement/ Relocation

The owner of the private land demanded the followings;

- Lucrative Land against land
- Fair Compensation against acquiring land
- Compensation of Land before the commencement of the work

Local Employment

Communities in the project area emphasized that local poor community should be given priority when employing people for various project-related works and activities according to their skills.

Interaction with Local Community

Non-Local work force coming in the project area that will not be aware of the local customs and norms, may result in conflicts with the local community, keeping in mind the sensitive law and order situation and culture of the area.

Impact on Livelihood

The communities also expressed some fear that project construction would disturb their living because of noise and vibration of constructional woks and due to vehicular movement. Another concern of local community is the road blockage and traffic problem in the surrounding areas of proposed project sites during construction.

7.8 LOCAL GOVERNMENT REPRESENTATIVES

The consultations were considered a good gesture and appreciated. They also expressed the jobs and business opportunities for the local community will be increased due to project activities. They also expressed the concern that most of the unskilled and skill jobs should be reserved for the local communities.

Section - 8

CONCLUSION AND RECOMMENDATIONS

8. CONCLUSION AND RECOMMENDATIONS

The project embarks upon the installation of 2.8 MW power project. On the basis of this IEE Report it is concluded that:

1- There are no sensitive elements /segments of environment around the project site.

2- The project has inbuilt efficient, state of the art and reliable mechanisms to control all type of pollutants like PM, gaseous emissions and noise in compliance levels well within the NEQS limits of the Pakistan.

3- The project shall not increase the load on the ground water table as the existing water resources will be utilized for the new project activity.

4- EMP and EMtP as recommended in this IEE Report are to be put in place during the entire operation of the project.

5- Quarterly monitoring of all out environmental pollution sources by a third party also certifies that the project will run in accordance with legal requirements.

6- The regular environmental monitoring for the existing plant ensures the environmental soundness of the project.

7- The use of bagasse as main fuel for the operation of the power plant will displace fossil-fuel based electricity generation.

8- EMP and EMtP, as recommended in this IEE Report, are to be implemented during construction and operation phases. This will manage all type of pollutants.

9- The proposed power plant will improve the economic status of the region and also contribute significantly to the overall economic growth of the country, when due to acute shortage of electric power long drawn out load sheddings are salient feature across the entire country. This state of affairs is resulting in huge economic loss to the national exchequer in the form of taxes and duties and drastic decrease in Industrial Productivity resulting in cut of the foreign exchange earnings, joblessness especially among the workers and related socio-economic issues.

Under the light of detailed discussions in IEE Study about likely impacts of the proposed project intervention, it can be safely concluded that the proposed Project would not cause any significant adverse impacts for which detailed EIA is required. On the basis of the facts summarized as above, the project merits for issuing No Objection Certificate/Environmental Approval by the Environmental Protection Agency, Government of Punjab Lahore.

TERMS OF REFERENCES

Listed below are some of the documents, reports and other references consulted during the preparation of this report:

a. Information and data provided by project proponents;

b. Project Pre-feasibility Study Report;

c. Technical Design Data related to the project.

d. Information gathered through discussions with the project related persons of the project proponent;

e. Discussion with concerned government officials;

f. Information collected from the Technical documents of various suppliers of machinery/equipment.

g. Guidelines for Self- Monitoring and Reporting by the Industry (SMART)," Final Report, March 1998, approved by Pakistan Environmental Protection Council (PEPC), August 1999;

h. National Environment Quality Standards for Municipal and Liquid Industrial Effluents, Statutory Notification (S.R.O.), Government of Pakistan, Ministry of Environment, Local Government and Rural Development, S.R.O.549 (1)/2000, Islamabad, the 8th August 2000;

i. National Environment Quality Standards for Ambient Air November 2010;

j. National Environment Quality Standards Noise Levels November 2010;

k. National Environment Quality Standards for Drinking Water November 2010:

l. Pakistan Environmental Protection Act, 1997;

m. The Punjab Environmental Protection (Amendment) Act 2012 covers aspects related to:

- the protection, conservation, rehabilitation and improvement of the environment and the prevention, control of pollution and promotion of sustainable development;
- establishing complete regulatory and monitoring bodies, policies, rules, regulations and national environmental quality standards; and

- to ensure enforcement, the act establishes regulating bodies i.e. Punjab Environmental Protection Council (PEPC) and responsible bodies i.e. Punjab Environmental Protection Agency (Punjab EPA) at Provincial level.

a. Land Use Policies and Environmental Legal Framework including;
b. Environment related Laws in Pakistan and the Province of Punjab;
c. The Pakistan National Conservation Strategy, Environment and Urban Affairs' Division (presently- Ministry of Environment, Urban Affairs and Wild Life), Government of Pakistan, Islamabad;
d. Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995, Prepared and published jointly by: American Public Health Association, American Water Works Association, Water Environment Federation; Publication office: American Public Health Association, 1015 Fifteenth Street, NW Washington, DC 2005;
e. Government of Pakistan, Pakistan Environmental Protection Agency, Policy and Procedures for Filing, Review and Approval of Environmental Assessment, 2000;
f. The Canal and Drainage Act, 1873;
g. Environmental Assessment Requirements and Environmental Review Procedures of the Asian Development Bank, 1993;
h. Google Earth, Maps.
i. Guidelines for Public Consultations - These guidelines cover:
    - Consultation, involvement and participation of Stakeholders
    - Techniques for public consultation (principles, levels of involvements, tools, building trust)
    - Effective public consultation (planning, stages of EIA where consultation is appropriate)
    - Consensus building and dispute resolution
j. Factories Act, 1934;
k. Applicable International Environmental and Occupational Safety and Health Laws and Regulations;
l. Applicable International Environmental and Occupational Safety and Health Laws and Regulations;

m. Pollution Prevention and Abatement Handbook, The World Bank, 1998;

n. International Finance Corporation's Policy on Energy and Social Sustainability, January 1, 2012;

o. National Resettlement Policy (Draft), Government of Pakistan, March 2002.

FEASIBILITY STUDY

2.8 MW KHOKHRA HYDROPOWER PROJECT

KHOKHRA HYDROPOWER PROJECT

FEASIBILITY STUDIES

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

An Agreement was signed on 04-10-2004, between Irrigation and Power Department Govt. of Punjab and a consortium of Pakistan Engineering Services (Pvt) Ltd and Barqaab consulting services (Pvt) Ltd "Consultants".

The consultants besides other assignment were instructed to carryout feasibility studies of Khokhra Hydropower Project.

1.1 The Project

Khokhra Hydropower Project, has been conceived by utilizing 3 falls available at Gujrat branch off taking from right bank of UJC at RD 255+080.

The design discharge is 1433 Cusecs while design head is 26.74 ft. The installed capacity has been worked out as 2.8 MW while annual net deliverable energy expected to be generated is 16.488042 Gwh. The plant factor is 67.0 %.

1.2 Access

From Kharian going towards Jhelum on GT road there is a road bridge on UJC at RD 142, at a distance of 11 Km from Kharian. Just before crossing the bridge a side road leads to the left and right bank of UJC. Travelling D/Stream on right bank of UJC, the project site is at a distance of 35 Km.

2.0 CLIMATE

The climate of the project area is semi arid and characterized by four distinct seasons in the year that is winter, spring, summer and autumn. The average rainfall for last 30 years is 852.50 mm. The average maximum temperature is 39°.4C. Maximum temperature recorded so far is 49°.2C on 31-05-1988, while minimum temperature recorded so far is - 3°C on 22-12-1950.

Predominant wind direction has been North to North West, while during monsoon period it is from east to South East – Average maximum wind speed recorded at Jhelum is 29.65 Km/hr.The average relative humidity is 69.4 % and 42.8 % for morning and evening respectively

3.0 HYDROLOGY

Potential energy of natural falls on Gujrat Branch off taking from UJC at RD 255+080 is utilized for electric power generation. This is accomplished by routing water flowing in the Gujrat Branch through turbines located in the off channel downstream of the falls at Khokhra Head regulator. The following hydrologic data for critical period of 10-years from January 2006 to December 2015 was used for planning of hydel power station at Khokhra head works:

- Gauge and discharge data at RD000+600 upstream of a fall structure on Gujrat Branch just downstream of the head regulator of the Gujrat Branch.
- Gauge and discharge data for Chillianwala distributary at RD 1+000 of Gujrat Branch.

Since Chillianwala distributary would be rerouted and by pass the proposed power station, the discharge of the distributary was deducted from the discharge recorded at RD 00+600 of Gujrat Branch for deriving net flows passing through the turbines.

The equation for derivation of variable gross heads is as follows:

Gross head = Upstream Level of UJC – Tail Water Elevation (TWE)

TWE's are the variable tail water elevations calculated using the following equation:

TWE = Daily Water elevations at RD 0+600 of Gujrat Branch (ft AMSL) – 21.42 ft

Water levels at RD 0+600 and at RD 2+000 of Gujrat Branch Canal were used for deriving a fall of 21.42 ft. which was used to determine tail water levels.

Net head for the power generation is the gross head minus the losses in the penstock, trash-rack and losses in turbines etc. In case of Khokhra Hydropower Project, these losses are taken to be equal to 0.3 meters.

Flow duration curves were plotted and it was found that the flow of 1433 cusecs remained available for approximately 15% of the time throughout the year.

4.0 GEOLOGICAL AND GEOTECHNICAL STUDIES

The project area lies in Chaj Doab between Sarai Alamgir and Mandi Bahaudin. Thus area is comprised of the alluvium deposited by the Chaj Doab rivers in layers. The top layer is sandy silt underlain by silty sand with their layer of silt, silty clay etc. Gravels were also encountered at 93' of GTC-1, 90 ft of GTC-2, 50' of GTC-3 53' of GTC-4 and 46 ft of borehole GTC-5.

The project site is located in the zone where distinct earthquake may cause minor damage to the structure with fundamental period greater than 1-0 record corresponding to the intensity V and VI of the MM Scale.

5.0 POWER POTENTIAL AND ENERGY CONSIDERATION

Over the analysed 10 year period (from January 2006 to Dec 2015), the maximum discharge in Gujrat Branch has been 1537 cusecs and the maximum discharge of Chillianwala Distributary has been 104 cusecs. Hence the maximum discharge available for power generation has been recorded as 1433 cusecs (1537 minus 104). It is observed from the Flow Duration curve that 1433 cusecs remains available for approximately 15% of the total time. Therefore the net design discharge of power generation is kept as Qd = 1433 Cusecs (40.60 m^3/sec).

The gross head available is 27.72 ft. deducting head loss of 0.30 m through penstock the net design head has been kept as Hd = 26.74 ft. (8.15 m). The efficiency of turbine is taken as 92%, transformer efficiency as 98%, Generator efficiency as 96%. Thus combined efficiency (η_c) works out as 86.54 %. The installed capacity on the basis of formula

P(Walts) = $9.81 \times \eta_c \times Qd \times Hd$ works out as 2.809 MW i.e 2.8 MW.

The annual energy expected has been worked out as 16.488 Gwh

6.0 PROJECT LAYOUT AND DESCRIPTION OF PROJECT COMPONENT

An intake structure of Head Race has been planned 50 ft on the right side of right bank of UJC at RD 154+500 about 500 ft U/S of Khokhra Head Works. Through Intake water will be diverted to Head race power channel. About 50 ft from Intake Structure the design discharge of (104 Cusecs) shall off-take from right side of Head Race for conveying water to Chillianwala Distributary. The remaining discharge will pass through 2 penstocks each of dia 10 ft to run the Kaplan turbines. The water after passing through turbine will discharge to tail race and ultimately discharged back to Gujrat Branch at RD 2+250.

6.1 Head Race

The Head Race is 304 ft long designed for discharge of 1537 Cusecs. The bed width is 37 ft, Bed slope is 1: 10,000. Side slopes are 1.5 : 1.

6.2 Power House

The main power house is 50 ft long, 51.25 ft wide and 37.5 ft length. A double storey office building 64 ft long and 23.5 wide is provided on right side of power house while loading bay is on the left. The power house has been designed as an RCC framed structure.

6.3 Tail Race

Tail race has been designed as a brick lined trapezoidal section for a maximum discharge of 1433 Cusecs. The bed slopes has been kept as 1:5000, bed width as 60 ft

6.4 Turbines & Generators

Two Kaplan turbines each of capacity 1.4 MW have been selected. Two Generators each of 1.4 MW capacity will be coupled with turbines through a speed increase, thus increasing the speed of generator to 1000 rpm as compared to speed of turbine as 214.3 rpm.

7.0 ENVIRONMENTAL ASSESSMENT

The Khokhra Hydropower Project seems to be environment friendly. It has minimal environmental impacts. Environmental considerations have formed an integral part of the evaluation of layout and design alternatives with the result that all the potential effects of the project have been mitigated.

8.0 CONSTRUCTION PLANNING & SCHEDULING

The project area is approximately 28 acres. During construction planning the following consideration has been given top priority.

I. No interference with irrigation supply.

II. No damage to right bank of UJC and Gujrat Branch.

III. To ensure regular supply to Gujrat branch and Chillianwala distributary during construction.

The construction of Civil Works on all the components can be started simultaneously. The mobilization period has been kept as 2 months. The civil works shall be completed by the end of 16th month. E & M equipment delivery and erection shall be started from 10th month and completed by the end of 24th month. Commercial operation shall start from the 1st of 25th month.

9.0 PROJECT COST ESTIMATE

The project cost estimate is based on the conversion rate of 1 US $ = Rs. 101.95/-

The project is expected to be financed with 100% local debt. The total project cost is estimated to be US $ 11.815 million.

Salient Features

1)	**Location**	Near Khokhra Headworks on Gujrat Branch at RD 255 of UJC
2)	**Name of canal**	Gujrat Branch
3)	**Design discharge Qd**	1433 cusecs (40.6 m^3/sec)
4)	**Design head Hd**	26.74 ft (8.15 meter)
5)	**Construction period**	24 months
6)	**Head race (Brick lined)**	
	Design discharge	1537 cusecs
	Length	304 ft
	Bed width	37 ft
	Side slopes	1.5H : 1V
	Bed slope	1 : 10,000
7)	**Tail race (Brick lined)**	
	Design discharge	1433 cusecs
	Length	1800 ft
	Bed width	60 ft
	Side slopes	1.5H : 1V
	Bed slope	1 : 5,000
8)	**Chillianwala Distributary (Brick lined)**	
	Bed width	9.16 ft
	Side slopes	1.5H : 1V
9)	**Powerhouse**	
	Length	50 ft
	Width	51.25 ft
	Height	37.50 ft
	Type of turbine	Kaplan style
	No of Units	2 Nos
	Installed capacity	(2 x 1.4 MW) = 2.8 MW
	Annual energy	16.488 GWh
	Plant factor	67.0 %

10) **Cost of Project** (in million US $)

Total Project Cost	**11.815**

CHAPTER 1

Introduction

CHAPTER – 1

INTRODUCTION

1.1 GENERAL

An "Agreement" was signed on 04-10-2004 at Lahore, between Irrigation and Power Department Govt. of Punjab and a Consortium of Pakistan Engineering Services (Pvt.) Ltd and BARQAAB Consulting Services (Pvt.) Ltd.

As per agreement the Consultants (PES and Barqaab) besides other assignments shall review and rank the 8 sites having power potential between 3 MW to 7 MW. The consultant shall select two best schemes and shall carryout the detailed engineering design and prepare tender documents of two schemes.

The consultants were also instructed to carryout Feasibility Studies of Khokhra Hydropower Project at the earliest possible time. This report covers the feasibility studies of Khokhra Hydropower Project.

1.2 HYDEL POTENTIAL IN PUNJAB

In 1994, national consensus was developed to plan hydel power projects on canal sites in Punjab and, in pursuance thereof; the Punjab Power Development Board (PPDB) was created for the promotion of hydel power generation. At different canals and barrages, about 324 potential sites with a total capacity of 5895 MW were identified with medium and small heads.

Out of these, the following 7 projects are in operation:

Sr. #	Project	Capacity
1	Ghazi Barotha	1,450 MW
2	Rasul	22 MW
3	Shadiwal	14 MW
4	Nandipur	14 MW
5	Chichoki	13 MW
6	Renala	1 MW
7	Chashma	184 MW
Total		**1,698 MW**

Jinnah Hydropower project on Jinnah Barrage with proposed installed capacity of 96 MW is under implementation in Public Sector. There are 8 solicited sites (sites whose feasibility studies are already carried out) with below 50 MW power potential. As per Agreement, the Consultants have to do ranking of the sites and then select two sites for detailed studies involving updation of their feasibility study, detailed design and preparation of Tender Documents etc. The sites are tabulated under Table A:

Table – A

Solicited Sites Identified in Punjab (below 50 MW)

Sr. #	Project Name	Location	Capacity MW
1	Head Main Line Upper Chenab Canal	Bambanwala Sialkot RD 133298	6.29
2	Main Line Lower (Upper Chenab Canal)	Deg Fall Sheikhupura RD 283100	6.29
3	Pakpattan Canal Upper	Pakpattan RD 112350	3.26
4	Lower Bari Doab	LBDC Sahiwal RD 285454	2.43
5	Upper Gugera Br.	Upper Gugera Canal Sheikhupura RD 214000	2.34
6	Main line lower UCC	Main line UCC Sheikhupura RD 128000	3.5
7	Main line lower UCC	Main line UCC Sheikhupura RD 164400	3.5
8	Lower Bari Doab	Sahiwal RD 329058	4.56
Total			**32.17**

Besides these two projects (solicited sites) above 50 MW are ready for implementation. These are (1) Kalabagh 3600 MW and (2) Taunsa HPP on Taunsa Barrage with installed capacity of 120 MW.

306 raw sites with power potential below 50 MW have also been identified at different canals and distributaries. The total potential identified on these sites is 350 MW. Out of these 306 raw sites, the falls at three raw sites of Gujrat Branch off-taking from UJC at R.D 255.080 have been combined and Khokhra HPP with expected installed capacity of 3 MW has been conceived. This study covers the Khokhra HPP.

1.3 KHOKHRA HYDRO POWER PROJECT

In addition to the eight sites already mentioned, planning report has been prepared by Irrigation & Power Department, Government of Punjab about Khokhra Hydropower Project. According to the proposal, the project is located at the head of the Gujrat Branch which off takes on right side of Upper Jhelum Canal at RD 255.080 with a discharge of 1433 cusecs and available combined head of the three falls at RDs 0.600, 1.350 and 2.000 of the canal, the power potential has been worked out to be 3.0 MW.

Out of the two sites to be selected for detailed study as mentioned in para 1.2, the Secretary I&P Government of Punjab, vide his directive dated October 03, 2004 (copy attached), instructed Chief Engineer, Power, about initiating the work of Hydel Project on Gujrat Branch by the Consultants and the second Hydel Station to be identified shortly.

Accordingly the Consultant took up the work of the Feasibility study of Khokhra Hydropower Project immediately after signing of the Contract along with the review and making of the other project.

1.4 PROJECT LOCATION AND ACCESS

The project area is located at right side of UJC near R.D 254+500 and on right side of Gujrat Branch from R.D 0.000 to RD 2.500.

The access to the project area is possible by following alternatives

1) From Kharian going towards Jhelum on GT road there is a road bridge on UJC at R.D 142, at a distance of 11 Km from Kharian. Just before crossing the bridge a side road leeds to the left and right bank of UJC. Traveling on right bank of UJC, the site is at a distance of 35 Km. Most of the road on canal bank is metalled.

2) From Kharian going towards Dinga the metalled road crosses the UJC at a distance of 15 Km. Taking right bank of UJC and going U/S, the site is at a distance of 14 Km.

Project location map is placed as Drawing No 1.1 at the end of the Chapter.

1.5 UPPER JHELUM CANAL (UJC)

Upper Jhelum Canal was commissioned in 1915, primarily as a feeder canal to supplement supplies at Khanki Head Works on Chenab River. Prior to commissioning of Mangla Dam in 1967, the natural flows of Jhelum River were drawn by UJC through head works at Mangla. Presently the UJC is being regulated from a regulator just downstream of Old Bong Escape.

The present maximum discharge of UJC U/S of Khokhra Head Works is 8500 Cusecs, while safe out-falling discharge upstream of Khanki Head Works is about 4100 Cusecs. There are two Hydel Power Station i.e. Rasul at RD 240-000 and Shadiwal Hydel Power Station at RD 420.000 of UJC

1.6 GUJRAT BRANCH CANAL

Gujrat Branch canal off taken from right bank of UJC at R.D 255+080.The design discharge during Kharif is 1537 Cusecs and during Rabi it is 1295 Cusecs. The natural surface level of the head reach is steep as such there are three falls at R.D 0+600 R.D 1+350 and R.D 2+000, in addition to the drop at head regulator of Canal.

Chillianwala distributary off taken from right side of Gujrat branch at R.D 1+000.The design discharge of the distributary is 104 Cusecs. During planning of scheme the Chillianwala distributary shall be supplied the required discharge through head race of the scheme. Therefore the maximum discharge available for power generation during Kharif is 1537-104 = 1433 Cusecs and during Rabi It is 1295-104 = 1191 Cusecs.

1.7 TOPOGRAPHY IN GENERAL

The Project area is bounded by UJC in the North and Gujrat Branch is the east. The project area from North to south has a steep slope of approximately 1:66 for a distance of about 2000 ft.Beyond this along the right bank of Gujrat Branch the slope is mild.Topography map is placed as Drawing No. 1.2 at the end of this chapter.

1.8 CLIMATE

The climate of the Project area is semi-arid characterized by four distinct seasons in year, that is Winter from mid November to February, Spring during March and April, Summer from May to mid September and Autumn from mid September to mid November.

The average maximum temperature at Jhelum is 39.4°C while maximum temperature recorded so far has been 49.2°C on 31-05-1998. Minimum temperature recorded is -3°C on 22-12-1950.

Average annual rainfall at the Jhelum is 852.50mm. 62% of average annual rainfall occurs during monsoon season.

Predominant wind direction is from North to North West from October to May, while during Monsoon period (June to September) it is from East to South-East direction. Average maximum wind speed recorded at Jhelum is 29.65 Km/hr in June. Average relative humidity is 69.4% and 42.8% for morning and evening respectively.

1.9 ENVIRONMENTAL CONSIDERATIONS

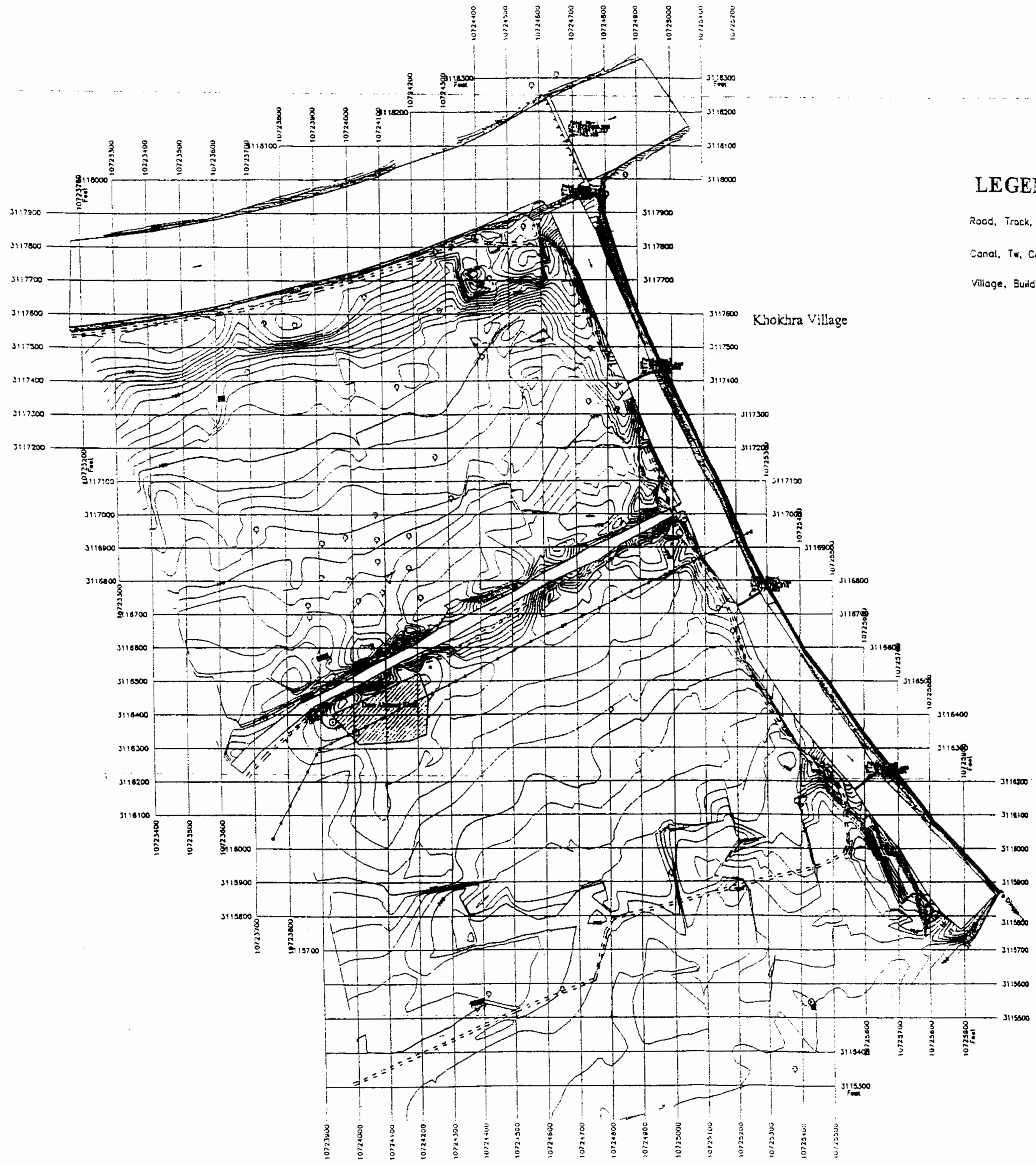
The Project area selected, does not involve shifting of people and houses, the surplus excavated material shall be used to fill the depression, or filled at location as shown on drawings. Due to construction of project, the environment will not be adversely affected rather it will improve standard of living of the people living in nearby villages, as the people of the area will get more employment chances.

Pollution and noise during construction will not effect the villages as the nearest village (Khokhra) is at a distance of 1500 ft from project site and Gujrat Canal in between.

1.10 SEISMOTECTONICS CONSIDERATIONS

The project area lies in Zone I of seismic Zoning Map of Pakistan. Zone I is minor damage zone. The earth quake period greater than 10 seconds Corresponds to intensity V and VI of the MM-Scale.

DRAWINGS



LEGEND

Road, Track, Bridge

Canal, Tw, Contours, Tree

Village, Building, Power Line

Scale 1 = 120 Ft
Contour Interval = 1 Ft

S.NO.	DATE	DESCRIPTIONS	CH

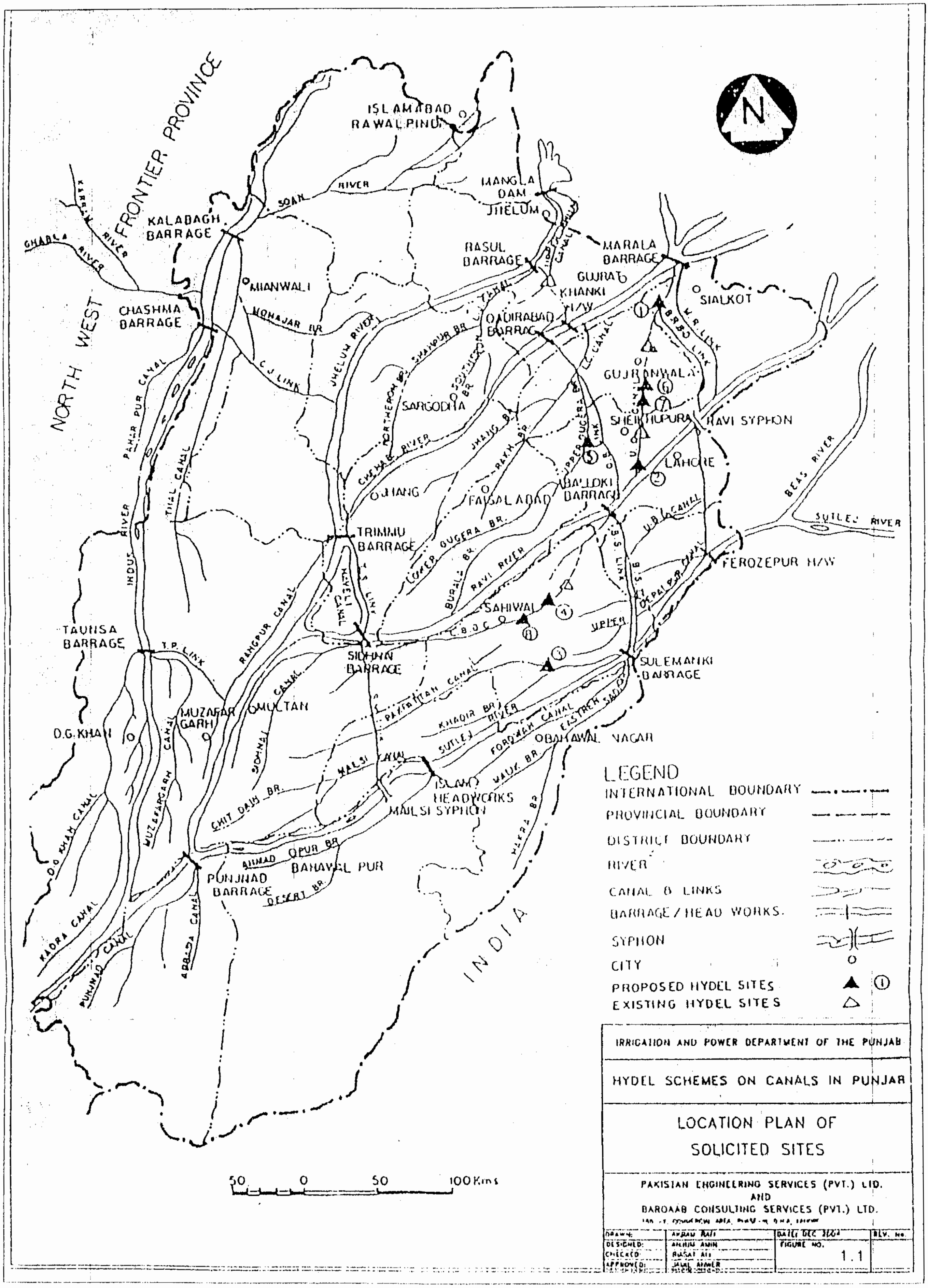
IRRIGATION AND POWER DEPARTMENT OF THE PUNJ.

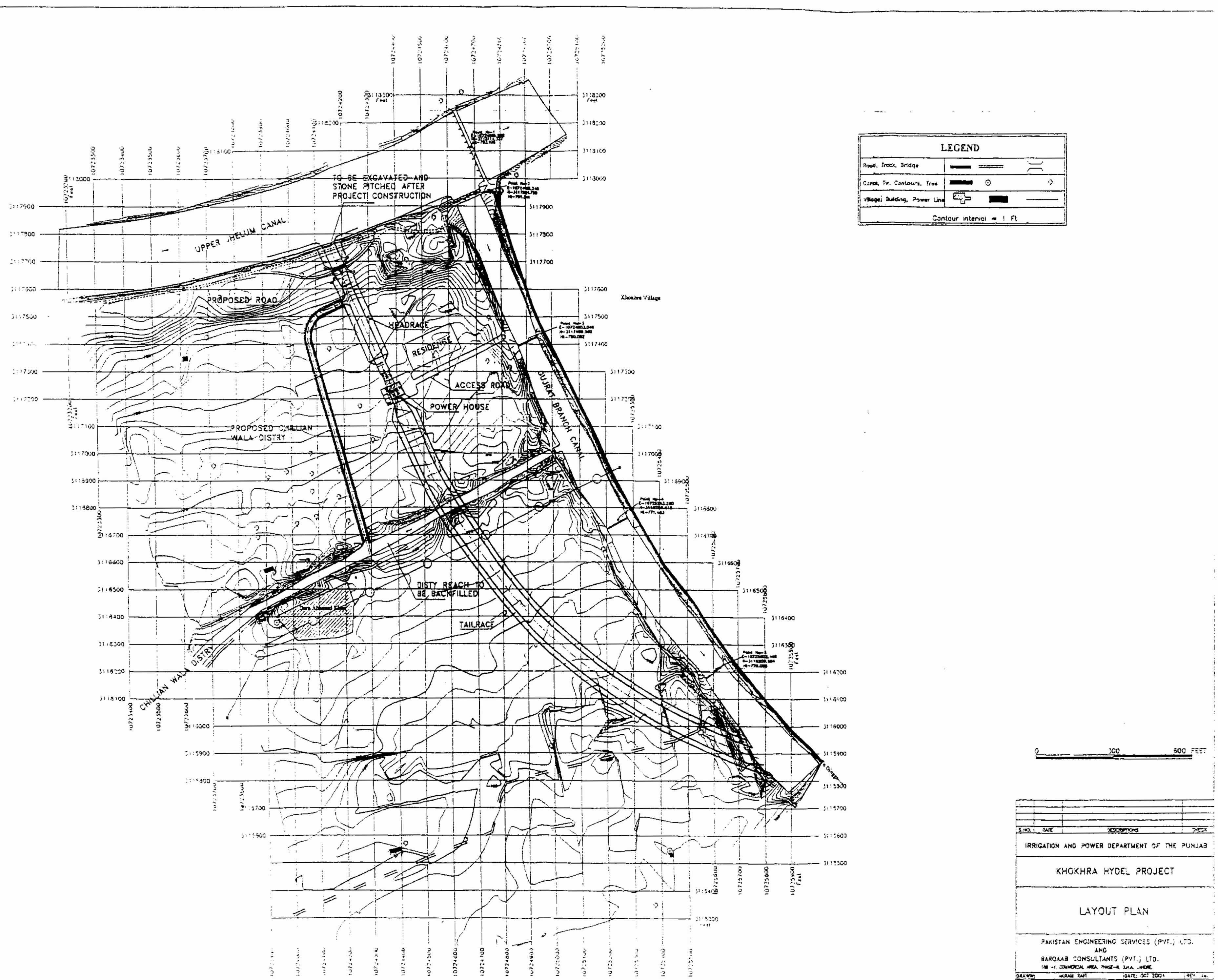
KHOKHRA HYDEL PROJECT

TOPOGRAPHICAL
SURVEY PLAN

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
100 -Y, COMMERCIAL AREA, PHASE-III, D.H.A. LAHORE.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV.
DESIGNED:	-	FIGURE NO. 1.2	
CHECKED:	-		
APPROVED:	JAVE ANWER		


NORTH WEST FRONTIER PROVINCE
ISLAMABAD
RAWALPINDI
SOAN RIVER
MANGLA DAM
JHELUM
KALABAGH BARRAGE
RASUL BARRAGE
MARALA BARRAGE
GUJRAT
KHANKI H/W
SIALKOT
MIANWALI
CHASHMA BARRAGE
QADIRABAD BARRAGE
GUJRANWALA
SARGODHA
SHEIKHUPURA
RAVI SYPHON
LAHORE
BALLOKI BARRAGE
JHANG
FAISALABAD
BEAS RIVER
SUTLEJ RIVER
TRIMMU BARRAGE
FEROZEPUR H/W
SAHIWAL
TAUNSA BARRAGE
SIDHNAI BARRAGE
SULEMANKI BARRAGE
MUZAFFAR GARH
MULTAN
D.G.KHAN
BAHAWAL NAGAR
ISLAM HEADWORKS
MAILSI SYPHON
BAHAWAL PUR
PUNJNAD BARRAGE
INDIA
LEGEND
INTERNATIONAL BOUNDARY
PROVINCIAL BOUNDARY
DISTRICT BOUNDARY
RIVER
CANAL & LINKS
BARRAGE / HEAD WORKS.
SYPHON
CITY
PROPOSED HYDEL SITES
EXISTING HYDEL SITES
50 0 50 100 Kms
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB
HYDEL SCHEMES ON CANALS IN PUNJAB
LOCATION PLAN OF SOLICITED SITES
PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTING SERVICES (PVT.) LTD.
FIGURE NO. 1.1


TO BE EXCAVATED AND STONE PITCHED AFTER PROJECT CONSTRUCTION
UPPER JHELUM CANAL
PROPOSED ROAD
Khokhra Village
HEADRACE
RESIDENCE
ACCESS ROAD
POWER HOUSE
GUJRAT BRANCH CANAL
PROPOSED CHILLIAN WALA DISTRY
DISTY REACH TO BE BACKFILLED
TAILRACE
CHILLIAN WALA DISTRY
LEGEND
Road, Track, Bridge
Canal, Tw, Contours, Tree
Village, Building, Power Line
Contour interval = 1 Ft
0
300
600 FEET
S.NO.
DATE
DESCRIPTIONS
CHECK
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB
KHOKHRA HYDEL PROJECT
LAYOUT PLAN
PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
DRAWN:
DATE: OCT 2004

CHAPTER 2

Project Location, Physiography and Climate

CHAPTER – 2

PROJECT LOCATION, PHYSIOGRAPHY AND CLIMATE

2.1 LOCATION AND ACCESS TO SITE

The project site is located on the right side of Upper Jhelum Canal at R.D. 254-255/R, near the off take of Gujrat Branch Canal. The site is accessed from the main G.T. road before Sarai Alamgir where UJC crossing, from the road to Rasul on right bank (Approx. 27 km from main G.T road), then further 5 km from Rasul to Khokhra village.

Upper Jhelum Canal (UJC) is off taking from River Jhelum at Mangle. This canal is also a link Canal being used for transferring of canal supply from River Jhelum to River Chenab at upstream of Khanki Head Works for sustaining the Lower Chenab System. There are two Hydel Power stations, Rasul and Shadiwal, are functioning at R.D. 244+000 and Tail R.D. 420+000 of this canal. The canal has its maximum capacity of 8,500 cusecs.

The project site is well connected to main cities of Punjab from G.T road near Sarai Alamgir. A road off takes from G.T. road along the Upper Jhelum Canal towards Rasool, then a service road on the right bank reaches the project site, where a cross regulator on UJC and head regulator exists at the off take of Gujrat Branch Canal. The road upto Rasul is single lane metalled and from Rasool to project site is single lane service road. The project site plan is already attached as Figure 1.1.

2.2 PHYSIOGRAPHY

The project area is located where River Jhelum formed large alluvial plains and deposited gravel, boulders, sand and silt for thousands of years. Topography consists of flat alluvial terraces. The alluvial terraces are made of alluvium consisting of gravel boulders embedded in sand and silt, the depth of which extend upto 400 ft. The surface is generally covered with two to three meters thick sandy silt layer forming topsoil which is quite fertile for cultivation. Various crops, like wheat, maize, sorghum, vegetables and fodder are grown on the flatter terraces. The slopes are generally covered with grass, variety of shrubs and trees where cattle grazing is practiced.

2.3 CLIMATE

The climate of the project area is semi-arid characterized by four distinct seasons in year, that is, winter from mid-November to February, spring during March and April, summer from May to mid September and autumn from mid September to mid November. One climate/meteorological data collection station is operating near the project site (in Jhelum city, established by Pakistan Meteorological Department). This station represents the climatic conditions of the project area adequately. The data is presented in graphical form.

2.3.1 Rainfall

Average annual rainfall at the Jhelum from the record of more than 30 years is 852.50 mm. Maximum rainfall (about 62 % of the total annual) occur during the monsoon season (summer months of July, August and September), while the period of minimum rainfall or dried period is October and November (autumn season). Rainfall histograms for 1961-1990 recorded at Jhelum is presented in Figure 2.1.

2.3.2 Temperature

The average maximum temperature at Jhelum is 39.4°C, while maximum temperature recorded so far have been 49.2°C on 31-05-1988, while minimum temperature is -3°C on 22-12-1950. Maximum and minimum monthly temperature for 1961-90 recorded at Jhelum is presented in graphical form in Figure 2.2.

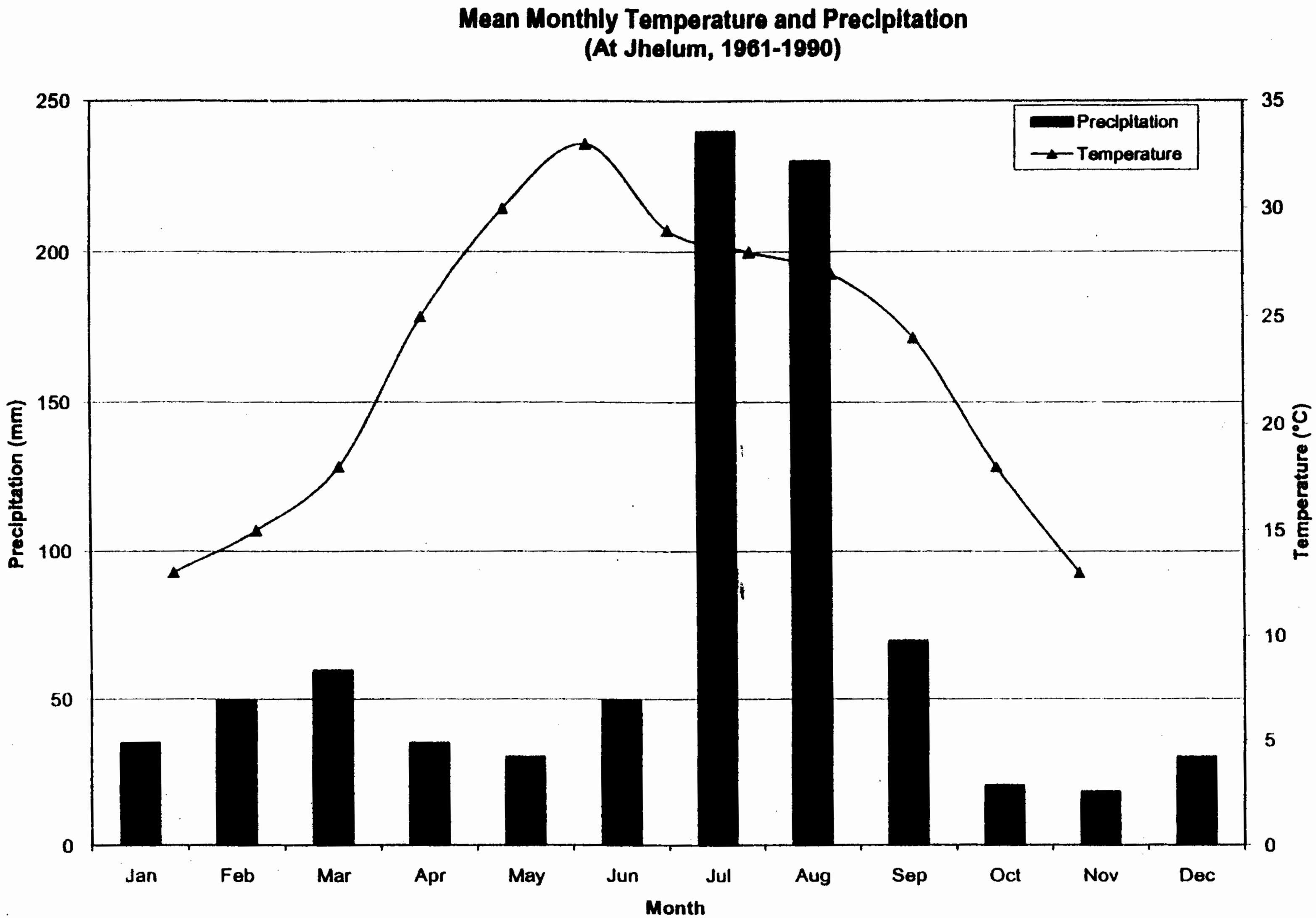
2.3.3 Wind Speed and Direction

Predominant wind direction has been North to North-West from October to May while during Monsoon period (June to September) it is from East to South-East direction. Average maximum wind speed recorded at Jhelum has been 29.65 km/hr. in June. Wind speed and direction is presented in graphical form in Figure 2.3.

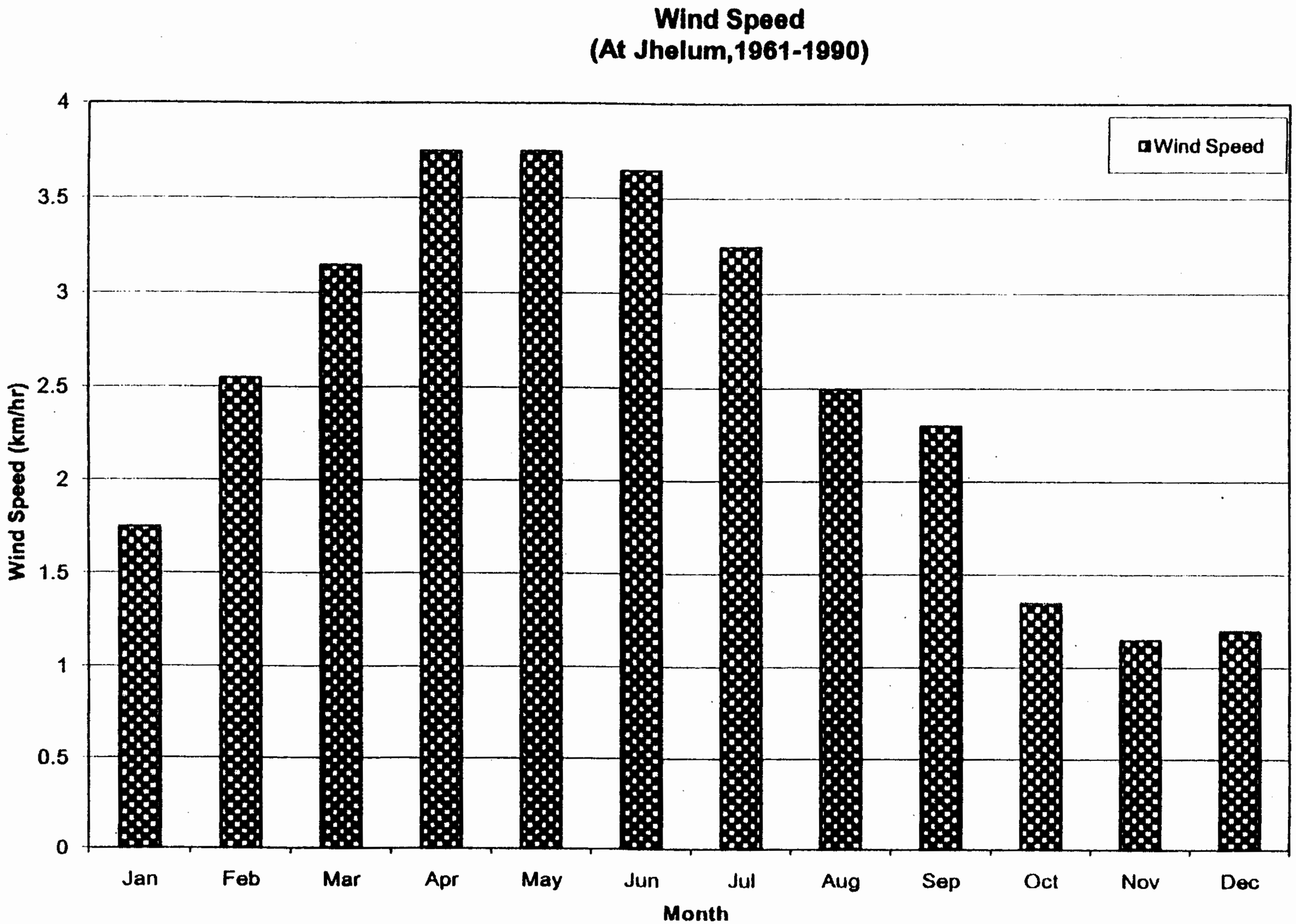
2.3.4 Humidity

From the Jhelum climatological station, average relative humidity is 69.4 and 42.8 for morning and evening respectively. The maximum average value is 85 and 53 in December for morning and evening respectively, while minimum average value is 42 and 24 in May for morning and evening. Relative humidity for 1960-90 recorded at Jhelum is presented in Figure 2.5, indicates sub-humid climate conditions exists in the project area.

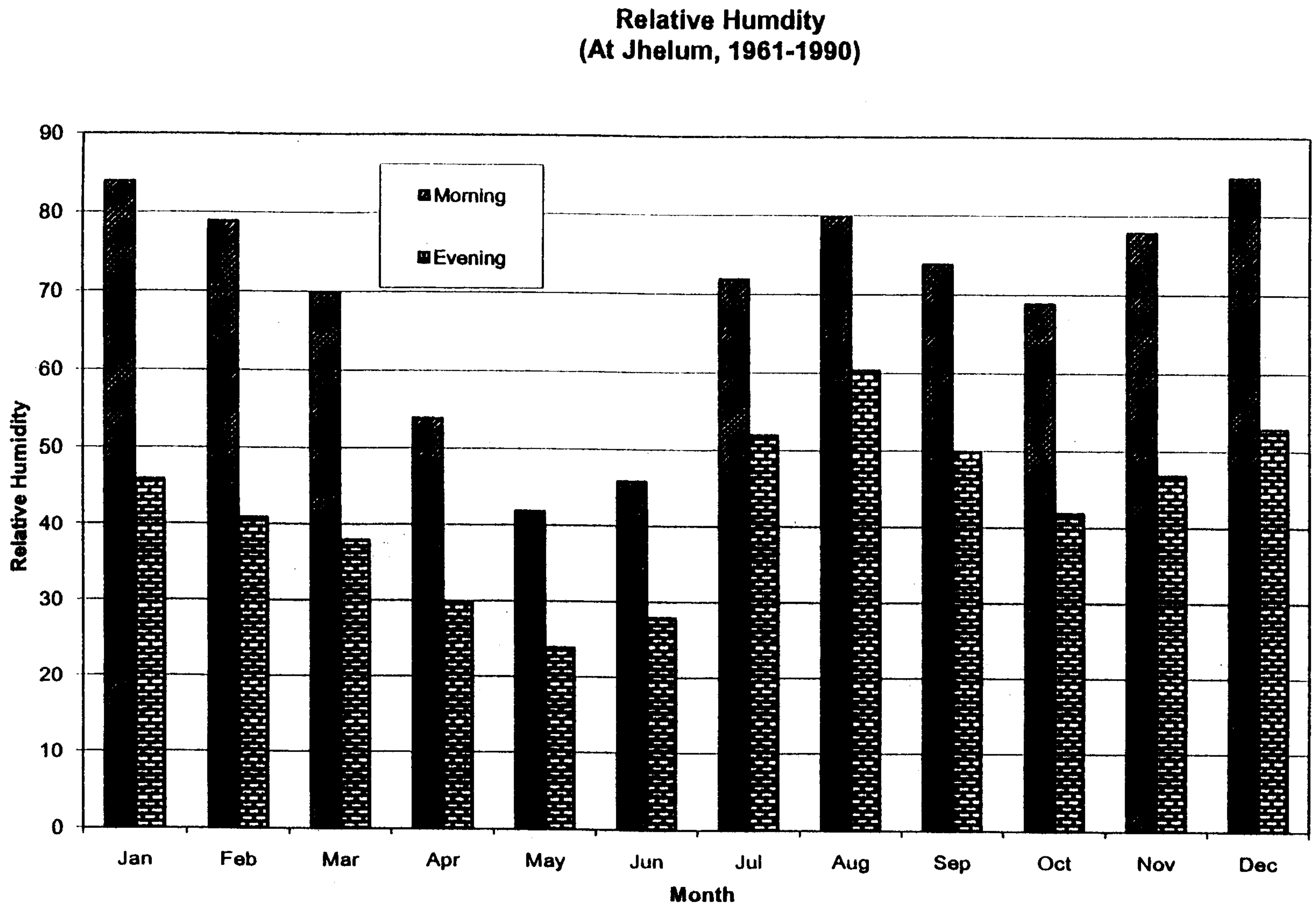
FIGURES



1: Mean Monthly Temperature and Precipitation at Jhelum



2: Wind Speed at Jhelum



3: Relative Humidity at Jhelum

CHAPTER 3

Hydrology

CHAPTER – 3

HYDROLOGY

3.1 UPPER JHELUM CANAL (UJC)

Prior to commissioning of Mangla Dam in 1967 the natural flows of Jhelum River were drawn directly by UJC from River Jhelum through headworks at Mangla. It supplies water to power channel of Rasul Hydropower Station commissioned in 1951-52 and partially feeds Lower Jhelum canal off -taking from Rasul for irrigation purposes At RD-244 it supplies water to UJC link to Upper Chenab Canal (UCC) out - falling upstream of Khanki Head works . It thus supplements water in river Chenab for irrigated areas under command of LCC besides generation of electricity at Shadiwal Hydropower Station commissioned during 1961-62 at RD 420+000 tail of UJC.

At RD 255+080 UJC has been supplying water to Gujrat Branch under operation since 1915. Present design discharge of Gujrat Branch is 1537 cusecs for Kharif and 1295 cusecs for Rabi seasons.

After commissioning of Mangla Dam in 1967 the silt free water had caused scour problems in the head reaches of UJC and siltation downstream of Khokhra Regulator from RD 255 to 448. The UJC had conveying capacity of 12625 cusecs, which was reduced to 9000 cusecs due to changed flow and sediment regime of the Jhelum River creating hydraulic and structural problems in UJC. Presently the UJC is being regulated from a regulator just downstream of the old Bong Escape with the maximum discharge of 8500 cusecs. Punjab Irrigation and Power Department has plans to remodel the UJC which could partially be implemented due to financial constraints. On full implementation of this plan the capacity of UJC would be restored to 12625 cusecs.

UJC remains closed for repairs and maintenance normally from the end of December till the third week of January next year. During this period the flow in the UJC and Gujrat Branch is practically nil

3.2 DATA FOR HYDROLOGIC ANALYSIS REQUIRED FOR PLANNING OF HYDEL POWER STATION AT KHOKHRA HEAD WORKS

Complete Hydrologic data in all respects of all the gauges at Khokhra Headworks complex for the critical period of last ten years from January 2006 to December 2015 has been collected. There are four gauges for measuring the levels of water at Khokhra Headworks to control and measure the flow. All the four gauges are calibrated in feet upto 2 decimal places. First gauge is installed at RD 254+500 (almost at originating point of proposed bypass arrangement) of UJC before the gates which monitors the level of water in UJC upstream of Khokhra Headworks. Second gauge is installed downstream in UJC immediately after Khokhra Headworks. The third gauge is installed at RD 0+600 of Gujrat Branch before the first fall to calculate the water (For Gujrat Branch and Chillianwala Distributary) being discharged into Gujrat Branch. The fourth gauge is installed at RD 1+000 of Gujrat Branch at the originating point of Chillianwala Distributary.

The collected data includes the following:

i) Gauge data of Upper Jehlum Canal at the origin of the proposed bypass arrangement for working out the water level at intake pond for each day of the relevant period.

ii) Gauge and discharge data at RD 0+600 upstream of the first fall structure on Gujrat Branch for working out total discharge into Gujrat Branch and for calculating the head available between UJC and RD 0+600 of Gujrat Branch for each day of the relevant period.

iii) Discharge data for Chillianwala distributary at RD 1+000 of Gujrat Branch for working out net flow available to turbines for each day of the relevant period.

3.3 DATA SCRUTINY

The Gujrat Branch and Chillianwala distributary gauge data is recorded twice in the morning and evening of each day. The gauge book record shows that gauge and discharge record had been systematically checked by the field staff of the Punjab Irrigation and Power Department with recorded instructions to run the canals at specific flow levels, close the canals according to the irrigation requirements and for annual repairs and maintenance purposes. The data was checked for any obvious errors in reporting, typing etc. The discharge was determined by using rating tables prepared by Irrigation and Power Department applicable to respective gauge locations. The daily discharge hydrographs were drawn on annual basis for assessment of accuracy of recorded daily flows.

3.4 DISCHARGE RATING TABLES

The discharges for Gujrat Branch and Chillianwala distributary have been calculated using established rating tables which are annexed as **Table 1**. Due to reasonably high approach velocities upstream of the falls and inflowing water being almost free of sand particles (which are retained in the Mangla reservoir), no siltation problem is expected upstream of the canal falls of Gujrat Branch. Therefore, the fall structures act as stable controls of the rating curves used for derivation of the discharges. Due to these reasons no seasonal or annual variation in the gauge discharge ratings has been considered.

3.5 FLOW ANALYSIS

Unlike river flows in the river Jhelum which fluctuate daily and seasonally due to snow melt and monsoon rainfalls, the variation of flow in UJC and its distributaries during twenty four hours of a day for some of the days was normally not appreciable. Therefore it was decided to use daily morning gauge and discharge readings as mean daily gauge and discharges. However, as expected, considerable variations in mean daily flows during a month do occur due to flow regulation by Punjab Irrigation & Power Department in accordance with irrigation water requirements which would enjoy priority over power generation. This operational policy would ensure water availability to Hydel Power Station in line with existing flow pattern in the canals. There is however, consistency in seasonal pattern of variation on yearly basis. Flows in the canals in Rabi season (October to March) are normally lower due to lower irrigation requirements than Kharif season (April to September). Storage water in Rabi season is released from the depleting Mangla Reservoir. Kharif season encompasses summer snow melt and monsoon rainfall with normally sufficient water for filling the reservoir till end of August and also meeting the water requirements of UJC and its tributaries.

The canals are closed annually, normally during winter when the irrigation requirements are minimum for repairs and maintenance purposes. The flows in the canals are also reduced due to rains in the irrigated areas and occasionally for other reasons. No flow would be available for hydel power generation according to that annual flow regulation practices which assign priority to irrigation.

Since the flows meant for Chillianwala distributary would not pass through the turbines of the proposed hydel power station, therefore the Net flows passing through the turbine shall be Gujrat Branch Discharge minus Chillianwala Distributary Discharge. Net flows passing through the turbine based on daily basis as well as mean monthly values are shown in **Table 2**. The flow duration curve versus percentage of time is shown in **Figure 2**. The mean monthly flows passing through the turbine are shown in **Table 8.**

3.6 UPSTREAM WATER LEVELS (UJC)

The intake pond of the Hydel Power Station would receive its water directly from UJC approx. 500 ft before the present off-take point of Gujrat Branch.

Hence the power generated from the Power Station would depend upon the water levels in the UJC and the tail water elevations. The daily gauge levels of UJC and Gujrat Branch at RD 0+600 are shown in **Table 3**. These daily gauge levels after conversion into elevation above mean sea level scales are shown in **Table 4**.

3.7 TAIL WATER ELEVATIONS (TWEs)

The total head available for power generation is the difference of water elevations in the UJC and the tail water elevations at RD 2+250 of Gujrat Branch, where the tail race channel of the Power House will join the existing Gujrat Branch. While the UJC daily levels are available through record, Tail water elevations have been calculated using the gauge reading at RD 0+600 of Gujrat Branch Canal.

For this purpose, a gauge graduated in feet upto two decimal places was installed at RD 2+250 of existing Gujrat Branch canal. The readings of the Tail water gauge at RD 2+250 and the gauge at RD 0+600 of the Gujrat Branch before the first fall, were minutely taken once a day over a period of 30 days. It was observed that the increase or decrease in water level at RD 0+600 proportionately increased or decreased the water level (after three falls) at RD 2+250. On average, the head difference between the two gauges came out to be 21.42 feet with values deviating from the average values by upto 0.07 feet only. The gauge values were then converted into feet above mean sea level scale to calculate the gross head available. Thus the variable water elevations at RD 0+600 of Gujrat Branch over the 10 year period were used for derivation of tail water elevations (TWEs). The following equation was used:

Tail Water Elevation (TWE) = Daily Water elevations at RD 0+600 of Gujrat Branch (ft AMSL) – 21.42 ft

The tail water elevations (TWEs) are given in **Table 5.**

3.8 GROSS HEAD

Gross head for power generation as mentioned in Section 3.7 is the difference of upstream water elevations in the UJC and tail water elevations at Rd 2+250 of Gujrat Branch. This has been worked out as follows:

Gross Head = Upstream Level of UJC – Tail Water Elevation (TWE)

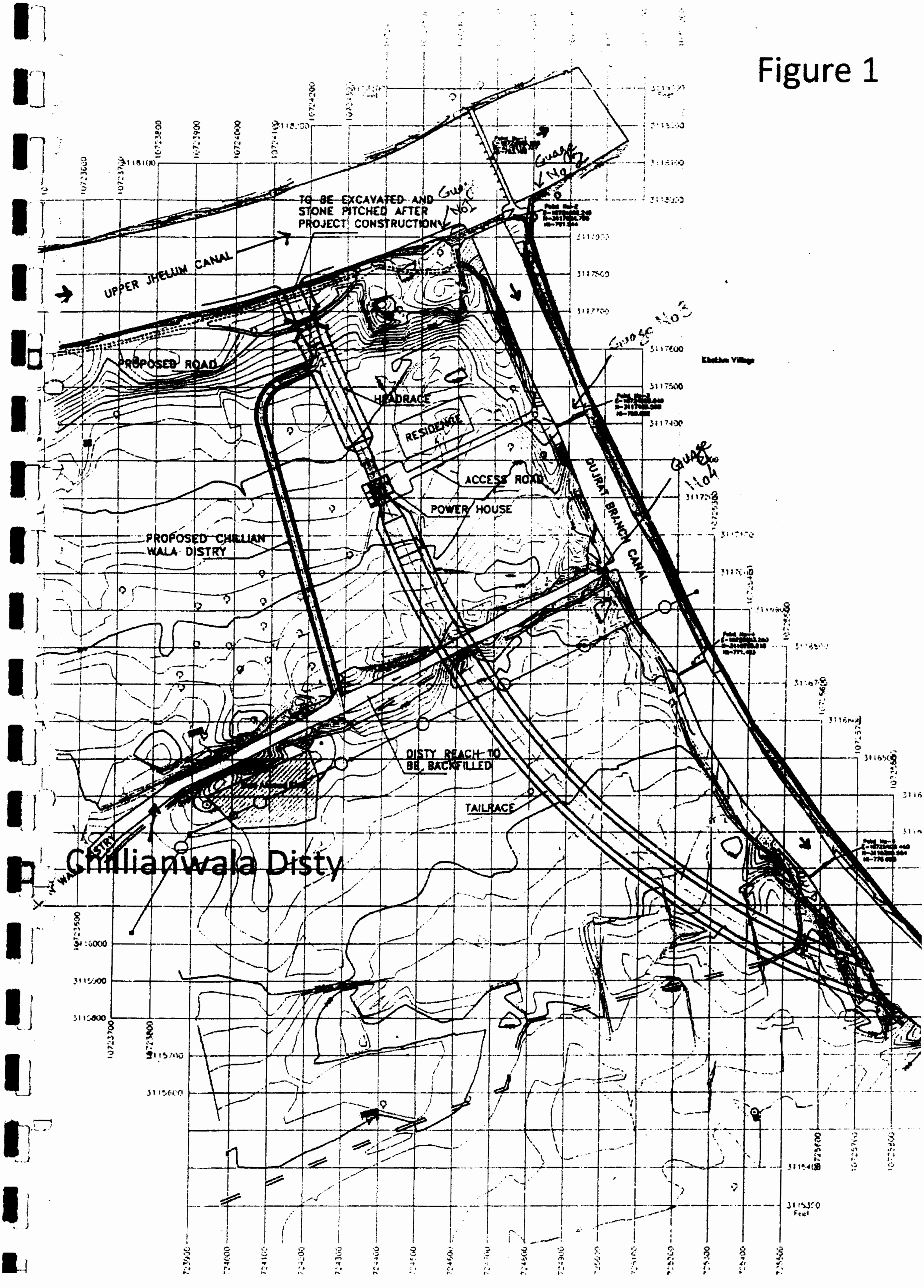
The daily gross head values for the 10 years period (from January 2006 to December 2015) are given in **Table 5.**

3.9 NET HEAD

Net head for the power generation is the gross head as described in Section 3.5 minus the losses in the penstock, trash-rack and losses in turbines etc. In case of Khokhra Hydropower Project, these losses are taken to be equal to 0.3 meters. Net head is the true effective head which is used for power generation.

FIGURES

Figure 1


UPPER JHELUM CANAL
TO BE EXCAVATED AND STONE PITCHED AFTER PROJECT CONSTRUCTION
PROPOSED ROAD
HEADRACE
RESIDENCE
ACCESS ROAD
POWER HOUSE
PROPOSED CHILLIAN WALA DISTRY
GUJRAT BRANCH CANAL
DISTY REACH TO BE BACKFILLED
TAILRACE
Chillianwala Disty
Khaliha Village
Guage No 1
Guage No 2
Guage No 3
Guage No 4

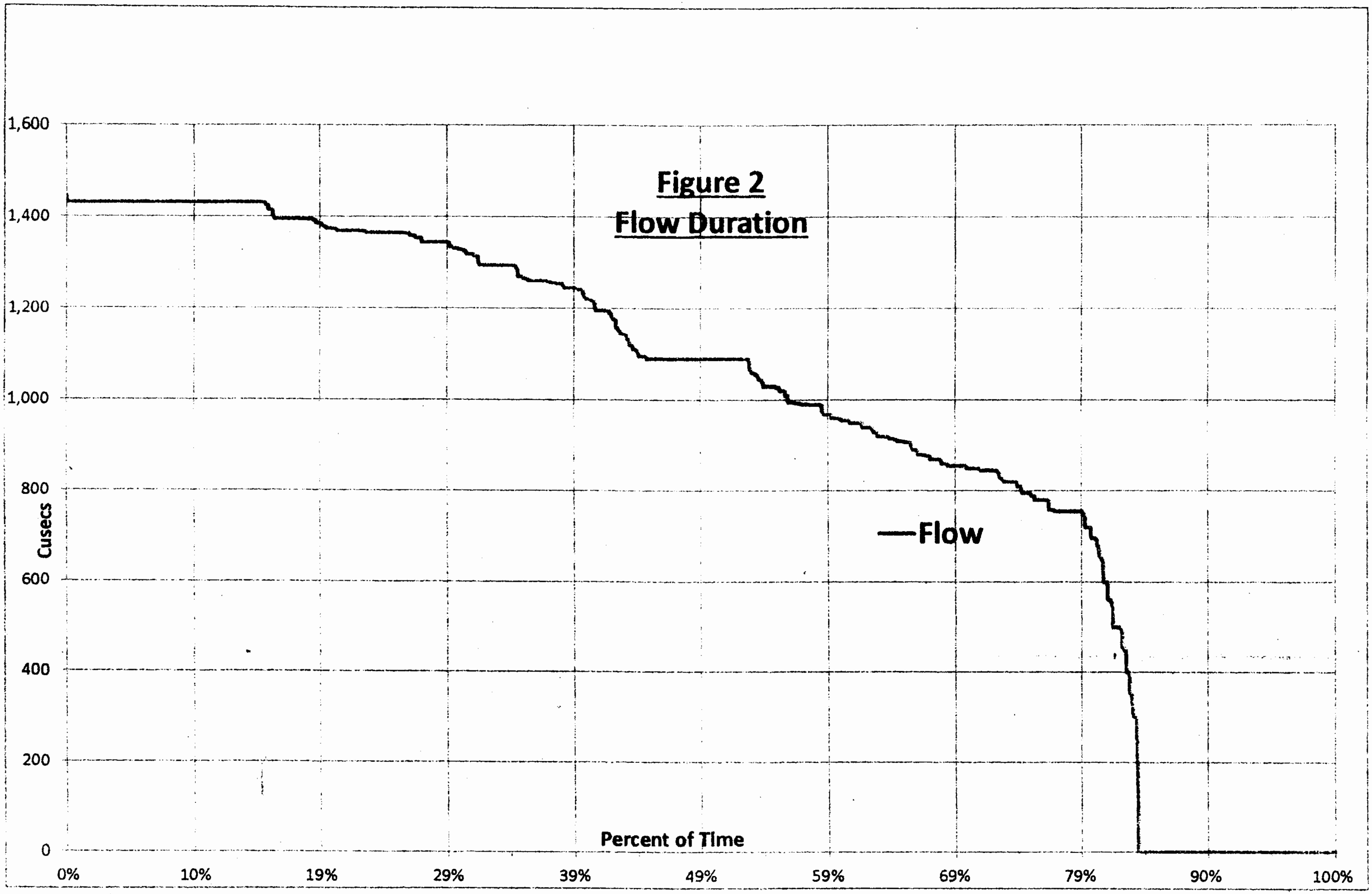


Figure 2
Flow Duration

TABLES

Table - 1

KHOKHRA HYDEL PROJECT

DISCHARGE RATING TABLE

GUJRAT BR. RD 00+600

GUAGE (ft)	DISCHARGE (Cusecs)	GUAGE (ft)	DISCHARGE (Cusecs)	GUAGE (ft)	DISCHARGE (Cusecs)
0.00	0	2.00	352	4.00	990
0.10	10	2.10	379	4.10	1035
0.20	15	2.20	406	4.20	1071
0.30	20	2.30	433	4.30	1110
0.40	30	2.40	460	4.40	1150
0.50	44	2.50	490	4.50	1189
0.60	58	2.60	520	4.60	1229
0.70	73	2.70	553	4.70	1269
0.80	89	2.80	584	4.80	1309
0.90	107	2.90	615	4.90	1350
1.00	125	3.00	640	5.00	1390
1.10	153	3.10	676	5.10	1434
1.20	161	3.20	712	5,20	1475
1.30	169	3.30	748	5.30	1520
1.40	177	3.40	784	5.40	1561
1.50	228	3.50	816	5.50	1606
1.60	252	3.60	852	5.60	1650
1.70	276	3.70	887		
1.80	300	3.80	923		
1.90	326	3.90	959		

DISCHARGE RATING TABLE

CHILLIAN WALA DISTRIBUTARY AT RD 1+000

GUAGE (ft)	DISCHARGE (Cusecs)
3.25	105.00
3.20	100.00
3.10	95.00
3.02	90.00
3.00	88.00
2.95	85.00
2.90	82.00
2.82	80.00
2.80	76.00
2.60	64.00
2.50	59.00
2.40	53.00
2.30	48.00

Source: Punjab Irrigation & Power Department

Table 2 Sheet 1 of 10
Year 2006
Net Flow through Turbine (Cusecs)

	January			February			March			April			May			June			July			August			September			October			November			December		
Date	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine
1	1,195	104	1,091	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,487	59	1,428	1,115	60	1,055	1,300	104	1,196	1,537	104	1,433	1,195	104	1,091	1,150	104	1,046
2	1,195	104	1,091	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,487	104	1,383	1,537	104	1,433	1,150	60	1,090	1,537	104	1,433	1,195	104	1,091	1,150	104	1,046
3	1,195	104	1,091	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,487	104	1,383	1,537	104	1,433	0	0	0	1,537	104	1,433	1,195	104	1,091	1,150	104	1,046
4	1,195	104	1,091	0	0	0	1,195	104	1,091	1,195	104	1,091	1,475	104	1,371	1,434	64	1,370	1,487	104	1,383	1,537	104	1,433	0	0	0	1,537	104	1,433	1,195	104	1,091	980	90	890
5	1,195	104	1,091	460	70	390	1,195	104	1,091	1,195	104	1,091	1,475	104	1,371	1,434	64	1,370	1,537	104	1,433	1,309	60	1,249	0	0	0	1,537	104	1,433	1,195	104	1,091	880	60	820
6	1,195	104	1,091	900	70	830	1,195	104	1,091	1,195	104	1,091	1,475	104	1,371	1,434	64	1,370	1,537	104	1,433	1,309	60	1,249	0	0	0	1,537	104	1,433	1,195	104	1,091	550	54	496
7	1,195	104	1,091	1,195	104	1,091	1,195	104	1,091	1,195	104	1,091	1,475	104	1,371	1,434	64	1,370	1,537	104	1,433	1,309	60	1,249	0	0	0	1,537	104	1,433	1,195	104	1,091	550	54	496
8	1,195	104	1,091	1,195	104	1,091	1,195	104	1,091	1,195	104	1,091	1,475	104	1,371	1,434	64	1,370	1,537	104	1,433	1,150	60	1,090	0	0	0	1,537	104	1,433	1,195	104	1,091	550	54	496
9	1,195	104	1,091	1,195	104	1,091	1,125	104	1,021	1,195	104	1,091	1,475	104	1,371	1,475	104	1,371	1,537	104	1,433	1,150	60	1,090	0	0	0	1,537	104	1,433	1,195	104	1,091	550	54	496
10	1,195	104	1,091	1,195	104	1,091	1,125	104	1,021	1,195	104	1,091	1,475	104	1,371	1,475	104	1,371	1,537	104	1,433	1,350	104	1,246	0	0	0	1,537	104	1,433	1,195	104	1,091	550	60	490
11	1,195	104	1,091	1,195	104	1,091	1,195	104	1,091	1,145	104	1,041	1,475	104	1,371	1,535	104	1,431	1,537	104	1,433	1,350	104	1,246	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	550	60	490
12	0	0	0	1,295	104	1,191	1,195	104	1,091	1,145	104	1,041	1,475	104	1,371	1,535	104	1,431	1,537	104	1,433	1,350	104	1,246	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
13	0	0	0	1,395	104	1,291	1,195	104	1,091	1,145	104	1,041	1,475	104	1,371	1,535	104	1,431	1,537	104	1,433	1,350	104	1,246	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
14	0	0	0	1,484	104	1,380	1,195	104	1,091	1,145	104	1,041	1,475	104	1,371	1,535	104	1,431	0	0	0	1,350	104	1,246	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
15	0	0	0	1,484	104	1,380	1,195	104	1,091	1,145	104	1,041	1,475	104	1,371	1,366	104	1,262	0	0	0	1,350	104	1,246	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
16	0	0	0	1,484	104	1,380	406	104	302	1,325	104	1,221	1,475	104	1,371	1,366	104	1,262	0	0	0	1,500	104	1,396	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
17	0	0	0	1,484	104	1,380	1,195	104	1,091	1,325	104	1,221	1,475	104	1,371	1,366	104	1,262	1,150	60	1,090	1,500	104	1,396	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
18	0	0	0	1,484	104	1,380	1,195	104	1,091	1,325	104	1,221	1,475	104	1,371	1,366	104	1,262	1,150	60	1,090	1,500	104	1,396	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
19	0	0	0	1,484	104	1,380	1,195	104	1,091	1,325	104	1,221	1,475	104	1,371	1,366	104	1,262	1,150	60	1,090	1,500	104	1,396	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
20	0	0	0	1,484	104	1,380	1,195	104	1,091	1,375	104	1,271	1,475	104	1,371	1,366	104	1,262	1,150	60	1,090	1,500	104	1,396	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	0	0	0
21	0	0	0	1,484	104	1,380	1,195	104	1,091	1,375	104	1,271	1,434	104	1,330	1,366	104	1,262	1,150	60	1,090	1,500	104	1,396	1,537	104	1,433	0	0	0	1,195	104	1,091	0	0	0
22	0	0	0	1,195	104	1,091	1,195	104	1,091	1,375	104	1,271	1,434	64	1,370	1,366	104	1,262	1,537	104	1,433	1,500	104	1,396	1,337	104	1,233	0	0	0	1,195	104	1,091	0	0	0
23	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,366	104	1,262	1,537	104	1,433	1,500	104	1,396	1,337	104	1,233	0	0	0	1,095	104	991	0	0	0
24	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,366	104	1,262	1,537	104	1,433	1,500	104	1,396	1,537	104	1,433	0	0	0	1,095	104	991	0	0	0
25	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,366	104	1,262	1,490	104	1,386	1,500	104	1,396	852	60	792	0	0	0	1,095	104	991	0	0	0
26	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,366	104	1,262	1,115	60	1,055	1,500	104	1,396	1,537	104	1,433	0	0	0	1,095	104	991	0	0	0
27	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,506	104	1,402	1,115	60	1,055	1,500	104	1,396	1,537	104	1,433	0	0	0	945	104	841	0	0	0
28	0	0	0	1,195	104	1,091	1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,506	104	1,402	1,115	60	1,055	1,125	60	1,065	1,537	104	1,433	0	0	0	945	104	841	0	0	0
29	0	0	0				1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,506	104	1,402	1,115	60	1,055	1,500	104	1,396	1,537	104	1,433	0	0	0	945	104	841	0	0	0
30	0	0	0				1,195	104	1,091	1,425	104	1,321	1,434	64	1,370	1,506	104	1,402	1,115	60	1,055	1,500	104	1,396	1,537	104	1,433	0	0	0	945	90	855	0	0	0
31	0	0	0				1,195	104	1,091				1,434	64	1,370				1,115	60	1,055	1,300	104	1,196				0	0	0				0	0	0
Month Mean			387			994			1,061			1,179			1,364			1,339			1,159			1,308			997			924			1,044			252

Year 2007
Net Flow through Turbine (Cusecs)

Date	January			February			March			April			May			June			July			August			September			October			November			December		
	Gujrat B	Chillian	Net Thro	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat B	Chillian	Net Thro	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine
1	0	0	0	0	0	0	0	0	0	400	0	400	1,434	104	1,330	1,537	104	1,433	1,035	60	975	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	1,195	104	1,091	1,045	104	941
2	0	0	0	1,195	104	1,091	0	0	0	800	54	746	1,537	104	1,433	1,537	104	1,433	1,035	60	975	1,537	104	1,433	1,537	104	1,433	1,487	104	1,383	1,195	104	1,091	1,045	104	941
3	0	0	0	1,195	104	1,091	0	0	0	1,195	104	1,091	1,537	104	1,433	1,537	104	1,433	1,035	60	975	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,045	104	941
4	0	0	0	1,195	104	1,091	0	0	0	1,195	104	1,091	1,537	104	1,433	1,537	104	1,433	1,235	92	1,143	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,045	104	941
5	0	0	0	1,195	104	1,091	0	0	0	1,095	104	991	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,045	104	941
6	0	0	0	1,195	104	1,091	0	0	0	1,095	104	991	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,045	104	941
7	0	0	0	1,195	104	1,091	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,287	104	1,183	1,337	92	1,245	1,537	104	1,433	1,195	104	1,091	1,045	104	941
8	0	0	0	1,195	104	1,091	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,437	92	1,345	1,537	104	1,433	1,337	92	1,245	1,537	104	1,433	1,195	104	1,091	1,045	104	941
9	0	0	0	1,195	90	1,105	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,437	92	1,345	1,537	104	1,433	1,337	92	1,245	1,537	104	1,433	1,195	104	1,091	1,045	104	941
10	0	0	0	1,195	90	1,105	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,437	92	1,345	1,537	104	1,433	1,337	92	1,245	1,537	104	1,433	1,195	104	1,091	1,045	104	941
11	0	0	0	600	55	545	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,337	92	1,245	1,537	104	1,433	1,195	104	1,091	995	104	891
12	0	0	0	0	0	0	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,337	92	1,245	1,537	104	1,433	1,195	104	1,091	995	104	891
13	0	0	0	0	0	0	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	995	104	891
14	0	0	0	0	0	0	0	0	0	1,095	85	1,010	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,307	86	1,221	1,195	104	1,091	995	104	891
15	0	0	0	0	0	0	0	0	0	1,192	104	1,088	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,230	92	1,138	1,537	104	1,433	1,307	86	1,221	1,195	104	1,091	995	104	891
16	0	0	0	0	0	0	0	0	0	1,309	104	1,205	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,230	92	1,138	1,537	104	1,433	1,307	86	1,221	1,195	104	1,091	995	104	891
17	0	0	0	0	0	0	0	0	0	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,307	86	1,221	1,195	104	1,091	995	104	891
18	0	0	0	0	0	0	0	0	0	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,195	104	1,091	1,095	104	991
19	0	0	0	0	0	0	0	0	0	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,195	104	1,091	1,095	104	991
20	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,195	104	1,091	1,195	104	1,091	1,045	104	941
21	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	0	0	0	1,195	104	1,091	1,045	104	941
22	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	0	0	0	1,195	104	1,091	1,045	104	941
23	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	0	0	0	1,195	104	1,091	1,045	104	941
24	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	0	0	0	1,195	104	1,091	1,045	104	941
25	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	0	0	0	1,195	104	1,091	1,045	104	941
26	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	0	0	0	1,195	104	1,091	1,045	104	941
27	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	0	0	0	1,195	104	1,091	959	0	959
28	0	0	0	0	0	0	0	0	0	1,434	104	1,330	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	0	0	0	1,195	104	1,091	959	0	959
29	0	0	0				0	0	0	1,434	104	1,330	1,537	104	1,433	1,287	92	1,195	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	0	0	0	1,195	104	1,091	959	0	959
30	0	0	0				0	0	0	1,434	104	1,330	1,537	104	1,433	1,035	60	975	1,537	104	1,433	1,537	104	1,433	1,437	104	1,333	0	0	0	1,045	104	941	1,195	104	1,091
31	0	0	0				0	0	0				1,537	104	1,433				1,537	104	1,433	1,537	104	1,433				0	0	0				1,195	104	1,091
Month Mean			0			371			0			1,153			1,426			1,409			1,370			1,405			1,375			859			1,086			944

Table 2 Sheet 4 of 10
Year 2009
Net Flow through Turbine (Cusecs)

	January			February			March			April			May			June			July			August			September			October			November			December		
Date	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbine
1	930	0	930	0	0	0	940	90	850	0	0	0	1,400	105	1,296	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	960	105	856	960	80	880
2	930	0	930	0	0	0	940	90	850	930	60	870	1,400	105	1,296	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	960	105	856	960	80	880
3	930	0	930	0	0	0	940	90	850	930	105	826	1,400	105	1,296	1,537	105	1,433	1,412	0	1,412	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	960	105	856	960	80	880
4	930	80	850	0	0	0	940	90	850	930	105	826	1,400	105	1,296	1,537	105	1,433	1,365	50	1,315	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	960	105	856	960	80	880
5	930	80	850	0	0	0	940	90	850	930	105	826	1,400	105	1,296	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
6	930	80	850	0	0	0	935	90	845	930	105	826	1,400	105	1,296	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
7	930	80	850	0	0	0	935	90	845	930	100	830	1,400	105	1,296	1,537	105	1,433	1,364	105	1,260	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
8	930	80	850	0	0	0	935	90	845	930	100	830	1,400	105	1,296	1,537	105	1,433	1,364	105	1,260	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
9	930	80	850	0	0	0	935	90	845	930	100	830	1,400	105	1,296	1,537	105	1,433	1,364	105	1,260	1,537	105	1,433	1,237	105	1,133	1,537	105	1,433	1,100	105	996	960	80	880
10	930	80	850	0	0	0	935	90	845	930	100	830	1,400	105	1,296	1,537	105	1,433	1,364	105	1,260	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
11	930	80	850	500	0	500	935	90	845	0	0	0	1,400	105	1,296	1,479	105	1,375	1,364	105	1,260	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
12	352	0	352	995	0	995	935	90	845	0	0	0	1,400	105	1,296	1,479	105	1,375	1,537	105	1,433	1,437	105	1,333	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
13	0	0	0	995	35	960	935	90	845	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
14	0	0	0	995	60	935	935	90	845	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,100	105	996	960	80	880
15	0	0	0	995	60	935	935	90	845	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	1,537	105	1,433	960	105	856	1,100	80	1,020
16	0	0	0	995	90	905	935	90	845	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,100	80	1,020
17	0	0	0	995	0	995	935	90	845	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
18	0	0	0	995	0	995	935	90	845	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
19	0	0	0	995	0	995	0	0	0	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,237	105	1,133	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
20	0	0	0	995	0	995	0	0	0	0	0	0	1,450	105	1,346	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
21	0	0	0	995	105	891	0	0	0	1,000	60	940	1,537	105	1,433	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
22	0	0	0	995	105	891	0	0	0	1,000	105	896	1,537	105	1,433	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
23	0	0	0	995	105	891	0	0	0	1,200	105	1,096	1,537	105	1,433	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	105	856	1,000	80	920
24	0	0	0	995	105	891	0	0	0	1,200	105	1,096	1,537	105	1,433	1,479	105	1,375	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	80	880	1,000	80	920
25	0	0	0	995	105	891	0	0	0	1,300	105	1,196	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	0	560	960	80	880	860	80	780
26	0	0	0	940	90	850	0	0	0	1,300	105	1,196	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	105	456	960	80	880	860	80	780
27	0	0	0	940	90	850	0	0	0	1,300	105	1,196	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	105	456	960	80	880	860	80	780
28	0	0	0	940	90	850	0	0	0	1,300	105	1,196	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	105	456	960	80	880	860	80	780
29	0	0	0				0	0	0	1,400	105	1,296	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	105	456	960	80	880	860	80	780
30	0	0	0				0	0	0	1,400	105	1,296	1,537	105	1,433	1,465	105	1,361	1,537	105	1,433	1,537	105	1,433	1,361	105	1,257	560	105	456	960	80	880	860	80	780
31	0	0	0				0	0	0				1,537	105	1,433				1,537	105	1,433	1,537	105	1,433				560	105	456				860	80	780
Month Mean			321			579			491			630			1,357			1,391			1,396			1,420			1,329			951			908			877

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Year 2010
Net Flow through Turbine (Cusecs)

Date	January			February			March			April			May			June			July			August			September			October			November			December		
	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbin	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine
1	860	80	780	0	0	0	0	0	0	960	105	856	1,012	105	908	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,475	105	1,371	1,475	105	1,371	860	105	756	1,050	90	960
2	860	80	780	0	0	0	860	0	860	960	0	960	1,012	105	908	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,050	90	960
3	860	80	780	300	0	300	860	0	860	960	0	960	1,012	105	908	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,425	105	1,321	1,475	105	1,371	1,195	105	1,091	1,050	90	960
4	860	80	780	200	0	200	860	0	860	960	0	960	1,012	105	908	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,050	90	960
5	860	80	780	300	0	300	960	105	856	960	0	960	1,012	105	908	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
6	860	80	780	300	0	300	960	105	856	960	0	960	1,346	105	1,242	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
7	860	80	780	300	0	300	960	105	856	960	0	960	1,346	105	1,242	1,460	105	1,356	1,537	105	1,433	1,000	60	940	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
8	860	80	780	352	29	323	960	105	856	960	0	960	1,346	105	1,242	1,460	105	1,356	1,537	105	1,433	1,000	60	940	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
9	860	80	780	352	45	307	960	105	856	960	0	960	1,346	105	1,242	1,460	105	1,356	1,537	105	1,433	1,000	60	940	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
10	860	80	780	352	45	307	960	105	856	960	0	960	1,346	105	1,242	1,460	105	1,356	1,537	105	1,433	1,200	105	1,096	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
11	0	0	0	352	0	352	960	105	856	960	0	960	1,346	105	1,242	1,460	105	1,356	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
12	0	0	0	860	0	860	960	105	856	960	105	856	1,346	105	1,242	1,165	105	1,061	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
13	0	0	0	860	0	860	960	105	856	960	105	856	1,346	105	1,242	1,165	105	1,061	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
14	0	0	0	860	0	860	960	105	856	960	105	856	1,346	105	1,242	1,165	105	1,061	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
15	0	0	0	860	0	860	960	105	856	960	105	856	1,346	105	1,242	1,316	105	1,212	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,425	105	1,321	1,195	105	1,091	1,120	90	1,030
16	0	0	0	860	0	860	960	105	856	0	0	0	1,200	105	1,096	1,316	105	1,212	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
17	0	0	0	860	0	860	960	105	856	0	0	0	1,200	105	1,096	1,316	105	1,212	1,537	105	1,433	1,360	105	1,256	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
18	0	0	0	860	0	860	960	105	856	0	0	0	1,200	105	1,096	1,256	105	1,152	1,237	105	1,133	1,360	105	1,256	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
19	0	0	0	860	0	860	960	105	856	0	0	0	1,200	105	1,096	1,256	105	1,152	1,537	105	1,433	1,420	105	1,316	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
20	0	0	0	860	0	860	960	105	856	0	0	0	1,200	105	1,096	1,256	105	1,152	1,537	105	1,433	1,420	105	1,316	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
21	0	0	0	860	105	756	960	105	856	0	0	0	1,200	105	1,096	1,256	105	1,152	1,537	105	1,433	1,420	105	1,316	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
22	0	0	0	860	105	756	960	105	856	0	0	0	1,200	105	1,096	1,256	105	1,152	1,537	105	1,433	1,420	105	1,316	1,475	105	1,371	1,475	105	1,371	1,195	105	1,091	1,120	90	1,030
23	0	0	0	660	105	556	960	105	856	0	0	0	1,200	105	1,096	1,537	105	1,433	1,237	105	1,133	1,420	105	1,316	1,475	105	1,371	1,475	105	1,371	1,155	105	1,051	1,120	90	1,030
24	0	0	0	660	105	556	960	105	856	0	0	0	1,200	105	1,096	1,537	105	1,433	1,390	105	1,286	1,420	105	1,316	1,475	105	1,371	1,475	105	1,371	1,155	105	1,051	1,120	90	1,030
25	0	0	0	660	105	556	960	105	856	0	0	0	1,200	105	1,096	1,537	105	1,433	1,460	105	1,356	1,300	105	1,196	1,475	105	1,371	1,475	105	1,371	1,050	90	960	1,120	90	1,030
26	0	0	0	0	0	0	960	105	856	0	0	0	1,284	105	1,180	1,537	105	1,433	1,460	105	1,356	1,300	105	1,196	1,475	105	1,371	860	105	756	1,050	90	960	1,120	90	1,030
27	0	0	0	0	0	0	960	105	856	0	0	0	1,284	105	1,180	1,537	105	1,433	1,460	105	1,356	1,300	105	1,196	1,475	105	1,371	860	105	756	1,050	90	960	1,120	90	1,030
28	0	0	0	0	0	0	960	105	856	0	0	0	1,284	105	1,180	1,537	105	1,433	1,460	105	1,356	1,300	105	1,196	1,475	105	1,371	860	105	756	1,050	90	960	1,120	90	1,030
29	0	0	0				960	105	856	960	0	960	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,300	105	1,196	1,475	105	1,371	860	105	756	1,050	90	960	1,120	90	1,030
30	0	0	0				960	105	856	1,012	105	908	1,460	105	1,356	1,537	105	1,433	1,520	105	1,416	1,300	105	1,196	1,475	105	1,371	860	105	756	1,050	90	960	1,120	90	1,030
31	0	0	0				960	105	856				1,460	105	1,356				1,520	105	1,416	1,475	105	1,371				860	105	756				1,120	90	1,030
Month Mean			252			486			828			525			1,146			1,298			1,397			1,254			1,369			1,234			1,051			1,021

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Year 2011

Net Flow through Turbine (Cusecs)

Date	January			February			March			April			May			June			July			August			September			October			November			December		
	Gujrat Branch	Chillianwa	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwala	Net Through Turbi	Gujrat Branch	Chillianwa	Net Through
1	1,120	90	1,030	0	0	0	500	0	500	1,195	105	1,091	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,500	105	1,396	1,400	105	1,296	1,350	105	1,246	1,195	105	1,091	1,080	90	990
2	1,120	90	1,030	0	0	0	400	0	400	1,195	105	1,091	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,500	105	1,396	1,200	105	1,096	1,350	105	1,246	1,195	105	1,091	1,080	90	990
3	1,120	90	1,030	0	0	0	400	0	400	1,125	105	1,021	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,537	105	1,433	1,200	105	1,096	1,350	105	1,246	1,195	105	1,091	1,080	90	990
4	1,120	90	1,030	0	0	0	400	0	400	1,125	105	1,021	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,537	105	1,433	1,200	105	1,096	1,350	105	1,246	1,195	105	1,091	1,080	90	990
5	1,120	90	1,030	0	0	0	400	0	400	1,125	105	1,021	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,537	105	1,433	1,200	105	1,096	1,350	105	1,246	1,195	105	1,091	1,080	90	990
6	1,120	90	1,030	0	0	0	400	0	400	1,125	105	1,021	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,537	105	1,433	1,300	105	1,196	1,350	105	1,246	1,195	105	1,091	1,080	90	990
7	1,120	90	1,030	0	0	0	400	0	400	785	105	681	1,470	105	1,366	1,537	105	1,433	1,497	105	1,393	1,537	105	1,433	1,400	105	1,296	1,350	105	1,246	1,195	105	1,091	1,080	90	990
8	1,120	90	1,030	331	0	331	400	0	400	785	105	681	1,470	105	1,366	1,537	105	1,433	1,432	105	1,328	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
9	1,120	90	1,030	600	0	600	750	0	750	785	105	681	1,470	105	1,366	1,537	105	1,433	1,432	105	1,328	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
10	1,120	90	1,030	600	0	600	750	0	750	785	105	681	1,490	105	1,386	1,537	105	1,433	1,432	105	1,328	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
11	1,120	90	1,030	1,100	105	996	1,100	80	1,020	785	80	705	1,490	105	1,386	0	0	0	1,432	105	1,328	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
12	0	0	0	1,100	105	996	1,100	80	1,020	770	80	690	1,490	105	1,386	1,537	105	1,433	1,432	105	1,328	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
13	0	0	0	1,100	105	996	1,100	80	1,020	770	80	690	1,490	105	1,386	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
14	0	0	0	1,100	105	996	1,100	80	1,020	770	80	690	1,490	105	1,386	1,492	105	1,388	1,537	105	1,433	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
15	1,060	91	969	900	80	820	1,100	80	1,020	1,370	80	1,290	1,490	105	1,386	1,492	105	1,388	1,337	105	1,233	1,537	105	1,433	1,400	105	1,296	1,450	105	1,346	1,195	105	1,091	1,080	90	990
16	1,060	91	969	900	80	820	1,100	80	1,020	1,370	105	1,266	1,490	105	1,386	1,492	105	1,388	1,437	105	1,333	1,537	105	1,433	1,400	105	1,296	860	105	756	1,195	105	1,091	1,080	90	990
17	1,060	91	969	900	80	820	1,100	80	1,020	1,370	105	1,266	1,490	105	1,386	1,492	105	1,388	1,437	105	1,333	1,537	105	1,433	1,400	105	1,296	860	105	756	1,195	105	1,091	1,080	90	990
18	1,060	91	969	900	80	820	1,195	105	1,091	1,370	105	1,266	1,490	105	1,386	1,537	105	1,433	1,437	105	1,333	1,537	105	1,433	1,400	105	1,296	860	105	756	1,195	105	1,091	1,080	90	990
19	0	0	0	900	80	820	1,195	105	1,091	1,370	105	1,266	1,490	105	1,386	1,537	105	1,433	1,437	105	1,333	1,537	105	1,433	1,400	105	1,296	860	105	756	1,195	105	1,091	1,080	90	990
20	0	0	0	900	80	820	1,195	105	1,091	1,370	105	1,266	1,537	105	1,433	1,537	105	1,433	1,520	105	1,416	1,537	105	1,433	1,400	105	1,296	860	105	756	1,195	105	1,091	1,080	90	990
21	0	0	0	900	80	820	1,195	105	1,091	1,370	105	1,266	1,537	105	1,433	1,537	105	1,433	1,520	105	1,416	1,537	105	1,433	1,400	105	1,296	860	105	756	1,195	105	1,091	1,080	90	990
22	0	0	0	900	80	820	1,195	105	1,091	1,370	105	1,266	1,537	105	1,433	1,537	105	1,433	1,520	105	1,416	1,537	105	1,433	1,350	105	1,246	860	105	756	1,195	105	1,091	1,080	90	990
23	0	0	0	750	80	670	1,195	105	1,091	1,370	105	1,266	1,537	105	1,433	1,537	105	1,433	1,520	105	1,416	1,537	105	1,433	1,350	105	1,246	860	105	756	1,045	90	955	1,080	90	990
24	0	0	0	650	0	650	1,195	105	1,091	1,370	105	1,266	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,350	105	1,246	860	105	756	1,045	90	955	1,080	90	990
25	0	0	0	650	0	650	1,195	105	1,091	1,370	105	1,266	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,350	105	1,246	860	105	756	1,045	90	955	1,080	90	990
26	0	0	0	650	0	650	1,195	105	1,091	1,420	105	1,316	1,537	105	1,433	1,537	105	1,433	0	0	0	1,237	105	1,133	1,350	105	1,246	860	105	756	1,000	90	910	1,080	90	990
27	0	0	0	500	0	500	1,195	105	1,091	1,420	105	1,316	1,537	105	1,433	1,537	105	1,433	900	0	900	1,500	105	1,396	1,350	105	1,246	860	105	756	1,000	90	910	1,080	90	990
28	0	0	0	500	0	500	1,195	105	1,091	1,420	105	1,316	1,537	105	1,433	1,537	105	1,433	724	80	644	1,500	105	1,396	1,350	105	1,246	860	105	756	1,000	90	910	1,080	90	990
29	0	0	0				1,195	105	1,091	1,420	105	1,316	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,500	105	1,396	1,350	105	1,246	860	105	756	1,000	90	910	1,080	90	990
30	0	0	0				1,195	105	1,091	1,470	105	1,366	1,537	105	1,433	1,537	105	1,433	1,537	105	1,433	1,500	105	1,396	1,350	105	1,246	1,195	105	1,091	1,030	90	940	1,080	90	990
31	0	0	0				1,195	105	1,091				1,537	105	1,433				1,500	105	1,396	1,400	105	1,296				1,195	105	1,091				1,080	90	990
Month Mean			491			560			878			1,078			1,398			1,379			1,295			1,411			1,251			1,040			1,048			990

Table 2 Sheet 7 of 10
Year 2012
Net Flow through Turbine (Cusecs)

Date	January			February			March		
	Gujrat Branch	Chillianwala	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Tur
1	1,080	90	990	0	0	0	960	105	856
2	1,080	90	990	0	0	0	960	105	856
3	1,080	90	990	0	0	0	960	105	856
4	1,080	90	990	500	0	500	960	105	856
5	1,080	90	990	500	0	500	960	105	856
6	1,080	90	990	500	0	500	960	105	856
7	1,050	90	960	500	0	500	960	105	856
8	1,030	90	940	500	0	500	960	105	856
9	1,030	90	940	500	0	500	960	105	856
10	1,030	90	940	500	0	500	960	105	856
11	1,030	90	940	850	105	746	800	105	696
12	724	90	634	850	105	746	800	105	696
13	0	0	0	860	105	756	800	105	696
14	0	0	0	860	105	756	800	105	696
15	0	0	0	860	105	756	800	105	696
16	0	0	0	860	0	860	800	105	696
17	0	0	0	860	0	860	800	105	696
18	0	0	0	860	0	860	800	105	696
19	0	0	0	860	0	860	800	105	696
20	0	0	0	860	0	860	800	105	696
21	0	0	0	860	105	756	800	105	696
22	0	0	0	860	105	756	660	0	660
23	0	0	0	860	105	756	860	105	756
24	0	0	0	860	105	756	860	105	756
25	0	0	0	860	105	756	860	105	756
26	0	0	0	860	105	756	860	105	756
27	0	0	0	860	105	756	860	105	756
28	0	0	0	860	105	756	860	105	756
29	0	0	0	860	105	756	860	105	756
30	0	0	0				860	105	756
31	0	0	0				860	105	756
Month Mean			364			633			763

Date	April			May			June		
	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine
1	860	105	756	1,450	105	1,346	1,190	0	1,190
2	860	105	756	1,450	105	1,346	1,500	105	1,396
3	860	105	756	1,450	105	1,346	1,500	105	1,396
4	860	105	756	1,450	105	1,346	1,500	105	1,396
5	860	105	756	1,450	105	1,346	1,471	105	1,367
6	860	105	756	1,450	105	1,346	1,471	105	1,367
7	860	105	756	1,450	105	1,346	1,321	105	1,217
8	860	105	756	1,096	105	992	1,471	105	1,367
9	860	105	756	1,096	105	992	1,371	105	1,267
10	860	105	756	1,096	105	992	1,371	105	1,267
11	860	105	756	991	105	887	1,371	105	1,267
12	860	105	756	936	105	832	1,471	105	1,367
13	860	105	756	936	90	846	1,471	105	1,367
14	860	105	756	936	90	846	1,471	105	1,367
15	860	105	756	936	90	846	1,471	105	1,367
16	1,260	105	1,156	936	0	936	1,471	105	1,367
17	1,150	105	1,046	914	0	914	1,471	105	1,367
18	1,150	105	1,046	914	0	914	1,471	105	1,367
19	1,150	105	1,046	914	0	914	1,471	105	1,367
20	1,260	0	1,260	914	0	914	1,471	105	1,367
21	1,400	105	1,296	914	0	914	1,471	105	1,367
22	1,400	105	1,296	914	0	914	1,471	105	1,367
23	1,400	105	1,296	914	0	914	1,471	105	1,367
24	1,400	105	1,296	145	0	145	1,471	105	1,367
25	1,450	105	1,346	0	0	0	1,471	105	1,367
26	1,450	105	1,346	0	0	0	1,471	105	1,367
27	1,450	105	1,346	0	0	0	1,471	105	1,367
28	1,450	105	1,346	0	0	0	1,471	105	1,367
29	1,450	105	1,346	0	0	0	1,471	105	1,367
30	1,450	105	1,346	0	0	0	1,471	105	1,367
31				0	0	0			
Month Mean			1,005			778			1,349

Date	July			August			September		
	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine
1	1,471	105	1,367	1,471	105	1,367	1,471	105	1,367
2	1,471	105	1,367	1,471	105	1,367	1,471	105	1,367
3	1,471	105	1,367	1,471	105	1,367	1,471	105	1,367
4	1,471	105	1,367	1,471	105	1,367	1,471	105	1,367
5	1,471	105	1,367	1,471	105	1,367	900	80	820
6	1,471	105	1,367	1,471	105	1,367	900	80	820
7	1,471	105	1,367	1,471	105	1,367	800	80	720
8	1,471	105	1,367	1,471	105	1,367	800	80	720
9	1,471	105	1,367	1,471	105	1,367	800	80	720
10	1,471	105	1,367	1,471	105	1,367	800	80	720
11	1,471	105	1,367	1,471	105	1,367	800	80	720
12	1,471	105	1,367	1,471	105	1,367	800	80	720
13	1,471	105	1,367	1,471	105	1,367	800	80	720
14	1,471	105	1,367	1,471	105	1,367	800	80	720
15	1,471	105	1,367	1,471	105	1,367	800	80	720
16	1,471	105	1,367	1,471	105	1,367	800	80	720
17	1,471	105	1,367	1,471	105	1,367	0	0	0
18	1,471	105	1,367	1,471	105	1,367	0	0	0
19	1,471	105	1,367	1,471	105	1,367	0	0	0
20	1,471	105	1,367	1,471	105	1,367	0	0	0
21	1,471	105	1,367	1,248	105	1,144	0	0	0
22	1,471	105	1,367	1,248	105	1,144	0	0	0
23	1,471	105	1,367	1,471	105	1,367	0	0	0
24	1,471	105	1,367	1,471	105	1,367	0	0	0
25	1,471	105	1,367	1,471	105	1,367	0	0	0
26	1,471	105	1,367	1,471	105	1,367	0	0	0
27	1,471	105	1,367	1,471	105	1,367	0	0	0
28	1,471	105	1,367	1,471	105	1,367	0	0	0
29	1,471	105	1,367	1,471	105	1,367	0	0	0
30	1,471	105	1,367	1,471	105	1,367	600	0	600
31	1,471	105	1,367	1,471	105	1,367			
Month Mean			1,367			1,352			497

Date	October			November			December		
	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Tur
1	600	0	600	1,098	105	994	1,000	90	910
2	800	0	800	1,098	105	994	1,000	90	910
3	1,350	105	1,246	1,098	105	994	1,000	90	910
4	1,450	105	1,346	1,098	105	994	1,000	90	910
5	1,450	105	1,346	1,195	105	1,091	1,000	90	910
6	1,250	105	1,146	1,195	105	1,091	1,000	90	910
7	1,250	105	1,146	1,195	105	1,091	1,000	90	910
8	1,250	105	1,146	1,195	105	1,091	1,000	90	910
9	1,250	105	1,146	1,195	105	1,091	1,000	90	910
10	1,250	105	1,146	1,195	105	1,091	1,000	90	910
11	1,150	90	1,060	1,195	105	1,091	900	90	810
12	1,150	90	1,060	1,195	105	1,091	900	90	810
13	1,150	90	1,060	1,195	105	1,091	900	90	810
14	1,150	90	1,060	1,195	105	1,091	900	90	810
15	1,150	90	1,060	1,195	105	1,091	900	90	810
16	1,150	90	1,060	1,195	105	1,091	900	90	810
17	1,250	105	1,146	1,195	105	1,091	1,000	90	910
18	1,250	105	1,146	1,095	105	991	1,000	90	910
19	1,250	105	1,146	1,095	105	991	1,000	90	910
20	1,250	105	1,146	1,095	105	991	900	90	810
21	1,098	105	994	1,095	105	991	900	90	810
22	1,098	105	994	1,095	105	991	900	90	810
23	1,098	105	994	1,095	105	991	900	90	810
24	1,098	105	994	1,095	105	991	900	90	810
25	1,098	105	994	1,095	105	991	900	80	820
26	1,098	105	994	1,095	105	991	900	80	820
27	1,098	105	994	1,095	105	991	900	80	820
28	1,098	105	994	1,035	100	935	900	80	820
29	1,098	105	994	1,035	100	935	900	80	820
30	1,098	105	994	1,000	90	910	900	80	820
31	1,098	105	994				900	80	820
Month Mean			1,062			1,028			854

Year 2013

Net Flow through Turbine (Cusecs)

Date	January			February			March			April			May			June			July			August			September			October			November			December		
	Gujrat Branch	Chillianwala	Net Through Tur	Gujrat Branch	Chillian	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Tur
1	900	80	820	0	0	0	0	0	0	860	80	780	1,345	104	1,241	1,200	104	1,096	1,200	104	1,096	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
2	900	80	820	0	0	0	0	0	0	860	80	780	1,345	104	1,241	1,200	104	1,096	1,400	104	1,296	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
3	900	80	820	0	0	0	0	0	0	860	80	780	1,295	104	1,191	1,400	104	1,296	1,400	104	1,296	1,350	90	1,260	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
4	900	80	820	0	0	0	500	0	500	860	80	780	1,295	104	1,191	1,400	104	1,296	1,400	104	1,296	1,450	90	1,360	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
5	900	80	820	0	0	0	900	0	900	860	80	780	1,295	104	1,191	1,400	104	1,296	1,400	104	1,296	1,450	90	1,360	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
6	900	80	820	0	0	0	900	80	820	860	80	780	1,295	104	1,191	1,400	104	1,296	1,400	104	1,296	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
7	900	80	820	0	0	0	900	80	820	860	80	780	1,295	104	1,191	1,400	104	1,296	1,400	104	1,296	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	1,195	104	1,091	950	80	870
8	900	80	820	0	0	0	900	80	820	860	80	780	1,280	104	1,176	1,450	104	1,346	1,400	104	1,296	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	1,000	80	920	950	80	870
9	900	80	820	0	0	0	1,000	80	920	860	80	780	1,280	104	1,176	1,450	104	1,346	1,400	104	1,296	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	900	80	820	950	80	870
10	900	80	820	0	0	0	1,000	80	920	860	80	780	1,280	104	1,176	1,450	104	1,346	1,400	104	1,296	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	900	80	820	1,030	80	950
11	900	80	820	0	0	0	1,000	80	920	860	80	780	1,280	104	1,176	1,450	104	1,346	1,200	80	1,120	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	800	80	720	1,030	80	950
12	357	0	357	0	0	0	1,000	80	920	860	80	780	1,280	104	1,176	1,450	104	1,346	1,200	80	1,120	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	800	80	720	1,030	80	950
13	0	0	0	0	0	0	1,000	80	920	860	80	780	1,280	104	1,176	1,325	104	1,221	1,200	80	1,120	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	950	80	870	1,030	80	950
14	0	0	0	350	0	350	1,000	80	920	860	80	780	1,280	104	1,176	1,325	104	1,221	1,200	80	1,120	1,350	90	1,260	1,537	104	1,433	1,480	104	1,376	950	80	870	1,030	80	950
15	0	0	0	350	0	350	1,000	80	920	860	80	780	1,280	104	1,176	1,375	104	1,271	1,200	80	1,120	1,200	90	1,110	1,537	104	1,433	1,420	104	1,316	950	80	870	1,030	80	950
16	0	0	0	250	0	250	1,000	80	920	1,360	80	1,280	1,172	104	1,068	1,375	104	1,271	1,537	104	1,433	1,200	90	1,110	1,537	104	1,433	1,195	104	1,091	950	80	870	1,030	80	950
17	0	0	0	0	0	0	1,000	80	920	1,360	104	1,256	1,172	104	1,068	1,375	104	1,271	1,537	104	1,433	1,200	90	1,110	1,537	104	1,433	1,195	104	1,091	950	80	870	1,030	80	950
18	0	0	0	0	0	0	1,000	80	920	1,360	104	1,256	1,172	104	1,068	1,375	104	1,271	1,537	104	1,433	1,200	90	1,110	1,500	104	1,396	1,195	104	1,091	950	80	870	1,030	80	950
19	0	0	0	0	0	0	1,000	80	920	1,360	104	1,256	1,172	104	1,068	1,375	104	1,271	1,450	90	1,360	1,200	90	1,110	1,500	104	1,396	1,195	104	1,091	950	80	870	1,030	80	950
20	0	0	0	0	0	0	1,000	90	910	1,360	104	1,256	1,172	104	1,068	1,375	104	1,271	1,450	90	1,360	1,200	90	1,110	1,500	104	1,396	1,195	104	1,091	950	80	870	1,030	80	950
21	0	0	0	0	0	0	1,000	90	910	1,360	104	1,256	1,400	104	1,296	1,375	104	1,271	1,450	90	1,360	1,200	90	1,110	1,500	104	1,396	1,195	104	1,091	950	80	870	1,030	80	950
22	0	0	0	0	0	0	860	80	780	1,360	104	1,256	1,400	104	1,296	1,375	104	1,271	1,450	90	1,360	1,200	90	1,110	1,500	104	1,396	920	104	816	950	80	870	1,030	80	950
23	0	0	0	0	0	0	860	80	780	1,360	104	1,256	1,400	104	1,296	1,375	104	1,271	1,450	90	1,360	1,200	90	1,110	1,500	104	1,396	894	104	790	950	80	870	1,030	80	950
24	0	0	0	0	0	0	860	80	780	1,360	104	1,256	1,400	104	1,296	1,375	104	1,271	1,450	90	1,360	1,200	90	1,110	1,500	104	1,396	894	104	790	950	80	870	1,030	80	950
25	0	0	0	0	0	0	860	80	780	1,360	104	1,256	1,400	104	1,296	1,450	104	1,346	1,350	90	1,260	1,200	90	1,110	1,400	104	1,296	894	104	790	950	80	870	1,030	80	950
26	0	0	0	0	0	0	860	80	780	1,360	104	1,256	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,200	90	1,110	1,400	104	1,296	894	104	790	950	80	870	1,030	80	950
27	0	0	0	0	0	0	860	80	780	1,225	104	1,121	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,400	104	1,296	1,400	104	1,296	894	104	790	950	80	870	1,030	80	950
28	0	0	0	0	0	0	860	80	780	1,225	104	1,121	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	894	104	790	950	80	870	1,030	80	950
29	0	0	0				860	80	780	1,225	104	1,121	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	894	104	790	950	80	870	1,030	80	950
30	0	0	0				860	80	780	1,345	104	1,241	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,537	104	1,433	1,480	104	1,376	894	104	790	950	80	870	1,030	80	950
31	0	0	0				860	80	780				1,200	104	1,096				1,500	104	1,396	1,537	104	1,433				894	104	790				1,030	80	950
Month Mean			302			34			761			1,005			1,201			1,296			1,305			1,276			1,404			1,130			910			927

Table 2 Sheet 9 of 10
Year 2014
Net Flow through Turbine (Cusecs)

	January			February			March			April			May			June			July			August			September			October			November			December		
Date	Gujrat Branch	Chilli an wala	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chilli an wala	Net Through Turbine
1	1,030	80	950	0	0	0	1,060	105	956	800	80	720	1,275	80	1,195	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	1,300	105	1,196	1,400	105	1,296	1,195	105	1,091	1,000	92	908
2	1,030	80	950	0	0	0	1,060	105	956	800	80	720	1,275	80	1,195	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	1,300	105	1,196	1,400	105	1,296	1,195	105	1,091	1,000	92	908
3	1,030	80	950	300	0	300	1,060	105	956	800	80	720	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	1,300	105	1,196	1,400	105	1,296	1,195	105	1,091	1,000	92	908
4	1,030	80	950	600	0	600	1,060	105	956	1,000	80	920	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	1,300	105	1,196	1,400	105	1,296	1,195	105	1,091	1,000	92	908
5	1,030	80	950	600	0	600	1,060	105	956	1,000	80	920	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,400	105	1,296	1,195	105	1,091	1,000	92	908
6	1,030	80	950	1,000	50	950	1,060	105	956	1,000	80	920	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,400	105	1,296	1,195	105	1,091	1,060	92	968
7	1,030	80	950	0	0	0	1,060	105	956	750	105	646	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,400	105	1,296	1,195	105	1,091	1,060	92	968
8	1,030	80	950	0	0	0	1,060	105	956	0	0	0	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,400	105	1,296	995	105	891	1,060	92	968
9	1,030	80	950	0	0	0	1,060	105	956	0	0	0	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,400	105	1,296	995	92	903	1,060	92	968
10	1,030	80	950	0	0	0	1,060	105	956	0	0	0	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,440	105	1,336	995	92	903	1,060	92	968
11	1,030	80	950	0	0	0	1,060	105	956	0	0	0	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
12	1,030	80	950	0	0	0	0	0	0	0	0	0	1,350	105	1,246	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
13	357	0	357	500	0	500	0	0	0	0	0	0	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,366	105	1,262	0	0	0	1,440	105	1,336	850	92	758	960	92	868
14	0	0	0	500	80	420	0	0	0	0	0	0	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	55	1,371	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
15	0	0	0	1,000	80	920	0	0	0	301	0	301	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	55	1,371	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
16	0	0	0	1,000	80	920	0	0	0	700	80	620	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	55	1,371	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
17	0	0	0	1,000	80	920	0	0	0	1,000	80	920	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	0	1,426	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
18	0	0	0	1,125	80	1,045	0	0	0	1,000	80	920	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	0	1,426	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
19	0	0	0	1,125	80	1,045	0	0	0	900	80	820	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	0	1,426	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
20	0	0	0	1,125	80	1,045	0	0	0	900	80	820	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,346	0	1,346	0	0	0	1,440	105	1,336	850	92	758	1,060	92	968
21	0	0	0	1,060	105	956	0	0	0	900	80	820	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	0	1,426	0	0	0	900	105	796	850	92	758	1,060	92	968
22	0	0	0	1,060	105	956	0	0	0	1,200	80	1,120	1,400	105	1,296	1,450	105	1,346	1,366	105	1,262	1,426	0	1,426	0	0	0	900	105	796	850	92	758	1,060	92	968
23	0	0	0	1,060	105	956	0	0	0	1,200	80	1,120	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,426	0	1,426	0	0	0	900	105	796	850	92	758	1,060	92	968
24	0	0	0	1,060	105	956	0	0	0	1,350	80	1,270	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	600	0	600	900	105	796	850	92	758	1,120	92	1,028
25	0	0	0	1,060	105	956	0	0	0	1,350	80	1,270	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	1,000	80	920	900	105	796	850	92	758	1,120	92	1,028
26	0	0	0	1,060	105	956	0	0	0	1,350	80	1,270	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	1,000	80	920	900	105	796	1,000	92	908	1,120	92	1,028
27	0	0	0	1,060	105	956	0	0	0	1,275	80	1,195	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	1,000	80	920	900	105	796	1,000	92	908	1,070	92	978
28	0	0	0	1,060	105	956	0	0	0	1,275	80	1,195	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	1,000	80	920	900	105	796	1,000	92	908	1,070	92	978
29	0	0	0				0	0	0	1,275	80	1,195	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	1,000	80	920	900	105	796	1,000	92	908	970	92	878
30	0	0	0				0	0	0	1,275	80	1,195	1,450	105	1,346	1,450	105	1,346	1,366	105	1,262	1,300	105	1,196	1,000	80	920	900	105	796	1,000	92	908	970	92	878
31	0	0	0				600	0	600				1,450	105	1,346				1,366	105	1,262	1,300	105	1,196				900	105	796				970	92	878
Mpnth Mean			379			604			358			721			1,287			1,346			1,262			1,290			363			1,132			875			953

[redacted]

Year 2015

Net Flow through Turbine (Cusecs)

Date	January			February			March			April			May			June			July			August			September			October			November			December		
	Gujrat Branch	Chilliwala	Net Through Tur	Gujrat Branch	Chilliwala	Net Through Tur	Gujra	Chillian	Net Th	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Turbine	Gujrat Branch	Chillianwala	Net Through Tur	Gujrat Branch	Chillianwala	Net Through Tur
1	970	92	878	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,490	104	1,386	1,400	104	1,296	1,000	104	896	900	104	796
2	970	92	878	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,490	104	1,386	1,450	104	1,346	1,000	104	896	900	104	796
3	970	92	878	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,537	104	1,433	1,500	104	1,396	1,060	104	956	900	104	796
4	970	92	878	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,500	104	1,396	1,500	104	1,396	1,537	104	1,433	1,500	104	1,396	1,060	104	956	900	104	796
5	970	92	878	0	0	0	0	0	0	0	0	0	1,250	104	1,146	1,470	104	1,366	1,537	104	1,433	1,500	104	1,396	1,537	104	1,433	1,500	104	1,396	950	104	846	780	104	676
6	970	92	878	0	0	0	0	0	0	0	0	0	1,250	104	1,146	1,470	104	1,366	1,537	104	1,433	1,500	104	1,396	1,437	104	1,333	1,500	104	1,396	950	104	846	900	104	796
7	970	92	878	0	0	0	0	0	0	0	0	0	1,400	104	1,296	1,470	104	1,366	1,537	104	1,433	1,500	104	1,396	1,437	104	1,333	1,470	104	1,366	950	104	846	900	104	796
8	970	92	878	0	0	0	0	0	0	0	0	0	1,400	104	1,296	1,470	104	1,366	1,537	104	1,433	1,500	104	1,396	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
9	970	92	878	0	0	0	0	0	0	0	0	0	1,400	104	1,296	1,470	104	1,366	1,537	104	1,433	1,430	104	1,326	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
10	970	92	878	301	0	301	0	0	0	0	0	0	1,400	104	1,296	1,470	104	1,366	1,537	104	1,433	1,430	104	1,326	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
11	970	92	878	301	0	301	0	0	0	0	0	0	1,400	104	1,296	1,470	104	1,366	1,380	80	1,300	1,430	104	1,326	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
12	252	0	252	301	0	301	0	0	0	0	0	0	1,400	104	1,296	1,500	104	1,396	1,380	80	1,300	1,330	104	1,226	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
13	0	0	0	449	0	449	0	0	0	600	0	600	1,400	104	1,296	1,500	104	1,396	1,380	80	1,300	1,330	104	1,226	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
14	0	0	0	449	0	449	0	0	0	600	0	600	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,330	104	1,226	1,500	104	1,396	1,470	104	1,366	950	104	846	900	104	796
15	0	0	0	449	0	449	0	0	0	600	0	600	1,400	104	1,296	1,500	104	1,396	1,500	104	1,396	1,330	104	1,226	1,500	104	1,396	1,470	104	1,366	950	104	846	800	104	696
16	0	0	0	449	0	449	0	0	0	600	55	545	1,400	104	1,296	1,400	104	1,296	1,500	104	1,396	1,330	104	1,226	1,500	104	1,396	860	104	756	950	104	846	800	104	696
17	0	0	0	449	0	449	0	0	0	1,100	80	1,020	1,400	104	1,296	1,400	104	1,296	1,500	104	1,396	1,330	104	1,226	1,500	104	1,396	860	104	756	950	104	846	950	104	846
18	0	0	0	750	0	750	0	0	0	1,100	104	996	1,400	104	1,296	1,400	104	1,296	1,300	104	1,196	1,400	104	1,296	1,500	104	1,396	860	104	756	950	104	846	950	104	846
19	0	0	0	750	50	700	0	0	0	1,100	104	996	1,400	104	1,296	1,500	104	1,396	1,300	80	1,220	1,400	104	1,296	1,500	104	1,396	860	104	756	950	104	846	950	104	846
20	0	0	0	750	50	700	0	0	0	1,020	104	916	1,400	104	1,296	1,450	55	1,395	1,300	80	1,220	1,400	104	1,296	1,500	104	1,396	860	104	756	950	104	846	950	104	846
21	0	0	0	0	0	0	0	0	0	1,020	104	916	1,400	104	1,296	1,450	55	1,395	1,300	80	1,220	1,500	104	1,396	1,500	104	1,396	860	104	756	950	104	846	950	104	846
22	0	0	0	0	0	0	0	0	0	1,020	104	916	1,400	104	1,296	1,450	55	1,395	1,300	80	1,220	1,500	104	1,396	1,450	104	1,346	860	104	756	950	104	846	950	104	846
23	0	0	0	0	0	0	0	0	0	1,020	104	916	1,400	104	1,296	1,450	55	1,395	1,500	104	1,396	1,500	104	1,396	0	0	0	860	104	756	950	104	846	950	104	846
24	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,500	104	1,396	0	0	0	860	104	756	950	104	846	950	104	846
25	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,537	104	1,433	0	0	0	860	104	756	950	104	846	950	104	846
26	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,537	104	1,433	0	0	0	860	104	756	950	104	846	950	104	846
27	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,500	55	1,445	1,500	104	1,396	1,537	104	1,433	0	0	0	860	104	756	950	104	846	950	104	846
28	0	0	0	0	0	0	0	0	0	1,020	104	916	1,470	104	1,366	1,200	55	1,145	1,500	104	1,396	1,537	104	1,433	0	0	0	860	104	756	950	104	846	1,012	104	908
29	0	0	0				0	0	0	1,020	104	916	1,470	104	1,366	1,200	55	1,145	1,500	104	1,396	1,537	104	1,433	800	0	800	860	104	756	900	104	796	1,012	104	908
30	0	0	0				0	0	0	1,020	104	916	1,470	104	1,366	1,450	55	1,395	1,500	104	1,396	1,537	104	1,433	800	55	745	860	104	756	900	104	796	1,031	104	927
31	0	0	0				0	0	0				1,470	104	1,366				1,500	104	1,396	1,537	104	1,433			0	860	104	756				1,060	104	956
Month Mean			320			189			0			514			1,255			1,359			1,364			1,355			1,037			1,052			853			820

Table 3 Sheet 1 of 10
Year 2006
Guage Reading (Feet)

Date	January		February		March		April		May		June		July		August		September		October		November		December	
	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br
1	9.80	4.52	0	0	9.70	4.52	10.00	4.52	7.90	5.1	9.20	5.1	9.80	5.23	10.00	4.32	11.00	4.78	9.50	5.34	8.40	4.52	9.50	4.4
2	9.80	4.52	0	0	9.70	4.52	10.00	4.52	7.90	5.1	9.20	5.1	10.40	5.23	10.00	5.34	11.00	4.4	9.50	5.34	8.00	4.52	9.50	4.4
3	9.80	4.52	0	0	9.70	4.52	10.00	4.52	7.90	5.1	9.20	5.1	10.00	5.23	10.00	5.34	0	0	9.50	5.34	8.00	4.52	9.50	4.4
4	9.80	4.52	0	0	9.70	4.52	10.00	4.52	7.90	5.2	9.60	5.1	10.50	5.23	9.40	5.34	0	0	9.50	5.34	7.70	4.52	9.50	3.97
5	9.80	4.52	8.70	2.4	9.70	4.52	10.00	4.52	7.90	5.2	10.00	5.1	9.70	5.34	10.00	4.8	0	0	10.20	5.34	7.90	4.52	9.50	3.68
6	9.80	4.52	8.50	3.74	9.80	4.52	10.00	4.52	7.90	5.2	10.00	5.1	10.50	5.34	10.20	4.8	0	0	9.50	5.34	8.10	4.52	11.00	2.69
7	9.70	4.52	8.30	4.52	9.80	4.52	10.00	4.52	7.90	5.2	9.40	5.1	9.00	5.34	9.00	4.8	0	0	9.50	5.34	9.30	4.52	9.00	2.69
8	9.80	4.52	9.00	4.52	9.80	4.52	10.00	4.52	7.90	5.2	9.20	5.1	9.00	5.34	9.20	4.4	0	0	9.50	5.34	9.90	4.52	9.40	2.69
9	9.80	4.52	9.10	4.52	9.80	4.34	10.00	4.52	7.90	5.2	9.20	5.2	8.70	5.34	8.50	4.4	0	0	9.50	5.34	9.70	4.52	10.00	2.69
10	9.80	4.52	9.20	4.52	9.80	4.34	10.00	4.52	7.90	5.2	8.30	5.2	8.50	5.34	7.60	4.9	0	0	9.50	5.34	9.70	4.52	10.00	2.69
11	9.80	4.52	9.40	4.52	9.70	4.52	10.00	4.39	7.90	5.2	8.00	5.34	9.50	5.34	7.30	4.9	9.60	5.34	9.50	5.34	9.60	4.52	10.00	2.69
12	0	0	8.10	4.76	9.70	4.52	10.00	4.39	7.90	5.2	7.90	5.34	9.80	5.34	7.10	4.9	9.30	5.34	9.50	5.34	9.70	4.52	0	0
13	0	0	8.10	5.01	9.80	4.52	10.00	4.39	7.90	5.2	7.90	5.34	11.40	5.34	7.10	4.9	9.50	5.34	9.50	5.34	9.90	4.52	0	0
14	0	0	9.00	5.22	9.80	4.52	9.50	4.39	7.90	5.2	7.80	5.34	0	0	7.10	4.9	9.10	5.34	9.50	5.34	10.00	4.52	0	0
15	0	0	9.10	5.22	9.60	4.52	9.50	4.39	7.90	5.2	8.00	4.94	0	0	7.10	4.9	9.10	5.34	9.50	5.34	10.00	4.52	0	0
16	0	0	9.00	5.22	9.10	2.2	9.80	4.84	7.90	5.2	8.00	4.94	0	0	7.00	5.26	9.10	5.34	9.50	5.34	10.10	4.52	0	0
17	0	0	9.30	5.22	10.00	4.52	9.80	4.84	8.00	5.2	8.80	4.94	8.00	4.4	7.90	5.26	9.10	5.34	9.50	5.34	10.10	4.52	0	0
18	0	0	9.50	5.22	10.00	4.52	9.70	4.84	11.00	5.2	9.00	4.94	9.00	4.4	8.00	5.26	9.10	5.34	9.50	5.34	10.00	4.52	0	0
19	0	0	9.50	5.22	10.00	4.52	9.90	4.84	10.50	5.2	9.00	4.94	8.70	4.4	8.00	5.26	9.10	5.34	9.00	5.34	10.00	4.52	0	0
20	0	0	9.50	5.22	10.00	4.52	9.70	4.96	10.00	5.2	9.00	4.94	8.60	4.4	8.20	5.26	9.00	5.34	7.50	5.34	9.50	4.52	0	0
21	0	0	9.50	5.22	10.00	4.52	9.50	4.96	8.80	5.1	8.90	4.94	9.30	4.4	8.20	5.26	8.90	5.34	0	0	9.50	4.52	0	0
22	0	0	9.60	4.52	8.80	4.52	9.50	4.96	8.00	5.1	8.80	4.94	9.40	5.34	8.10	5.26	9.40	4.87	0	0	9.50	4.52	0	0
23	0	0	9.60	4.52	8.50	4.52	9.50	5.08	7.80	5.1	8.80	4.94	9.00	5.34	8.10	5.26	9.40	4.87	0	0	9.50	4.26	0	0
24	0	0	9.70	4.52	8.40	4.52	9.50	5.08	8.00	5.1	8.90	4.94	9.00	5.34	8.00	5.26	9.50	5.34	0	0	9.50	4.26	0	0
25	0	0	9.70	4.52	8.40	4.52	9.50	5.08	8.00	5.1	8.90	4.94	9.00	5.23	8.00	5.26	6.00	3.6	0	0	9.50	4.26	0	0
26	0	0	9.70	4.52	8.40	4.52	9.50	5.08	8.00	5.1	8.80	4.94	10.00	4.32	8.00	5.26	9.50	5.34	0	0	9.50	4.26	0	0
27	0	0	9.70	4.52	8.40	4.52	9.30	5.08	9.20	5.1	8.70	5.27	10.40	4.32	8.00	5.26	9.50	5.34	0	0	9.50	3.86	0	0
28	0	0	9.70	4.52	8.40	4.52	9.20	5.08	9.30	5.1	10.50	5.27	9.80	4.32	8.20	4.34	9.50	5.34	0	0	9.50	3.86	0	0
29	0	0			8.40	4.52	9.20	5.08	9.30	5.1	10.80	5.27	9.60	4.32	9.70	5.26	9.50	5.34	0	0	9.50	3.86	0	0
30	0	0			10.00	4.52	7.90	5.08	9.20	5.1	10.50	5.27	9.30	4.32	10.50	5.26	9.50	5.34	0	0	9.50	3.86	0	0
31	0	0			10.00	4.52			9.20	5.1			9.80	4.32	11.00	4.78			0	0			0	0

Table 3 Sheet 2 of 10
Year 2007
Guage Reading (Feet)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Guage U	Guage G	Guage UJC	Guage Gujr at Br	Guage U	Guage G	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br	Guage UJC	Guage Gujr at Br
1	0	0	0	0	0	0	10.00	2.18	10.20	5.10	8.50	5.34	8.40	4.10	8.20	5.34	9.00	5.34	10.00	5.10	7.40	4.52	10.40	4.13
2	0	0	8.00	4.52	0	0	10.00	3.45	10.20	5.34	8.50	5.34	8.40	4.10	10.70	5.34	9.00	5.34	10.00	5.23	10.30	4.52	10.40	4.13
3	0	0	8.00	4.52	0	0	10.00	4.52	10.20	5.34	8.50	5.34	9.10	4.10	9.50	5.34	9.00	5.34	10.00	5.34	10.50	4.52	10.40	4.13
4	0	0	8.10	4.52	0	0	10.00	4.52	10.20	5.34	8.50	5.34	9.40	4.62	8.70	5.34	9.00	5.34	9.90	5.34	10.50	4.52	10.40	4.13
5	0	0	8.10	4.52	0	0	10.00	4.26	10.20	5.10	8.50	5.34	9.10	5.34	10.50	5.34	9.00	5.34	10.00	5.34	10.50	4.52	10.40	4.13
6	0	0	8.10	4.52	0	0	10.00	4.26	10.20	5.34	8.50	5.34	8.00	5.34	10.70	5.34	9.10	5.34	9.90	5.34	10.50	4.52	10.40	4.13
7	0	0	8.20	4.52	0	0	10.00	4.26	10.20	5.34	8.50	5.34	11.00	5.34	10.30	4.75	9.40	4.87	9.90	5.34	10.20	4.52	10.40	4.13
8	0	0	8.50	4.52	0	0	10.00	4.26	10.20	5.34	8.60	5.34	9.50	5.10	9.70	5.34	9.00	4.87	9.90	5.34	10.50	4.52	10.40	4.13
9	0	0	8.90	4.52	0	0	10.00	4.26	10.20	5.34	8.60	5.34	9.00	5.10	10.00	5.34	9.00	4.87	10.00	5.34	10.40	4.52	10.40	4.13
10	0	0	9.20	4.52	0	0	10.00	4.26	10.20	5.34	8.60	5.34	8.00	5.10	10.00	5.34	9.00	4.87	10.00	5.34	10.50	4.52	10.40	4.13
11	0	0	8.80	2.85	0	0	10.00	4.26	10.20	5.34	8.80	5.34	9.20	5.34	10.00	5.34	9.00	4.87	10.00	5.34	10.50	4.52	10.50	4.01
12	0	0	0	0	0	0	10.00	4.26	10.20	5.34	9.00	5.34	7.70	5.34	10.00	5.34	9.00	4.87	10.00	5.34	10.50	4.52	10.50	4.01
13	0	0	0	0	0	0	10.00	4.26	10.20	5.34	9.00	5.34	7.70	5.34	10.00	5.34	9.00	5.34	10.00	5.34	10.50	4.52	10.50	4.01
14	0	0	0	0	0	0	10.00	4.26	10.20	5.34	8.70	5.34	7.70	5.34	10.20	5.34	9.00	5.34	9.90	4.79	10.50	4.52	10.50	4.01
15	0	0	0	0	0	0	10.00	4.51	10.20	5.34	9.80	5.34	7.90	5.34	9.90	4.60	9.00	5.34	9.90	4.79	10.50	4.52	10.50	4.01
16	0	0	0	0	0	0	10.00	4.80	10.20	5.34	9.10	5.34	7.90	5.34	9.40	4.60	9.00	5.34	9.80	4.79	10.50	4.52	10.40	4.01
17	0	0	0	0	0	0	10.00	5.34	10.20	5.34	9.00	5.34	7.90	5.34	9.50	5.34	9.00	5.34	9.80	4.79	10.50	4.52	10.40	4.01
18	0	0	0	0	0	0	10.00	5.34	10.20	5.34	8.90	5.34	7.70	5.34	9.30	5.34	9.00	5.34	10.30	4.52	10.50	4.52	10.40	4.26
19	0	0	0	0	0	0	10.00	5.34	9.50	5.34	9.10	5.34	7.70	5.34	9.40	5.34	9.00	5.34	9.90	4.52	10.50	4.52	10.40	4.26
20	0	0	0	0	0	0	10.20	5.10	10.00	5.34	8.70	5.34	7.90	5.34	9.40	5.34	9.00	5.34	9.40	4.52	10.50	4.52	10.40	4.13
21	0	0	0	0	0	0	10.20	5.10	9.80	5.34	8.70	5.34	7.70	5.34	9.40	5.34	9.00	5.34	0	0	10.50	4.52	10.40	4.13
22	0	0	0	0	0	0	10.00	5.10	9.40	5.34	8.60	5.34	10.70	5.34	9.30	5.34	9.00	5.34	0	0	10.50	4.52	10.40	4.13
23	0	0	0	0	0	0	10.00	5.10	9.10	5.34	8.50	5.34	11.10	5.34	9.30	5.34	9.00	5.34	0	0	10.50	4.52	10.40	4.13
24	0	0	0	0	0	0	10.00	5.10	9.50	5.34	8.50	5.34	11.10	5.34	9.30	5.34	9.00	5.34	0	0	10.50	4.52	10.40	4.13
25	0	0	0	0	0	0	10.00	5.10	9.10	5.34	7.30	5.34	10.00	5.34	9.30	5.34	9.00	5.10	0	0	10.50	4.52	9.90	4.13
26	0	0	0	0	0	0	10.00	5.10	9.10	5.34	9.00	5.34	9.50	5.34	9.30	5.34	9.00	5.10	0	0	10.50	4.52	10.00	4.13
27	0	0	0	0	0	0	10.20	5.10	9.10	5.34	9.20	5.34	9.10	5.34	9.30	5.34	9.00	5.10	0	0	10.50	4.52	9.70	3.90
28	0	0	0	0	0	0	10.20	5.10	9.10	5.34	8.90	5.34	8.70	5.34	9.30	5.34	9.00	5.10	0	0	10.50	4.52	10.20	3.90
29	0	0			0	0	10.20	5.10	8.90	5.34	8.80	4.75	8.70	5.34	9.30	5.34	9.00	5.10	0	0	10.50	4.52	10.20	3.90
30	0	0			0	0	10.20	5.10	8.80	5.34	8.80	4.10	8.20	5.34	9.30	5.34	9.00	5.10	0	0	10.40	4.13	10.20	4.52
31	0	0			0	0			8.50	5.34			8.20	5.34	9.30	5.34			0	0			10.20	4.52

Table 3 Sheet 3 of 10
Year 2008
Guage Reading (Feet)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	10.10	4.52	0	0	9.40	4.26	9.30	3.35	8.70	4.68	8.70	5.34	10.20	5.34	8.50	5.34	9.00	5.34	8.50	5.34	10.00	4.52	9.60	3.82
2	10.00	4.52	0	0	9.40	4.26	9.90	3.35	8.70	4.68	8.50	5.34	9.00	5.34	9.50	5.34	8.80	5.34	8.50	5.34	9.50	4.52	10.00	3.82
3	10.00	4.52	0	0	9.30	4.52	10.00	3.35	8.70	4.68	8.50	5.34	8.40	5.34	10.50	5.34	9.30	4.74	8.50	5.34	9.20	4.52	10.00	3.82
4	10.00	4.52	0	0	9.30	4.52	10.00	3.35	8.80	4.18	8.50	5.34	8.40	5.34	10.00	5.34	9.10	5.34	8.50	5.34	9.20	4.52	10.30	3.82
5	10.00	4.52	0	0	9.30	4.52	10.00	3.35	8.80	4.18	8.40	5.34	8.70	5.34	9.70	5.34	9.00	5.34	8.50	5.34	9.20	4.52	10.10	3.82
6	10.00	4.52	0	0	9.30	4.52	0	0	8.90	3.87	8.40	5.34	8.40	5.34	8.60	5.34	9.40	5.34	8.40	5.34	9.20	4.52	10.10	3.82
7	10.00	4.52	0	0	9.30	4.52	0	0	8.70	4.90	8.40	5.34	8.70	5.34	8.30	5.34	9.50	5.34	8.50	5.34	9.50	4.52	10.10	3.82
8	10.00	4.52	0	0	9.30	4.52	0	0	8.60	4.83	8.40	5.34	8.40	5.34	7.50	5.34	9.30	5.34	8.40	5.34	9.50	4.52	9.90	3.82
9	9.60	3.90	0	0	9.30	4.52	0	0	8.50	4.83	8.80	4.62	8.30	5.34	7.30	5.34	9.30	5.34	8.40	5.34	9.50	4.52	9.70	3.82
10	9.60	3.90	0	0	9.30	4.52	0	0	8.60	4.83	12.00	4.62	8.30	5.34	7.40	5.34	9.30	5.34	8.40	5.34	9.50	4.52	9.60	3.82
11	9.10	3.90	0	0	9.30	4.52	0	0	8.60	4.83	9.40	5.10	8.30	5.34	8.50	5.34	9.40	5.34	8.40	5.34	9.50	4.52	9.60	3.82
12	0	0	8.80	2.53	9.30	4.52	0	0	8.60	4.83	9.50	5.34	8.30	5.34	8.50	5.34	9.50	5.34	8.40	5.34	9.50	4.52	9.90	3.82
13	0	0	8.50	2.53	9.40	4.52	0	0	8.60	4.83	8.50	5.34	8.50	5.34	8.80	5.34	9.50	5.34	8.40	5.34	9.50	4.52	9.90	3.82
14	0	0	8.90	2.53	9.40	4.52	0	0	8.60	4.83	8.50	5.34	8.30	5.34	9.00	5.34	9.20	5.34	8.40	5.34	9.50	4.52	9.90	3.82
15	0	0	8.90	2.53	9.20	4.52	0	0	8.60	4.83	8.50	5.34	8.30	5.34	9.20	5.34	9.10	5.34	8.40	5.34	9.50	4.52	9.90	3.82
16	0	0	9.00	2.53	9.40	4.52	0	0	8.70	4.35	8.50	5.34	8.30	5.34	9.20	5.34	9.50	5.34	8.50	5.34	9.50	4.52	9.90	3.82
17	0	0	9.00	2.53	9.40	4.52	0	0	8.80	4.35	8.40	5.34	8.50	5.34	9.10	5.34	9.20	5.34	8.40	5.34	9.50	4.52	9.90	3.82
18	0	0	9.00	2.53	9.30	4.52	0	0	8.80	4.35	8.40	5.34	8.40	5.34	9.40	5.34	8.40	5.34	8.40	5.34	9.30	4.52	10.00	3.82
19	0	0	9.00	2.53	9.40	4.52	0	0	8.80	4.35	8.40	5.34	8.40	5.34	9.30	5.34	8.50	5.34	8.40	5.34	9.40	4.52	10.00	3.82
20	0	0	8.80	3.62	9.30	4.52	9.50	4.78	8.80	4.35	8.80	4.62	8.50	5.34	9.30	5.34	8.50	5.34	7.00	5.34	9.40	4.52	10.00	3.82
21	0	0	8.60	3.62	9.80	4.52	9.50	4.78	8.90	4.35	8.60	5.00	8.30	5.34	9.50	5.34	8.50	5.34	0	0	9.40	4.52	10.00	3.82
22	0	0	8.60	3.62	9.30	4.52	9.10	4.78	8.60	5.34	8.50	5.34	8.20	5.34	9.50	5.34	8.40	5.34	0	0	9.40	4.52	9.80	3.82
23	0	0	8.90	3.62	9.30	4.52	9.00	4.78	8.50	5.34	8.40	5.34	8.20	5.34	9.70	5.34	8.40	5.34	0	0	9.40	4.52	9.40	3.82
24	0	0	8.90	3.62	9.30	4.52	10.00	4.78	8.50	5.34	8.40	5.34	8.20	5.34	9.80	5.34	8.90	4.50	0	0	9.40	4.52	9.50	3.82
25	0	0	8.90	3.62	9.20	4.52	8.90	4.78	8.50	4.50	8.30	5.34	8.20	5.34	9.80	5.34	8.60	5.34	0	0	9.40	4.52	7.90	3.82
26	0	0	8.90	3.62	8.60	4.52	9.00	4.68	9.40	4.50	8.40	5.34	8.20	5.34	10.00	5.34	8.50	5.34	7.70	2.20	9.30	4.52	8.20	3.82
27	0	0	8.90	3.62	9.20	4.52	9.20	4.68	8.50	5.34	8.50	5.34	8.40	5.34	9.00	5.34	8.50	5.34	8.10	3.82	9.30	4.52	8.50	3.82
28	0	0	9.30	4.52	9.30	4.52	8.80	4.68	8.50	5.34	8.40	5.34	8.40	5.34	9.00	5.34	8.50	5.34	8.80	3.82	9.30	4.52	8.30	3.82
29	0	0	9.40	4.26	9.30	4.52	8.80	4.43	8.50	5.34	8.80	5.34	8.40	5.34	9.00	5.34	8.50	5.34	10.00	3.82	9.30	4.52	8.30	3.82
30	0	0			9.30	4.52	8.80	4.43	8.50	5.34	9.50	5.34	8.40	5.34	9.00	5.34	8.50	5.34	10.00	3.82	9.30	4.52	8.20	3.82
31	0	0			9.30	4.52			8.50	5.34			8.30	5.34	8.70	5.34			10.00	4.52			8.20	3.82

Table 3 Sheet 4 of 10

Year 2009

Guage Reading (Feet)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	8.20	3.82	0	0	9.50	3.84	0	0	9.50	5.03	9.50	5.34	9.00	5.18	8.70	5.34	9.50	5.34	9.70	4.93	9.60	3.90	8.70	3.90
2	8.10	3.82	0	0	9.80	3.84	8.10	3.82	9.50	5.03	9.50	5.34	9.00	5.18	8.80	5.34	9.50	5.34	9.50	4.93	9.90	3.90	8.00	3.90
3	8.20	3.82	0	0	9.80	3.84	7.90	3.82	9.50	5.03	9.50	5.34	8.80	5.05	9.30	5.34	9.50	5.34	9.50	5.34	9.70	3.90	9.30	3.90
4	8.30	3.82	0	0	9.80	3.84	8.40	3.82	9.50	5.03	9.50	5.34	9.10	4.94	8.90	5.34	9.70	5.34	9.50	5.34	9.50	3.90	9.50	3.90
5	8.20	3.82	0	0	9.80	3.84	8.40	3.82	9.50	5.03	9.50	5.34	9.00	5.34	9.10	5.34	11.50	5.34	9.50	5.34	9.50	4.28	9.60	3.90
6	8.20	3.82	0	0	9.70	3.83	8.40	3.82	9.50	5.03	9.50	5.34	8.90	5.34	9.10	5.34	9.70	5.34	9.50	5.34	9.50	4.28	9.50	3.90
7	8.20	3.82	0	0	9.80	3.83	8.40	3.82	9.50	5.03	9.50	5.34	7.70	4.94	8.90	5.34	9.00	5.34	9.50	5.34	9.50	4.28	9.50	3.90
8	8.20	3.82	0	0	9.80	3.83	8.30	3.82	9.70	5.03	9.50	5.34	9.10	4.94	9.70	5.34	10.20	5.34	9.00	5.34	9.50	4.28	9.50	3.90
9	8.20	3.82	0	0	9.80	3.83	8.30	3.82	9.70	5.03	9.50	5.34	8.00	4.94	9.20	5.34	10.10	4.62	9.00	5.34	9.50	4.28	9.50	3.90
10	8.20	3.82	0	0	9.80	3.83	8.40	3.82	9.70	5.03	9.50	5.34	7.90	4.94	9.10	5.34	10.20	5.34	9.00	5.34	9.50	4.28	9.50	3.90
11	9.10	3.82	8.80	2.53	9.80	3.83	0	0	9.70	5.03	9.50	5.21	7.90	4.94	9.40	5.34	10.50	5.34	9.00	5.34	9.50	4.28	9.50	3.90
12	5.40	2.00	8.80	4.01	9.80	3.83	0	0	9.80	5.03	9.50	5.21	7.90	5.34	9.80	5.11	10.30	5.34	9.00	5.34	9.50	4.28	9.60	3.90
13	0	0	8.70	4.01	9.80	3.83	0	0	9.70	5.14	9.50	5.21	7.90	5.34	9.50	5.34	9.50	5.34	9.00	5.34	9.50	4.28	9.50	3.90
14	0	0	8.40	4.01	9.80	3.83	0	0	9.70	5.14	9.50	5.21	8.50	5.34	9.50	5.34	9.50	5.34	9.00	5.34	9.50	4.28	9.50	3.90
15	0	0	8.40	4.01	9.80	3.83	0	0	9.70	5.14	9.50	5.21	8.30	5.34	9.50	5.34	9.90	4.93	8.40	5.34	9.40	3.90	9.50	4.28
16	0	0	8.30	4.01	9.80	3.83	0	0	9.50	5.14	9.50	5.21	8.50	5.34	9.50	5.34	9.90	4.93	8.50	2.72	9.40	3.90	9.40	4.28
17	0	0	8.30	4.01	9.80	3.83	0	0	9.50	5.14	9.50	5.21	8.30	5.34	10.40	5.34	9.50	4.93	9.20	2.72	9.40	3.90	9.40	4.02
18	0	0	8.20	4.01	10.00	3.83	0	0	9.50	5.14	9.50	5.21	8.30	5.34	9.70	5.34	9.50	4.93	9.90	2.72	9.40	3.90	9.40	4.02
19	0	0	8.30	4.01	0	0	0	0	9.50	5.14	9.50	5.21	10.80	5.34	9.90	4.62	9.50	4.93	10.00	2.72	9.30	3.90	9.40	4.02
20	0	0	8.30	4.01	0	0	0	0	9.50	5.14	9.50	5.21	9.00	5.34	9.10	5.34	9.50	4.93	10.00	2.72	9.30	3.90	9.40	4.02
21	0	0	8.30	4.01	0	0	9.50	4.02	9.50	5.34	9.50	5.21	8.90	5.34	8.40	5.34	9.50	4.93	10.00	2.72	9.30	3.90	9.40	4.02
22	0	0	8.30	4.01	0	0	9.50	4.02	9.50	5.34	9.50	5.21	10.70	5.34	8.40	5.34	9.50	4.93	10.00	2.72	9.30	3.90	9.40	4.02
23	0	0	8.30	4.01	0	0	9.50	4.53	9.50	5.34	9.50	5.21	10.30	5.34	9.00	5.34	9.50	4.93	10.00	2.72	9.30	3.90	9.50	4.02
24	0	0	8.80	4.01	0	0	9.50	4.53	9.50	5.34	9.30	5.21	9.00	5.34	8.90	5.34	9.50	4.93	10.00	2.72	9.30	3.90	8.00	4.02
25	0	0	8.90	4.01	0	0	9.50	4.78	9.50	5.34	9.00	5.18	9.40	5.34	8.90	5.34	9.50	4.93	10.00	2.72	9.30	3.90	8.00	3.62
26	0	0	9.00	3.84	0	0	9.50	4.78	9.50	5.34	9.00	5.18	8.80	5.34	9.10	5.34	9.50	4.93	10.00	2.72	9.30	3.90	8.00	3.62
27	0	0	9.20	3.84	0	0	9.50	4.78	9.50	5.34	9.00	5.18	9.50	5.34	9.30	5.34	9.50	4.93	10.00	2.72	9.30	3.90	8.00	3.62
28	0	0	9.50	3.84	0	0	9.50	4.78	9.50	5.34	9.00	5.18	8.10	5.34	9.10	5.34	9.50	4.93	10.00	2.72	8.70	3.90	8.30	3.62
29	0	0			0	0	9.50	5.03	9.50	5.34	9.30	5.18	11.00	5.34	9.10	5.34	9.50	4.93	10.00	2.72	8.70	3.90	8.30	3.62
30	0	0			0	0	9.50	5.03	9.40	5.34	9.80	5.18	9.10	5.34	9.30	5.34	10.30	4.93	11.00	2.72	8.70	3.90	8.30	3.62
31	0	0			0	0			9.50	5.34			9.90	5.34	9.50	5.34			10.90	2.72			8.30	3.62

Year 2010
Guage Reading (Feet)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	8.10	3.62	0.00	0.00	0.0	0.0	9.30	3.90	8.60	4.05	9.50	5.16	9.50	5.34	10.30	5.30	9.50	5.20	10.00	5.20	10.40	3.62	10.00	4.14
2	8.10	3.62	0.00	0.00	10.20	3.62	10.30	3.90	8.60	4.05	9.50	5.16	9.20	5.34	10.30	5.30	9.50	5.20	10.00	5.20	10.00	4.52	10.00	4.14
3	8.20	3.62	7.30	1.80	8.10	3.62	11.00	3.90	8.50	4.05	9.50	5.16	9.20	5.34	10.80	5.30	9.50	5.08	9.90	5.20	10.30	4.52	10.00	4.14
4	8.10	3.62	7.60	1.45	10.00	3.62	11.00	3.90	8.50	4.05	9.50	5.16	9.20	5.34	10.10	5.30	9.50	5.20	10.00	5.20	10.00	4.52	10.00	4.14
5	8.10	3.62	7.60	1.80	10.00	3.90	11.00	3.90	8.50	4.05	9.50	5.16	9.30	5.34	9.90	5.30	9.50	5.20	10.00	5.08	10.00	4.52	9.50	4.32
6	8.10	3.62	7.60	1.80	10.00	3.90	11.00	3.90	8.40	4.89	9.50	5.16	9.40	5.34	9.60	5.30	10.50	5.20	10.00	5.08	10.00	4.52	9.00	4.32
7	8.10	3.62	7.70	1.80	10.00	3.90	11.00	3.90	8.00	4.89	9.50	5.16	10.00	5.34	10.00	4.02	9.70	5.20	10.00	5.08	10.00	4.52	8.90	4.32
8	8.10	3.62	7.80	2.00	10.00	3.90	11.30	3.90	7.80	4.89	9.50	5.16	10.60	5.34	9.80	4.02	9.70	5.20	10.00	5.08	10.00	4.52	8.90	4.32
9	8.10	3.62	8.20	2.00	10.00	3.90	11.20	3.90	8.00	4.89	9.50	5.16	9.30	5.34	9.70	4.02	9.50	5.20	10.10	5.08	10.30	4.52	8.90	4.32
10	8.10	3.62	9.30	2.00	10.00	3.90	11.20	3.90	8.10	4.89	10.00	5.16	9.50	5.34	9.10	4.53	9.50	5.20	10.00	5.08	10.00	4.52	9.30	4.32
11	0	0	10.52	2.00	10.00	3.90	11.10	3.90	8.20	4.89	10.00	5.16	11.10	5.34	10.50	4.93	9.10	5.20	10.00	5.08	10.00	4.52	8.70	4.32
12	0	0	9.70	3.62	10.00	3.90	11.10	3.90	8.40	4.89	9.90	4.44	9.00	5.34	9.80	4.93	9.50	5.20	10.00	5.08	10.00	4.52	9.50	4.32
13	0	0	9.50	3.62	10.00	3.90	11.00	3.90	9.50	4.89	9.90	4.44	10.10	5.34	9.50	4.93	9.50	5.20	10.00	5.08	10.00	4.52	9.10	4.32
14	0	0	10.00	3.62	9.50	3.90	11.20	3.90	9.50	4.89	9.90	4.44	8.40	5.34	9.50	4.93	9.50	5.20	10.00	5.08	10.00	4.52	9.30	4.32
15	0	0	10.00	3.62	9.50	3.90	11.00	3.90	9.50	4.89	10.00	4.82	8.40	5.34	9.00	4.93	10.00	5.20	10.00	5.08	10.00	4.52	9.40	4.32
16	0	0	10.00	3.62	9.50	3.90	0	0	9.50	4.53	10.00	4.82	8.50	5.34	9.50	4.93	9.80	5.20	10.00	5.20	9.90	4.52	9.40	4.32
17	0	0	10.00	3.62	9.90	3.90	0	0	9.50	4.53	9.50	4.82	9.00	5.34	9.00	4.93	9.80	5.20	10.00	5.20	9.90	4.52	9.40	4.32
18	0	0	10.00	3.62	9.90	3.90	0	0	9.50	4.53	9.50	4.67	9.40	4.62	11.00	4.93	11.40	5.20	10.00	5.20	9.90	4.52	9.40	4.32
19	0	0	10.00	3.62	9.90	3.90	0	0	9.50	4.53	9.50	4.67	11.50	5.34	10.80	5.07	10.20	5.20	10.10	5.20	9.90	4.52	9.40	4.32
20	0	0	10.00	3.62	10.50	3.90	0	0	9.50	4.53	9.50	4.67	9.30	5.34	10.00	5.07	9.70	5.20	10.20	5.20	10.00	4.52	9.50	4.32
21	0	0	10.00	3.62	10.60	3.90	0	0	9.50	4.53	9.50	4.67	9.80	5.34	9.50	5.07	9.60	5.20	10.00	5.20	10.00	4.52	9.50	4.32
22	0	0	10.00	3.62	10.60	3.90	0	0	9.50	4.53	9.50	4.67	9.30	5.34	10.00	5.07	10.00	5.20	10.00	5.20	10.00	4.52	9.50	4.32
23	0	0	10.00	3.06	10.60	3.90	0	0	9.50	4.53	9.50	5.34	9.10	4.62	9.80	5.07	11.00	5.20	10.30	5.20	10.00	4.41	9.50	4.32
24	0	0	10.00	3.06	10.60	3.90	0	0	9.50	4.53	9.50	5.34	10.50	5.00	11.00	5.07	10.30	5.20	10.50	5.20	10.00	4.41	9.50	4.32
25	0	0	9.50	3.06	10.60	3.90	0	0	9.50	4.53	9.50	5.34	10.00	5.16	9.00	4.78	10.00	5.20	10.10	5.20	10.50	4.14	8.00	4.32
26	0	0	0	0	10.60	3.90	0	0	9.50	4.74	9.50	5.34	9.30	5.16	9.30	4.78	10.40	5.20	10.40	3.62	10.50	4.14	9.50	4.32
27	0	0	0	0	10.60	3.90	0	0	9.50	4.74	9.50	5.34	9.60	5.16	9.40	4.78	10.40	5.20	10.00	3.62	10.50	4.14	9.50	4.32
28	0	0	0	0	10.80	3.90	0	0	9.50	4.74	10.90	5.34	9.70	5.16	9.70	4.78	10.20	5.20	10.30	3.62	10.00	4.14	9.50	4.32
29	0	0			10.90	3.90	8.40	3.90	9.50	5.16	9.50	5.34	9.80	5.30	9.80	4.78	10.00	5.20	10.40	3.62	10.00	4.14	9.50	4.32
30	0	0			10.70	3.90	8.20	4.05	9.50	5.16	9.20	5.34	8.40	5.30	9.70	4.78	10.00	5.20	10.40	3.62	10.00	4.14	9.50	4.32
31	0	0			10.30	3.90			9.50	5.16			9.00	5.30	9.50	5.20			10.40	3.62			9.50	4.32

Table 3 Sheet 6 of 10
Year 2011
Guage Reading (Feet)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	9.40	4.28	0	0	9.50	2.50	10.00	4.47	10.00	5.13	10.00	5.28	10.00	5.19	6.50	5.20	7.30	4.97	7.90	4.85	8.00	4.47	9.30	4.18
2	9.40	4.28	0	0	9.50	2.15	10.00	4.47	10.00	5.13	10.00	5.28	11.00	5.19	7.00	5.20	7.70	4.48	7.90	4.85	8.00	4.47	9.30	4.18
3	9.30	4.28	0	0	9.50	2.15	10.00	4.29	10.00	5.13	10.00	5.28	10.50	5.19	7.10	5.28	7.80	4.48	8.00	4.85	8.00	4.47	9.30	4.18
4	9.30	4.28	0	0	9.70	2.15	10.00	4.29	10.00	5.13	10.00	5.28	9.80	5.19	7.10	5.28	7.80	4.48	7.90	4.85	8.00	4.47	9.30	4.18
5	9.40	4.28	0	0	10.00	2.15	10.00	4.29	10.00	5.13	10.00	5.28	9.20	5.19	7.10	5.28	7.70	4.48	7.80	4.85	8.00	4.47	9.30	4.18
6	9.30	4.28	0	0	10.00	2.15	10.00	4.29	10.00	5.13	10.00	5.28	9.00	5.19	7.10	5.28	8.00	4.73	7.80	4.85	8.00	4.47	9.30	4.18
7	9.20	4.28	0	0	10.00	2.15	10.00	3.38	10.00	5.13	9.80	5.28	9.00	5.19	7.10	5.28	7.80	4.97	7.70	4.85	8.00	4.47	9.30	4.18
8	9.20	4.28	7.20	1.90	10.00	2.15	10.00	3.38	10.00	5.13	9.00	5.28	10.50	5.05	6.50	5.28	8.50	4.97	7.70	5.08	8.00	4.47	9.30	4.18
9	9.20	4.28	10.00	2.86	10.00	3.28	10.00	3.38	10.00	5.13	9.20	5.28	10.00	5.05	7.50	5.28	8.70	4.97	7.70	5.08	7.50	4.47	9.30	4.18
10	9.20	4.28	9.10	2.86	10.00	3.28	10.00	3.38	10.00	5.18	9.30	5.28	10.60	5.05	7.60	5.28	10.00	4.97	7.70	5.08	8.00	4.47	9.30	4.18
11	9.20	4.28	9.10	4.23	10.00	4.23	10.00	3.38	10.30	5.18	0.00	0.00	9.50	5.05	7.00	5.28	8.70	4.97	7.70	5.08	8.00	4.47	9.30	4.18
12	0	0	9.30	4.23	10.00	4.23	10.00	3.34	10.00	5.18	9.00	5.28	9.00	5.05	7.00	5.28	7.80	4.97	7.60	5.08	8.00	4.47	9.30	4.18
13	0	0	9.70	4.23	10.00	4.23	10.00	3.34	10.00	5.18	9.00	5.28	9.00	5.28	9.50	5.28	7.60	4.97	7.60	5.08	8.50	4.47	9.30	4.18
14	0	0	9.50	4.23	10.00	4.23	10.00	3.34	10.30	5.18	9.00	5.18	9.00	5.28	7.50	5.28	7.60	4.97	7.60	5.08	9.00	4.47	9.30	4.18
15	8.90	4.12	9.70	3.70	10.00	4.23	10.00	4.90	10.00	5.18	9.00	5.18	11.00	4.82	9.80	5.28	7.50	4.97	7.70	5.08	9.10	4.47	9.30	4.18
16	9.20	4.12	9.70	3.70	10.00	4.23	10.00	4.90	10.00	5.18	9.40	5.18	9.40	5.06	7.10	5.28	7.60	4.97	7.60	3.59	9.20	4.47	9.30	4.18
17	9.00	4.12	9.70	3.70	10.00	4.23	10.00	4.90	10.00	5.18	9.50	5.18	9.00	5.06	7.10	5.28	9.60	4.97	7.50	3.59	9.40	4.47	9.30	4.18
18	8.30	4.12	10.00	3.70	10.00	4.47	10.00	4.90	10.00	5.18	9.20	5.28	9.00	5.06	7.10	5.28	8.40	4.97	7.70	3.59	9.50	4.47	9.30	4.18
19	0	0	10.00	3.70	10.00	4.47	10.00	4.90	10.00	5.18	9.20	5.28	9.00	5.06	8.80	5.28	8.00	4.97	7.60	3.59	9.50	4.47	9.30	4.18
20	0	0	10.00	3.70	10.50	4.47	10.00	4.90	10.00	5.28	9.20	5.28	8.80	5.24	8.00	5.28	7.50	4.97	7.50	3.59	9.40	4.47	9.30	4.18
21	0	0	10.00	3.70	10.50	4.47	10.00	4.90	10.00	5.28	9.00	5.28	8.70	5.24	7.90	5.28	7.50	4.97	7.70	3.59	9.40	4.47	9.30	4.18
22	0	0	10.30	3.70	10.50	4.47	10.00	4.90	10.00	5.28	9.00	5.28	8.80	5.24	7.50	5.28	7.60	4.85	8.00	3.59	9.40	4.47	9.30	4.18
23	0	0	10.50	3.28	10.50	4.47	10.00	4.90	10.00	5.28	9.00	5.28	10.60	5.24	7.60	5.28	7.80	4.85	8.50	3.59	9.30	4.09	9.30	4.18
24	0	0	10.70	2.98	10.50	4.47	10.00	4.90	10.00	5.28	9.00	5.28	10.30	5.28	7.50	5.28	7.70	4.85	8.60	3.59	9.30	4.09	9.30	4.18
25	0	0	10.20	2.98	10.00	4.47	10.00	4.90	10.00	5.28	9.00	5.28	11.30	5.28	7.50	5.28	7.70	4.85	8.60	3.59	9.30	4.09	9.30	4.18
26	0	0	10.00	2.98	10.00	4.47	10.00	5.02	10.00	5.28	9.30	5.28	0	0	9.20	4.57	7.80	4.85	8.60	3.59	9.30	3.97	9.30	4.18
27	0	0	9.30	2.50	10.70	4.47	10.00	5.02	10.00	5.28	9.40	5.28	4.40	3.70	7.80	5.20	7.70	4.85	8.30	3.59	9.30	3.97	9.30	4.18
28	0	0	9.40	2.50	10.00	4.47	10.00	5.02	10.00	5.28	10.10	5.28	4.20	3.20	7.70	5.20	7.70	4.85	8.80	3.59	9.30	3.97	9.30	4.18
29	0	0			10.00	4.47	10.00	5.02	10.00	5.28	9.40	5.28	5.60	5.28	7.20	5.20	7.70	4.85	8.80	3.59	9.30	3.97	9.30	4.18
30	0	0			10.00	4.47	10.00	5.13	10.00	5.28	9.00	5.28	6.00	5.28	7.20	5.20	7.90	4.85	8.50	4.47	9.30	4.05	9.30	4.18
31	0	0			10.00	4.47			9.80	5.28			5.80	5.20	7.30	4.97			8.00	4.47			9.30	4.18

2012

Guage Reading (Feet)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	9.30	4.18	0	0	9.00	3.85	9.30	3.59	8.20	5.08	9.20	4.46	8.50	5.13	8.50	5.13	7.40	5.13	8.70	2.83	9.50	4.22	9.70	3.96
2	9.30	4.18	0	0	9.10	3.85	9.30	3.59	8.00	5.08	9.20	5.20	8.10	5.13	9.00	5.13	7.40	5.13	8.70	3.42	9.50	4.22	9.70	3.96
3	9.30	4.18	0	0	9.10	3.85	9.30	3.59	8.00	5.08	9.20	5.20	8.00	5.13	9.20	5.13	7.50	5.13	9.30	4.85	9.50	4.22	9.70	3.96
4	9.30	4.18	10.50	2.50	9.10	3.85	9.30	3.59	8.00	5.08	9.20	5.20	8.10	5.13	9.00	5.13	7.80	5.13	9.10	5.08	9.60	4.22	9.70	3.96
5	9.30	4.18	10.20	2.50	9.10	3.85	9.30	3.59	8.00	5.08	9.30	5.13	8.30	5.13	10.50	5.13	7.80	3.70	9.00	5.08	9.50	4.48	9.70	3.96
6	9.30	4.18	10.50	2.50	9.00	3.85	9.30	3.59	8.00	5.08	9.20	5.13	8.30	5.13	8.40	5.13	7.60	3.70	9.20	4.61	9.50	4.48	9.70	3.96
7	9.20	4.10	10.10	2.50	9.00	3.85	8.50	3.59	8.00	5.08	9.50	4.78	8.30	5.13	8.60	5.13	7.80	3.42	9.30	4.61	9.40	4.48	9.30	3.96
8	9.10	4.05	10.00	2.50	9.00	3.85	9.00	3.59	8.00	4.22	9.00	5.13	9.50	5.13	7.50	5.13	7.60	3.42	9.30	4.61	9.40	4.48	9.60	3.96
9	9.00	4.05	10.00	2.50	9.10	3.85	8.90	3.59	8.40	4.22	9.00	4.90	7.50	5.13	7.90	5.13	7.60	3.42	9.30	4.61	9.40	4.48	9.60	3.96
10	8.90	4.05	10.00	2.50	9.10	3.85	8.90	3.59	8.90	4.22	8.90	4.90	7.20	5.13	7.80	5.13	7.60	3.42	9.30	4.61	9.40	4.48	9.60	3.96
11	8.70	4.05	10.00	3.56	8.00	3.42	8.90	3.59	8.90	3.94	9.00	4.90	9.00	5.13	7.50	5.13	7.60	3.42	9.50	4.36	9.50	4.48	9.60	3.70
12	7.40	3.20	10.00	3.56	7.40	3.42	8.90	3.59	8.90	3.80	9.20	5.13	10.80	5.13	7.50	5.13	7.60	3.42	9.50	4.36	9.50	4.48	9.60	3.70
13	0	0	8.10	3.59	8.10	3.42	9.00	3.59	8.90	3.80	9.00	5.13	9.30	5.13	7.50	5.13	8.00	3.42	9.50	4.36	9.50	4.48	9.60	3.70
14	0	0	10.00	3.59	8.50	3.42	9.00	3.59	8.90	3.80	9.20	5.13	9.00	5.13	7.50	5.13	8.00	3.42	9.50	4.36	9.40	4.48	9.10	3.70
15	0	0	10.00	3.59	8.50	3.42	8.90	3.59	8.90	3.80	9.60	5.13	9.40	5.13	7.90	5.13	8.00	3.42	9.50	4.36	9.40	4.48	8.70	3.70
16	0	0	9.80	3.59	8.50	3.42	8.50	4.63	8.90	3.80	9.70	5.13	9.70	5.13	8.00	5.13	8.00	3.42	9.50	4.36	9.40	4.48	8.70	3.70
17	0	0	9.80	3.59	8.50	3.42	8.70	4.33	8.90	3.74	9.70	5.13	9.40	5.13	8.00	5.13	0	0	9.50	4.61	9.40	4.48	8.50	3.96
18	0	0	9.80	3.59	9.00	3.42	8.90	4.33	9.00	3.74	9.70	5.13	9.40	5.13	7.30	5.13	0	0	9.50	4.61	9.50	4.21	8.40	3.96
19	0	0	9.50	3.59	9.00	3.42	8.90	4.33	9.00	3.74	9.70	5.13	9.40	5.13	7.30	5.13	0	0	9.50	4.61	9.60	4.21	8.40	3.96
20	0	0	9.60	3.59	9.00	3.42	8.80	4.63	9.00	3.74	9.00	5.13	9.20	5.13	7.30	5.13	0	0	9.50	4.61	9.60	4.21	8.40	3.70
21	0	0	9.50	3.59	9.00	3.42	8.80	4.97	9.00	3.74	9.00	5.13	8.60	5.13	7.10	4.60	0	0	9.50	4.22	9.60	4.21	8.40	3.70
22	0	0	9.50	3.59	9.00	3.01	9.00	4.97	9.00	3.74	9.30	5.13	8.30	5.13	7.20	4.60	0	0	9.30	4.22	9.60	4.21	8.40	3.70
23	0	0	9.50	3.59	9.00	3.59	9.00	4.97	9.00	3.74	7.50	5.13	8.00	5.13	7.20	5.13	0	0	9.30	4.22	9.60	4.21	8.40	3.70
24	0	0	9.50	3.59	9.00	3.59	8.80	4.97	9.00	1.10	7.50	5.13	8.00	5.13	7.80	5.13	0	0	9.30	4.22	9.60	4.21	8.40	3.70
25	0	0	9.50	3.59	9.50	3.59	8.90	5.08	0	0	7.40	5.13	8.00	5.13	7.50	5.13	0	0	9.30	4.22	9.60	4.21	8.40	3.70
26	0	0	9.50	3.59	9.50	3.59	8.80	5.08	0	0	7.40	5.13	9.70	5.13	7.40	5.13	0	0	9.30	4.22	9.60	4.21	9.70	3.70
27	0	0	9.40	3.59	9.50	3.59	9.00	5.08	0	0	7.50	5.13	8.50	5.13	7.70	5.13	0	0	8.50	4.22	9.60	4.21	9.70	3.70
28	0	0	9.30	3.59	9.50	3.59	8.50	5.08	0	0	7.40	5.13	8.50	5.13	7.40	5.13	0	0	8.50	4.22	9.60	4.06	9.60	3.70
29	0	0	9.00	3.59	9.50	3.59	8.50	5.08	0	0	7.40	5.13	8.50	5.13	7.30	5.13	0	0	8.50	4.22	9.70	4.06	9.60	3.70
30	0	0			9.30	3.59	8.20	5.08	0	0	8.40	5.13	8.50	5.13	7.30	5.13	8.70	2.83	9.20	4.22	9.70	3.96	9.60	3.70
31	0	0			9.30	3.59			0	0			8.50	5.13	7.40	5.13			9.60	4.22			9.90	3.70

Table 3 Sheet 8 of 10
Year 2013
Guage Reading (Feet)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	9.60	3.70	0	0	0	0	9.50	3.59	8.00	4.84	9.20	4.48	8.70	4.48	10.70	5.20	10.30	5.28	10.00	5.15	10.00	4.47	10.50	3.83
2	9.40	3.70	0	0	0	0	8.00	3.59	8.00	4.84	9.20	4.48	8.40	4.97	10.70	5.20	10.30	5.28	9.80	5.15	10.00	4.47	10.50	3.83
3	9.40	3.70	0	0	0	0	7.80	3.59	8.00	4.71	9.00	4.97	9.90	4.97	10.30	4.85	10.50	5.28	9.90	5.15	10.00	4.47	10.50	3.83
4	9.40	3.70	0	0	8.60	2.50	7.80	3.59	8.00	4.71	9.00	4.97	9.70	4.97	11.00	5.08	10.00	5.28	10.00	5.15	10.00	4.47	10.50	3.83
5	9.30	3.70	0	0	8.50	3.70	8.00	3.59	8.00	4.71	9.00	4.97	9.70	4.97	11.00	5.08	10.30	5.28	10.00	5.15	10.00	4.47	10.50	3.83
6	9.30	3.70	0	0	8.70	3.70	8.00	3.59	8.10	4.71	9.00	4.97	9.00	4.97	10.70	5.20	10.50	5.28	10.00	5.15	10.00	4.47	10.50	3.83
7	9.30	3.70	0	0	8.50	3.70	8.00	3.59	8.10	4.71	9.00	4.97	8.60	4.97	10.50	5.20	10.50	5.28	10.00	5.15	10.00	4.47	10.50	3.83
8	9.30	3.70	0	0	8.50	3.70	8.00	3.59	8.20	4.68	9.00	5.08	9.10	4.97	11.00	5.20	10.50	5.28	10.00	5.15	10.00	3.96	10.50	3.83
9	9.30	3.70	0	0	8.30	3.96	8.00	3.59	8.20	4.68	9.00	5.08	9.10	4.97	10.60	5.20	10.50	5.28	10.00	5.15	10.00	3.70	10.50	3.83
10	9.40	3.70	0	0	8.30	3.96	8.00	3.59	8.10	4.68	9.00	5.08	10.10	4.97	10.70	5.20	10.50	5.28	10.00	5.15	10.00	3.70	10.50	4.05
11	9.40	3.70	0	0	8.30	3.96	8.10	3.59	8.10	4.68	9.00	5.08	10.00	4.48	10.50	5.20	10.50	5.28	10.00	5.15	10.00	3.42	10.50	4.05
12	6.50	2.00	0	0	8.30	3.96	8.10	3.59	8.10	4.68	9.00	5.08	9.80	4.48	10.50	5.20	10.50	5.28	10.00	5.15	10.00	3.42	10.40	4.05
13	0	0	0	0	8.30	3.96	8.10	3.59	8.00	4.68	9.00	4.79	9.80	4.48	10.50	5.20	10.50	5.28	10.00	5.15	10.00	3.83	10.40	4.05
14	0	0	8.60	1.98	9.00	3.96	8.10	3.59	8.10	4.68	9.00	4.79	9.50	4.48	10.50	4.85	10.50	5.28	10.00	5.15	10.00	3.83	10.40	4.05
15	0	0	8.60	1.98	9.70	3.96	8.10	3.59	8.10	4.68	9.00	4.91	9.70	4.48	10.90	4.48	10.50	5.28	10.00	5.02	10.00	3.83	10.40	4.05
16	0	0	8.60	1.58	9.70	3.96	8.20	4.87	8.20	4.41	8.50	4.91	9.80	5.28	10.50	4.48	10.50	5.28	10.00	4.47	10.00	3.83	10.40	4.05
17	0	0	0	0	9.80	3.96	8.20	4.87	8.20	4.41	8.50	4.91	10.00	5.28	10.60	4.48	10.50	5.28	10.00	4.47	10.00	3.83	10.40	4.05
18	0	0	0	0	9.80	3.96	8.20	4.87	8.20	4.41	8.20	4.91	10.00	5.28	10.60	4.48	10.70	5.20	10.00	4.47	10.00	3.83	10.40	4.05
19	0	0	0	0	9.10	3.96	8.20	4.87	8.20	4.41	8.20	4.91	10.50	5.08	11.00	4.48	10.70	5.20	10.00	4.47	10.00	3.83	10.30	4.05
20	0	0	0	0	9.00	3.96	8.20	4.87	8.20	4.41	9.00	4.91	10.70	5.08	10.70	4.48	11.00	5.20	10.00	4.47	10.30	3.83	10.40	4.05
21	0	0	0	0	9.00	3.96	8.20	4.87	8.60	4.97	9.00	4.91	10.80	5.08	11.00	4.48	10.70	5.20	10.00	4.47	10.50	3.83	10.50	4.05
22	0	0	0	0	9.00	3.59	8.20	4.87	8.60	4.97	9.00	4.91	10.50	5.08	11.00	4.48	10.60	5.20	10.00	3.75	10.50	3.83	10.50	4.05
23	0	0	0	0	9.50	3.59	8.00	4.87	8.60	4.97	9.00	4.91	11.00	5.08	11.00	4.48	10.50	5.20	10.40	3.68	10.50	3.83	10.50	4.05
24	0	0	0	0	9.50	3.59	8.00	4.87	9.00	4.97	9.00	4.91	11.00	5.08	11.00	4.48	10.40	5.20	10.40	3.68	10.50	3.83	10.50	4.05
25	0	0	0	0	9.50	3.59	8.00	4.87	9.00	4.97	9.00	5.08	11.00	4.85	11.00	4.48	10.50	4.97	10.40	3.68	10.50	3.83	10.50	4.05
26	0	0	0	0	9.50	3.59	8.00	4.87	9.00	4.97	9.00	5.20	10.30	5.20	11.00	4.48	10.50	4.97	10.00	3.68	10.50	3.83	8.00	4.05
27	0	0	0	0	9.50	3.59	8.10	4.53	9.20	4.97	9.00	5.20	10.70	5.20	11.00	4.97	10.20	4.97	10.00	3.68	10.50	3.83	8.00	4.05
28	0	0	0	0	9.50	3.59	8.10	4.53	9.00	4.97	8.50	5.20	10.70	5.20	10.00	5.28	10.00	5.15	10.00	3.68	10.50	3.83	8.00	4.05
29	0	0			9.50	3.59	8.10	4.53	9.00	4.97	7.90	5.20	10.70	5.20	10.60	5.28	10.00	5.15	10.00	3.68	10.50	3.83	8.00	4.05
30	0	0			9.50	3.59	8.00	4.84	9.00	4.97	8.90	5.20	10.80	5.20	10.60	5.28	10.00	5.15	10.00	3.68	10.50	3.83	8.00	4.05
31	0	0			9.50	3.59			9.20	4.48			10.70	5.20	8.50	5.28			10.00	3.68			8.00	4.05

Table 3 Sheet 9 of 10
Year 2014
Guage Reading (Feet)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	8.00	4.05	0	0	10.50	4.13	10.50	3.45	10.00	4.71	10.00	5.13	10.00	4.93	8.00	4.93	10.50	4.77	10.50	5.01	10.50	4.51	10.50	4.01
2	8.00	4.05	0	0	10.30	4.13	10.50	3.45	10.00	4.71	10.00	5.13	10.00	4.93	8.00	4.93	10.50	4.77	10.50	5.01	10.50	4.51	10.50	4.01
3	8.00	4.05	6.50	1.79	10.30	4.13	10.50	3.45	10.00	4.90	10.00	5.13	10.00	4.93	8.50	4.93	10.60	4.77	10.50	5.01	10.50	4.51	10.50	4.01
4	8.00	4.05	6.20	2.81	10.50	4.13	10.50	4.01	10.00	4.90	10.00	5.13	10.00	4.93	9.00	4.93	10.50	4.77	10.50	5.01	10.50	4.51	10.50	4.01
5	8.00	4.05	8.50	2.81	10.50	4.13	10.50	4.01	10.00	4.90	10.00	5.13	10.20	4.93	9.00	4.93	0	0	10.50	5.01	10.50	4.51	10.50	4.01
6	8.00	4.05	8.50	3.96	10.50	4.13	10.50	4.01	10.00	4.90	10.00	5.13	10.30	4.93	9.00	4.93	0	0	10.50	5.01	10.50	4.51	10.50	4.17
7	8.00	4.05	0	0	10.50	4.13	10.50	3.31	10.00	4.90	10.00	5.13	10.30	4.93	9.00	4.93	0	0	10.50	5.01	10.50	4.51	10.50	4.17
8	8.00	4.05	0	0	10.40	4.13	0	0	10.00	4.90	10.00	5.13	10.30	4.93	9.00	4.93	0	0	10.50	5.01	10.50	3.99	10.50	4.17
9	8.00	4.05	0	0	10.40	4.13	0	0	10.00	4.90	10.00	5.13	10.30	4.93	9.00	4.93	0	0	10.50	5.01	10.50	3.99	10.50	4.17
10	8.00	4.05	0	0	10.50	4.13	0	0	10.00	4.90	10.00	5.13	10.30	4.93	9.00	4.93	0	0	10.50	5.11	10.50	3.99	10.50	4.17
11	8.00	4.05	0	0	10.50	4.13	0	0	10.00	4.90	10.00	5.13	10.30	4.93	9.00	4.93	0	0	10.50	5.11	10.50	3.60	10.50	4.17
12	7.30	4.05	0	0	0	0	0	0	10.00	4.90	10.00	5.13	10.30	4.93	8.50	4.93	0	0	10.50	5.11	10.50	3.60	10.50	4.17
13	5.50	2.00	10.50	2.50	0	0	0	0	10.00	5.01	10.00	5.13	10.30	4.93	8.50	4.93	0	0	10.50	5.11	10.50	3.60	9.10	3.90
14	0	0	10.50	2.50	0	0	0	0	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	5.11	10.50	3.60	10.50	4.17
15	0	0	10.60	3.96	0	0	10.50	1.80	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	5.11	10.50	3.60	10.50	4.17
16	0	0	10.50	3.96	0	0	10.50	3.16	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	5.11	10.50	3.60	10.50	4.17
17	0	0	10.50	3.96	0	0	10.50	4.01	10.00	5.01	10.00	5.13	10.50	4.93	8.50	5.07	0	0	10.50	5.11	10.50	3.60	10.50	4.17
18	0	0	10.50	4.27	0	0	10.50	4.01	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	5.11	10.50	3.60	10.50	4.17
19	0	0	10.50	4.27	0	0	10.50	3.74	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	5.11	10.50	3.60	10.50	4.17
20	0	0	10.50	4.27	0	0	10.50	3.74	10.00	5.01	10.00	5.13	10.30	4.93	9.00	4.89	0	0	10.50	5.11	10.50	3.60	10.50	4.17
21	0	0	10.50	4.13	0	0	10.50	3.74	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.70	3.74	10.50	3.60	10.50	4.17
22	0	0	10.50	4.13	0	0	10.50	4.53	10.00	5.01	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	3.74	10.50	3.60	10.50	4.17
23	0	0	10.50	4.13	0	0	10.00	4.53	10.00	5.13	10.00	5.13	10.30	4.93	9.00	5.07	0	0	10.50	3.74	10.50	3.60	10.50	4.17
24	0	0	10.50	4.13	0	0	10.00	4.90	10.00	5.13	10.00	5.13	10.30	4.93	10.60	4.77	7.00	2.85	10.50	3.74	10.60	3.60	10.50	4.32
25	0	0	10.50	4.13	0	0	10.00	4.90	10.00	5.13	10.00	5.13	9.30	4.93	10.60	4.77	9.00	4.01	10.50	3.74	10.50	3.60	9.00	4.32
26	0	0	10.50	4.13	0	0	10.00	4.90	10.30	5.13	10.00	5.13	9.50	4.93	10.60	4.77	10.50	4.01	10.50	3.74	10.50	4.01	7.10	4.32
27	0	0	10.50	4.13	0	0	10.00	4.71	10.00	5.13	10.00	5.13	9.50	4.93	10.60	4.77	10.70	4.01	10.50	3.74	10.50	4.01	7.20	4.19
28	0	0	10.50	4.13	0	0	10.00	4.71	10.00	5.13	10.00	5.13	9.50	4.93	10.60	4.77	11.00	4.01	10.50	3.74	10.50	4.01	7.20	4.19
29	0	0			0	0	10.00	4.71	10.00	5.13	10.00	5.13	9.50	4.93	10.60	4.77	11.00	4.01	10.50	3.74	10.50	4.01	7.30	3.93
30	0	0			0	0	10.00	4.71	10.00	5.13	10.00	5.13	8.50	4.93	10.50	4.77	11.00	4.01	10.50	3.74	10.50	4.01	7.30	3.93
31	0	0			10.50	2.85			10.00	5.13			8.50	4.93	10.50	4.77			10.50	3.74			7.30	3.93

Year 2015

Daily Guage Reading (Feet)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage	Guage	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	7.30	3.93	0	0	0	0	0	0	10.00	4.06	9.90	5.18	8.80	5.13	8.40	5.25	8.90	5.23	10.30	5.01	9.50	4.01	10.00	3.74
2	7.30	3.93	0	0	0	0	0	0	10.00	4.06	9.90	5.18	8.80	5.13	8.50	5.25	9.50	5.23	10.00	5.13	9.30	4.01	10.40	3.74
3	7.30	3.93	0	0	0	0	0	0	10.00	4.06	9.90	5.18	8.80	5.13	8.50	5.25	9.10	5.34	10.40	5.25	9.00	4.17	10.40	3.74
4	7.40	3.93	0	0	0	0	0	0	10.00	4.06	9.90	5.18	8.60	5.25	8.70	5.25	8.30	5.34	10.40	5.25	9.00	4.17	10.30	3.74
5	7.40	3.93	0	0	0	0	0	0	10.00	4.65	10.00	5.18	8.50	5.34	8.50	5.25	9.60	5.34	10.40	5.25	10.00	3.88	10.40	3.39
6	7.40	3.93	0	0	0	0	0	0	9.90	4.65	9.90	5.18	8.50	5.34	8.10	5.25	9.00	5.10	10.70	5.25	10.00	3.88	10.30	3.74
7	7.40	3.93	0	0	0	0	0	0	9.90	5.01	9.90	5.18	8.50	5.34	8.40	5.25	9.40	5.10	10.00	5.18	10.00	3.88	10.70	3.74
8	7.30	3.93	0	0	0	0	0	0	10.00	5.01	10.00	5.18	8.50	5.34	8.30	5.25	9.40	5.25	10.30	5.18	9.80	3.88	10.30	3.74
9	7.30	3.93	0	0	0	0	0	0	10.00	5.01	10.00	5.18	8.60	5.34	8.10	5.08	9.30	5.25	10.00	5.18	9.80	3.88	10.40	3.74
10	7.30	3.93	10.50	1.80	0	0	0	0	10.00	5.01	9.90	5.18	8.50	5.34	8.50	5.08	9.40	5.25	10.00	5.18	9.80	3.88	10.40	3.74
11	7.30	3.93	10.50	1.80	0	0	0	0	10.00	5.01	9.50	5.18	10.00	4.97	8.50	5.08	10.00	5.25	9.30	5.18	9.80	3.88	10.30	3.74
12	5.30	1.60	10.50	1.80	0	0	0	0	10.00	5.01	9.80	5.25	10.00	4.97	9.50	4.85	10.20	5.25	9.00	5.18	10.00	3.88	10.30	3.74
13	0	0	10.50	2.35	0	0	10.30	2.85	10.00	5.01	9.80	5.25	10.00	4.97	10.20	4.85	10.20	5.25	8.70	5.18	9.90	3.88	10.40	3.74
14	0	0	10.50	2.35	0	0	10.30	2.85	10.00	5.01	9.80	5.25	9.80	5.25	10.00	4.85	10.20	5.25	8.70	5.18	10.00	3.88	10.30	3.74
15	0	0	10.50	2.35	0	0	10.30	2.85	10.00	5.01	9.80	5.25	9.80	5.25	10.00	4.85	10.20	5.25	8.30	5.18	10.00	3.88	10.50	3.45
16	0	0	10.50	2.35	0	0	10.20	2.85	10.00	5.01	9.90	5.01	9.70	5.25	10.00	4.85	10.20	5.25	8.50	3.62	10.00	3.88	10.50	3.45
17	0	0	10.50	2.35	0	0	10.20	4.27	10.00	5.01	9.90	5.01	9.80	5.25	10.00	4.85	9.70	5.25	9.90	3.62	10,00	3.88	10.30	3.88
18	0	0	10.50	3.31	0	0	10.00	4.27	10.00	5.01	9.90	5.01	9.30	4.78	10.20	5.01	9.50	5.25	9.90	3.62	10.00	3.88	10.30	3.88
19	0	0	10.50	3.31	0	0	10.00	4.27	10.00	5.01	9.80	5.25	9.80	4.78	10.30	5.01	9.50	5.25	10.00	3.62	10.00	3.88	10.30	3.88
20	0	0	10.30	3.31	0	0	10.00	4.06	10.00	5.01	9.80	5.13	9.50	4.78	10.50	5.01	9.40	5.25	10.00	3.62	10.00	3.88	10.30	3.88
21	0	0	0	0	0	0	10.00	4.06	10.00	5.01	9.80	5.13	9.00	4.78	10.50	5.25	9.20	5.25	9.90	3.62	10.00	3.88	10.30	3.88
22	0	0	0	0	0	0	10.00	4.06	10.00	5.01	9.80	5.13	9.50	4.78	10.50	5.25	9.90	5.13	9.30	3.62	10.00	3.88	10.30	3.88
23	0	0	0	0	0	0	10.00	4.06	10.00	5.01	9.80	5.13	9.50	5.25	10.50	5.25	0	0	9.30	3.62	10.20	3.88	10.30	3.88
24	0	0	0	0	0	0	10.00	4.06	10.00	5.18	9.80	5.13	8.60	5.25	10.50	5.25	0	0	9.30	3.62	10.00	3.88	10.30	3.88
25	0	0	0	0	0	0	10.00	4.06	9.90	5.18	9.80	5.13	8.60	5.25	10.50	5.34	0	0	9.30	3.62	10.00	3.88	10.30	3.88
26	0	0	0	0	0	0	10.00	4.06	9.90	5.18	9.30	5.13	8.60	5.25	10.40	5.34	0	0	9.20	3.62	10.00	3.88	6.50	3.88
27	0	0	0	0	0	0	10.00	4.06	9.90	5.18	9.00	5.25	8.50	5.25	10.50	5.34	0	0	9.20	3.62	10.00	3.88	6.70	3.88
28	0	0	0	0	0	0	10.00	4.06	9.90	5.18	9.60	4.53	8.50	5.25	10.50	5.34	0	0	9.50	3.62	10.00	3.88	7.00	4.04
29	0	0			0	0	10.00	4.06	9.90	5.18	9.30	4.53	8.30	5.25	10.50	5.34	10.50	3.46	9.50	3.62	10.00	3.74	7.00	4.04
30	0	0			0	0	10.00	4.06	10.00	5.18	8.60	5.13	8.40	5.25	10.50	5.34	10.50	3.46	10.00	3.62	10.00	3.74	7.00	4.09
31	0	0			0	0			9.80	5.18			8.40	5.25	9.80	5.34			9.70	3.62			7.00	4.17

Table 4 Sheet 1 of 10

Year 2006

Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

Date	January		February		March		April		May		June		July		August		September		October		November		December	
	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat Br	Guage UJC	Guage Gujrat Br
1	786.41	778.07	0	0	786.31	778.07	786.61	778.07	784.51	778.63	785.81	778.65	786.41	778.78	786.61	777.87	787.61	778.33	786.11	778.89	785.01	778.07	786.11	777.95
2	786.41	778.07	0	0	786.31	778.07	786.61	778.07	784.51	778.63	785.81	778.65	787.01	778.78	786.61	778.89	787.61	777.95	786.11	778.89	784.61	778.07	786.11	777.95
3	786.41	778.07	0	0	786.31	778.07	786.61	778.07	784.51	778.63	785.81	778.65	786.61	778.78	786.61	778.89	0	0	786.11	778.89	784.61	778.07	786.11	777.95
4	786.41	778.07	0	0	786.31	778.07	786.61	778.07	784.51	778.75	786.21	778.65	787.11	778.78	786.01	778.89	0	0	786.11	778.89	784.31	778.07	786.11	777.52
5	786.41	778.07	785.31	775.95	786.31	778.07	786.61	778.07	784.51	778.75	786.61	778.65	786.31	778.89	786.61	778.35	0	0	786.81	778.89	784.51	778.07	786.11	777.23
6	786.41	778.07	785.11	777.29	786.41	778.07	786.61	778.07	784.51	778.75	786.61	778.65	787.11	778.89	786.81	778.35	0	0	786.11	778.89	784.71	778.07	787.61	776.24
7	786.31	778.07	784.91	778.07	786.41	778.07	786.61	778.07	784.51	778.75	786.01	778.65	785.61	778.89	785.61	778.35	0	0	786.11	778.89	785.91	778.07	785.61	776.24
8	786.41	778.07	785.61	778.07	786.41	778.07	786.61	778.07	784.51	778.75	785.81	778.65	785.61	778.89	785.81	777.95	0	0	786.11	778.89	786.51	778.07	786.01	776.24
9	786.41	778.07	785.71	778.07	786.41	777.89	786.61	778.07	784.51	778.75	785.81	778.75	785.31	778.89	785.11	777.95	0	0	786.11	778.89	786.31	778.07	786.61	776.24
10	786.41	778.07	785.81	778.07	786.41	777.89	786.61	778.07	784.51	778.75	784.91	778.75	785.11	778.89	784.21	778.45	0	0	786.11	778.89	786.31	778.07	786.61	776.24
11	786.41	778.07	786.01	778.07	786.31	778.07	786.61	777.94	784.51	778.75	784.61	778.89	786.11	778.89	783.91	778.45	786.21	778.89	786.11	778.89	786.21	778.07	786.61	776.24
12	0	0	784.71	778.31	786.31	778.07	786.61	777.94	784.51	778.75	784.51	778.89	786.41	778.89	783.71	778.45	785.91	778.89	786.11	778.89	786.31	778.07	0	0
13	0	0	784.71	778.56	786.41	778.07	786.61	777.94	784.51	778.75	784.51	778.89	788.01	778.89	783.71	778.45	786.11	778.89	786.11	778.89	786.51	778.07	0	0
14	0	0	785.61	778.77	786.41	778.07	786.11	777.94	784.51	778.75	784.41	778.89	0	. 0	783.71	778.45	785.71	778.89	786.11	778.89	786.61	778.07	0	0
15	0	0	785.71	778.77	786.21	778.07	786.11	777.94	784.51	778.75	784.61	778.49	0	0	783.71	778.45	785.71	778.89	786.11	778.89	786.61	778.07	0	0
16	0	0	785.61	778.77	785.71	775.75	786.41	778.39	784.51	778.75	784.61	778.49	0	0	783.61	778.81	785.71	778.89	786.11	778.89	786.71	778.07	0	0
17	0	0	785.91	778.77	786.61	778.07	786.41	778.39	784.61	778.75	785.41	778.49	784.61	777.95	784.51	778.81	785.71	778.89	786.11	778.89	786.71	778.07	0	0
18	0	0	786.11	778.77	786.61	778.07	786.31	778.39	787.61	778.75	785.61	778.49	785.61	777.95	784.61	778.81	785.71	778.89	786.11	778.89	786.61	778.07	0	0
19	0	0	786.11	778.77	786.61	778.07	786.51	778.39	787.11	778.75	785.61	778.49	785.31	777.95	784.61	778.81	785.71	778.89	785.61	778.89	786.61	778.07	0	0
20	0	0	786.11	778.77	786.61	778.07	786.31	778.51	786.61	778.75	785.61	778.49	785.21	777.95	784.81	778.81	785.61	778.89	784.11	778.89	786.11	778.07	0	0
21	0	0	786.11	778.77	786.61	778.07	786.11	778.51	785.41	778.65	785.51	778.49	785.91	777.95	784.81	778.81	785.51	778.89	0	0	786.11	778.07	0	0
22	0	0	786.21	778.07	785.41	778.07	786.11	778.51	784.61	778.65	785.41	778.49	786.01	778.89	784.71	778.81	786.01	778.42	0	0	786.11	778.07	0	0
23	0	0	786.21	778.07	785.11	778.07	786.11	778.63	784.41	778.65	785.41	778.49	785.61	778.89	784.71	778.81	786.01	778.42	0	0	786.11	777.81	0	0
24	0	0	786.31	778.07	785.01	778.07	786.11	778.63	784.61	778.65	785.51	778.49	785.61	778.89	784.61	778.81	786.11	778.89	0	0	786.11	777.81	0	0
25	0	0	786.31	778.07	785.01	778.07	786.11	778.63	784.61	778.65	785.51	778.49	785.61	778.78	784.61	778.81	782.61	777.15	0	0	786.11	777.81	0	0
26	0	0	786.31	778.07	785.01	778.07	786.11	778.63	784.61	778.65	785.41	778.49	786.61	777.87	784.61	778.81	786.11	778.89	0	0	786.11	777.81	0	0
27	0	0	786.31	778.07	785.01	778.07	785.91	778.63	785.81	778.65	785.31	778.82	787.01	777.87	784.61	778.81	786.11	778.89	0	0	786.11	777.41	0	0
28	0	0	786.31	778.07	785.01	778.07	785.81	778.63	785.91	778.65	787.11	778.82	786.41	777.87	784.81	777.89	786.11	778.89	0	0	786.11	777.41	0	0
29	0	0			785.01	778.07	785.81	778.63	785.91	778.65	787.41	778.82	786.21	777.87	786.31	778.81	786.11	778.89	0	0	786.11	777.41	0	0
30	0	0			786.61	778.07	784.51	778.63	785.81	778.65	787.11	778.82	785.91	777.87	787.11	778.81	786.11	778.89	0	0	786.11	777.41	0	0
31	0	0			786.61	778.07			785.81	778.65			786.41	777.87	787.61	778.33			0	0			0	0

Table 4 Sheet 2 of 10
Year 2007
Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

Date	Jan UJC Level	Jan Gujrat Br	Feb UJC Level	Feb Gujrat Br Level	Mar UJC Level	Mar Gujrat Br	Apr UJC Level	Apr Gujrat Br Level	May UJC Level	May Gujrat Br Level	Jun UJC Level	Jun Gujrat Br Level	Jul UJC Level	Jul Gujrat Br Level	Aug UJC Level	Aug Gujrat Br Level	Sep UJC Level	Sep Gujrat Br Level	Oct UJC Level	Oct Gujrat Br Level	Nov Guage UJC	Nov Guage Gujrat Br	Dec Guage UJC	Dec Guage Gujrat Br
1	0	0	0	0	0	0	786.61	775.73	786.81	778.65	785.11	778.89	785.01	777.65	784.81	778.89	785.61	778.89	786.61	778.65	784.01	778.07	787.01	777.68
2	0	0	784.61	778.07	0	0	786.61	777.00	786.81	778.89	785.11	778.89	785.01	777.65	787.31	778.89	785.61	778.89	786.61	778.78	786.91	778.07	787.01	777.68
3	0	0	784.61	778.07	0	0	786.61	778.07	786.81	778.89	785.11	778.89	785.71	777.65	786.11	778.89	785.61	778.89	786.61	778.89	787.11	778.07	787.01	777.68
4	0	0	784.71	778.07	0	0	786.61	778.07	786.81	778.89	785.11	778.89	786.01	778.17	785.31	778.89	785.61	778.89	786.51	778.89	787.11	778.07	787.01	777.68
5	0	0	784.71	778.07	0	0	786.61	777.81	786.81	778.65	785.11	778.89	785.71	778.89	787.11	778.89	785.61	778.89	786.61	778.89	787.11	778.07	787.01	777.68
6	0	0	784.71	778.07	0	0	786.61	777.81	786.81	778.89	785.11	778.89	784.61	778.89	787.31	778.89	785.71	778.89	786.51	778.89	787.11	778.07	787.01	777.68
7	0	0	784.81	778.07	0	0	786.61	777.81	786.81	778.89	785.11	778.89	787.61	778.89	786.91	778.30	786.01	778.42	786.51	778.89	786.81	778.07	787.01	777.68
8	0	0	785.11	778.07	0	0	786.61	777.81	786.81	778.89	785.21	778.89	786.11	778.65	786.31	778.89	785.61	778.42	786.51	778.89	787.11	778.07	787.01	777.68
9	0	0	785.51	778.07	0	0	786.61	777.81	786.81	778.89	785.21	778.89	785.61	778.65	786.61	778.89	785.61	778.42	786.61	778.89	787.01	778.07	787.01	777.68
10	0	0	785.81	778.07	0	0	786.61	777.81	786.81	778.89	785.21	778.89	784.61	778.65	786.61	778.89	785.61	778.42	786.61	778.89	787.11	778.07	787.01	777.68
11	0	0	785.41	776.40	0	0	786.61	777.81	786.81	778.89	785.41	778.89	785.81	778.89	786.61	778.89	785.61	778.42	786.61	778.89	787.11	778.07	787.11	777.56
12	0	0	0	0	0	0	786.61	777.81	786.81	778.89	785.61	778.89	784.31	778.89	786.61	778.89	785.61	778.42	786.61	778.89	787.11	778.07	787.11	777.56
13	0	0	0	0	0	0	786.61	777.81	786.81	778.89	785.61	778.89	784.31	778.89	786.61	778.89	785.61	778.89	786.61	778.89	787.11	778.07	787.11	777.56
14	0	0	0	0	0	0	786.61	777.81	786.81	778.89	785.31	778.89	784.31	778.89	786.81	778.89	785.61	778.89	786.51	778.34	787.11	778.07	787.11	777.56
15	0	0	0	0	0	0	786.61	778.06	786.81	778.89	786.41	778.89	784.51	778.89	786.51	778.15	785.61	778.89	786.51	778.34	787.11	778.07	787.11	777.56
16	0	0	0	0	0	0	786.61	778.35	786.81	778.89	785.71	778.89	784.51	778.89	786.01	778.15	785.61	778.89	786.41	778.34	787.11	778.07	787.01	777.56
17	0	0	0	0	0	0	786.61	778.89	786.81	778.89	785.61	778.89	784.51	778.89	786.11	778.89	785.61	778.89	786.41	778.34	787.11	778.07	787.01	777.56
18	0	0	0	0	0	0	786.61	778.89	786.81	778.89	785.51	778.89	784.31	778.89	785.91	778.89	785.61	778.89	786.91	778.07	787.11	778.07	787.01	777.81
19	0	0	0	0	0	0	786.61	778.89	786.11	778.89	785.71	778.89	784.31	778.89	786.01	778.89	785.61	778.89	786.51	778.07	787.11	778.07	787.01	777.81
20	0	0	0	0	0	0	786.81	778.65	786.61	778.89	785.31	778.89	784.51	778.89	786.01	778.89	785.61	778.89	786.01	778.07	787.11	778.07	787.01	777.68
21	0	0	0	0	0	0	786.81	778.65	786.41	778.89	785.31	778.89	784.31	778.89	786.01	778.89	785.61	778.89	0	0	787.11	778.07	787.01	777.68
22	0	0	0	0	0	0	786.61	778.65	786.01	778.89	785.21	778.89	787.31	778.89	785.91	778.89	785.61	778.89	0	0	787.11	778.07	787.01	777.68
23	0	0	0	0	0	0	786.61	778.65	785.71	778.89	785.11	778.89	787.71	778.89	785.91	778.89	785.61	778.89	0	0	787.11	778.07	787.01	777.68
24	0	0	0	0	0	0	786.61	778.65	786.11	778.89	785.11	778.89	787.71	778.89	785.91	778.89	785.61	778.89	0	0	787.11	778.07	787.01	777.68
25	0	0	0	0	0	0	786.61	778.65	785.71	778.89	783.91	778.89	786.61	778.89	785.91	778.89	785.61	778.65	0	0	787.11	778.07	786.51	777.68
26	0	0	0	0	0	0	786.61	778.65	785.71	778.89	785.61	778.89	786.11	778.89	785.91	778.89	785.61	778.65	0	0	787.11	778.07	786.61	777.68
27	0	0	0	0	0	0	786.81	778.65	785.71	778.89	785.81	778.89	785.71	778.89	785.91	778.89	785.61	778.65	0	0	787.11	778.07	786.31	777.45
28	0	0	0	0	0	0	786.81	778.65	785.71	778.89	785.51	778.89	785.31	778.89	785.91	778.89	785.61	778.65	0	0	787.11	778.07	786.81	777.45
29	0	0			0	0	786.81	778.65	785.51	778.89	785.41	778.30	785.31	778.89	785.91	778.89	785.61	778.65	0	0	787.11	778.07	786.81	777.45
30	0	0			0	0	786.81	778.65	785.41	778.89	785.41	777.65	784.81	778.89	785.91	778.89	785.61	778.65	0	0	787.01	777.68	786.81	778.07
31	0	0			0	0			785.11	778.89			784.81	778.89	785.91	778.89			0	0			786.81	778.07

Table 4 Sheet 3 of 10

Year 2008

Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	787	778	0	0	786	778	785.91	776.90	785.31	778.23	785.31	778.89	786.81	778.89	785.11	778.89	785.61	778.89	785.11	778.89	786.61	778.07	786.21	777.37
2	787	778	0	0	786	778	786.51	776.90	785.31	778.23	785.11	778.89	785.61	778.89	786.11	778.89	785.41	778.89	785.11	778.89	786.11	778.07	786.61	777.37
3	787	778	0	0	786	778	786.61	776.90	785.31	778.23	785.11	778.89	785.01	778.89	787.11	778.89	785.91	778.29	785.11	778.89	785.81	778.07	786.61	777.37
4	787	778	0	0	786	778	786.61	776.90	785.41	777.73	785.11	778.89	785.01	778.89	786.61	778.89	785.71	778.89	785.11	778.89	785.81	778.07	786.91	777.37
5	787	778	0	0	786	778	786.61	776.90	785.41	777.73	785.01	778.89	785.31	778.89	786.31	778.89	785.61	778.89	785.11	778.89	785.81	778.07	786.71	777.37
6	787	778	0	0	786	778	0	0	785.51	777.42	785.01	778.89	785.01	778.89	785.21	778.89	786.01	778.89	785.01	778.89	785.81	778.07	786.71	777.37
7	787	778	0	0	786	778	0	0	785.31	778.45	785.01	778.89	785.31	778.89	784.91	778.89	786.11	778.89	785.11	778.89	786.11	778.07	786.71	777.37
8	787	778	0	0	786	778	0	0	785.21	778.38	785.01	778.89	785.01	778.89	784.11	778.89	785.91	778.89	785.01	778.89	786.11	778.07	786.51	777.37
9	786	777	0	0	786	778	0	0	785.11	778.38	785.41	778.17	784.91	778.89	783.91	778.89	785.91	778.89	785.01	778.89	786.11	778.07	786.31	777.37
10	786	777	0	0	786	778	0	0	785.21	778.38	788.61	778.17	784.91	778.89	784.01	778.89	785.91	779	785.01	778.89	786.11	778.07	786.21	777.37
11	786	777	0	0	786	778	0	0	785.21	778.38	786.01	778.65	784.91	778.89	785.11	778.89	786.01	778.89	785.01	778.89	786.11	778.07	786.21	777.37
12	0	0	785	776	786	778	0	0	785.21	778.38	786.11	778.89	784.91	778.89	785.11	778.89	786.11	778.89	785.01	778.89	786.11	778.07	786.51	777.37
13	0	0	785	776	786	778	0	0	785.21	778.38	785.11	778.89	785.11	778.89	785.41	778.89	786.11	778.89	785.01	778.89	786.11	778.07	786.51	777.37
14	0	0	786	776	786	778	0	0	785.21	778.38	785.11	778.89	784.91	778.89	785.61	778.89	785.81	778.89	785.01	778.89	786.11	778.07	786.51	777.37
15	0	0	786	776	786	778	0	0	785.21	778.38	785.11	778.89	784.91	778.89	785.81	778.89	785.71	778.89	785.01	778.89	786.11	778.07	786.51	777.37
16	0	0	786	776	786	778	0	0	785.31	777.90	785.11	778.89	784.91	778.89	785.81	778.89	786.11	778.89	785.11	778.89	786.11	778.07	786.51	777.37
17	0	0	786	776	786	778	0	0	785.41	777.90	785.01	778.89	785.11	778.89	785.71	778.89	785.81	778.89	785.01	778.89	786.11	778.07	786.51	777.37
18	0	0	786	776	786	778	0	0	785.41	777.90	785.01	778.89	785.01	778.89	786.01	778.89	785.01	778.89	785.01	778.89	785.91	778.07	786.61	777.37
19	0	0	786	776	786	778	0	0	785.41	777.90	785.01	778.89	785.01	778.89	785.91	778.89	785.11	778.89	785.01	778.89	786.01	778.07	786.61	777.37
20	0	0	785	777	786	778	786.11	778.33	785.41	777.90	785.41	778.17	785.11	778.89	785.91	778.89	785.11	778.89	783.61	778.89	786.01	778.07	786.61	777.37
21	0	0	785	777	786	778	786.11	778.33	785.51	777.90	785.21	778.55	784.91	778.89	786.11	778.89	785.11	778.89	0	0	786.01	778.07	786.61	777.37
22	0	0	785	777	786	778	785.71	778.33	785.21	778.89	785.11	778.89	784.81	778.89	786.11	778.89	785.01	778.89	0	0	786.01	778.07	786.41	777.37
23	0	0	786	777	786	778	785.61	778.33	785.11	778.89	785.01	778.89	784.81	778.89	786.31	778.89	785.01	778.89	0	0	786.01	778.07	786.01	777.37
24	0	0	786	777	786	778	786.61	778.33	785.11	778.89	785.01	778.89	784.81	778.89	786.41	778.89	785.51	778.05	0	0	786.01	778.07	786.11	777.37
25	0	0	786	777	786	778	785.51	778.33	785.11	778.05	784.91	778.89	784.81	778.89	786.41	778.89	785.21	778.89	0	0	786.01	778.07	784.51	777.37
26	0	0	786	777	785	778	785.61	778.23	786.01	778.05	785.01	778.89	784.81	778.89	786.61	778.89	785.11	778.89	784	776	785.91	778.07	784.81	777.37
27	0	0	786	777	786	778	785.81	778.23	785.11	778.89	785.11	778.89	785.01	778.89	785.61	778.89	785.11	778.89	785	777	785.91	778.07	785.11	777.37
28	0	0	786	778	786	778	785.41	778.23	785.11	778.89	785.01	778.89	785.01	778.89	785.61	778.89	785.11	778.89	785	777	785.91	778.07	784.91	777.37
29	0	0	786	778	786	778	785.41	777.98	785.11	778.89	785.41	778.89	785.01	778.89	785.61	778.89	785.11	778.89	787	777	785.91	778.07	784.91	777.37
30	0	0			786	778	785.41	777.98	785.11	778.89	786.11	778.89	785.01	778.89	785.61	778.89	785.11	778.89	787	777	785.91	778.07	784.81	777.37
31	0	0			786	778			785.11	778.89			784.91	778.89	785.31	778.89			787	778			784.81	777.37

Table 4 Sheet 4 of 10

Year 2009

Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	785	777	0	0	786	777	0	0	786.11	778.58	786.11	778.89	785.61	778.73	785.31	778.89	786.11	778.89	786.31	778.48	786.21	777.45	785.31	777.45
2	785	777	0	0	786	777	784.71	777.37	786.11	778.58	786.11	778.89	785.61	778.73	785.41	778.89	786.11	778.89	786.11	778.48	786.51	777.45	784.61	777.45
3	785	777	0	0	786	777	784.51	777.37	786.11	778.58	786.11	778.89	785.41	778.60	785.91	778.89	786.11	778.89	786.11	778.89	786.31	777.45	785.91	777.45
4	785	777	0	0	786	777	785.01	777.37	786.11	778.58	786.11	778.89	785.71	778.49	785.51	778.89	786.31	778.89	786.11	778.89	786.11	777.45	786.11	777.45
5	785	777	0	0	786	777	785.01	777.37	786.11	778.58	786.11	778.89	785.61	778.89	785.71	778.89	788.11	778.89	786.11	778.89	786.11	777.83	786.21	777.45
6	785	777	0	0	786	777	785.01	777.37	786.11	778.58	786.11	778.89	785.51	778.89	785.71	778.89	786.31	778.89	786.11	778.89	786.11	777.83	786.11	777.45
7	785	777	0	0	786	777	785.01	777.37	786.11	778.58	786.11	778.89	784.31	778.49	785.51	778.89	785.61	778.89	786.11	778.89	786.11	777.83	786.11	777.45
8	785	777	0	0	786	777	784.91	777.37	786.31	778.58	786.11	778.89	785.71	778.49	786.31	778.89	786.81	778.89	785.61	778.89	786.11	777.83	786.11	777.45
9	785	777	0	0	786	777	784.91	777.37	786.31	778.58	786.11	778.89	784.61	778.49	785.81	778.89	786.71	778.17	785.61	778.89	786.11	777.83	786.11	777.45
10	785	777	0	0	786	777	785.01	777.37	786.31	778.58	786.11	778.89	784.51	778.49	785.71	778.89	786.81	779	785.61	778.89	786.11	777.83	786.11	777.45
11	786	777	785.41	776.08	786	777	0	0	786.31	778.58	786.11	778.76	784.51	778.49	786.01	778.89	787.11	778.89	785.61	778.89	786.11	777.83	786.11	777.45
12	782	776	785.41	777.56	786	777	0	0	786.41	778.58	786.11	778.76	784.51	778.89	786.41	778.66	786.91	778.89	785.61	778.89	786.11	777.83	786.21	777.45
13	0	0	785.31	777.56	786	777	0	0	786.31	778.69	786.11	778.76	784.51	778.89	786.11	778.89	786.11	778.89	785.61	778.89	786.11	777.83	786.11	777.45
14	0	0	785.01	777.56	786	777	0	0	786.31	778.69	786.11	778.76	785.11	778.89	786.11	778.89	786.11	778.89	785.61	778.89	786.11	777.83	786.11	777.45
15	0	0	785.01	777.56	786	777	0	0	786.31	778.69	786.11	778.76	784.91	778.89	786.11	778.89	786.51	778.48	785.01	778.89	786.01	777.45	786.11	777.83
16	0	0	784.91	777.56	786	777	0	0	786.11	778.69	786.11	778.76	785.11	778.89	786.11	778.89	786.51	778.48	785.11	776.27	786.01	777.45	786.01	777.83
17	0	0	784.91	777.56	786	777	0	0	786.11	778.69	786.11	778.76	784.91	778.89	787.01	778.89	786.11	778.48	785.81	776.27	786.01	777.45	786.01	777.57
18	0	0	784.81	777.56	787	777	0	0	786.11	778.69	786.11	778.76	784.91	778.89	786.31	778.89	786.11	778.48	786.51	776.27	786.01	777.45	786.01	777.57
19	0	0	784.91	777.56	0	0	0	0	786.11	778.69	786.11	778.76	787.41	778.89	786.51	778.17	786.11	778.48	786.61	776.27	785.91	777.45	786.01	777.57
20	0	0	784.91	777.56	0	0	0	0	786.11	778.69	786.11	778.76	785.61	778.89	785.71	778.89	786.11	778.48	786.61	776.27	785.91	777.45	786.01	777.57
21	0	0	784.91	777.56	0	0	786.11	777.57	786.11	778.89	786.11	778.76	785.51	778.89	785.01	778.89	786.11	778.48	786.61	776.27	785.91	777.45	786.01	777.57
22	0	0	784.91	777.56	0	0	786.11	777.57	786.11	778.89	786.11	778.76	787.31	778.89	785.01	778.89	786.11	778.48	786.61	776.27	785.91	777.45	786.01	777.57
23	0	0	784.91	777.56	0	0	786.11	778.08	786.11	778.89	786.11	778.76	786.91	778.89	785.61	778.89	786.11	778.48	786.61	776.27	785.91	777.45	786.11	777.57
24	0	0	785.41	777.56	0	0	786.11	778.08	786.11	778.89	785.91	778.76	785.61	778.89	785.51	778.89	786.11	778.48	786.61	776.27	785.91	777.45	784.61	777.57
25	0	0	785.51	777.56	0	0	786.11	778.33	786.11	778.89	785.61	778.73	786.01	778.89	785.51	778.89	786.11	778.48	786.61	776.27	785.91	777.45	784.61	777.17
26	0	0	785.61	777.39	0	0	786.11	778.33	786.11	778.89	785.61	778.73	785.41	778.89	785.71	778.89	786.11	778.48	786.61	776.27	785.91	777.45	784.61	777.17
27	0	0	785.81	777.39	0	0	786.11	778.33	786.11	778.89	785.61	778.73	786.11	778.89	785.91	778.89	786.11	778.48	786.61	776.27	785.91	777.45	784.61	777.17
28	0	0	786.11	777.39	0	0	786.11	778.33	786.11	778.89	785.61	778.73	784.71	778.89	785.71	778.89	786.11	778.48	786.61	776.27	785.31	777.45	784.91	777.17
29	0	0			0	0	786.11	778.58	786.11	778.89	785.91	778.73	787.61	778.89	785.71	778.89	786.11	778.48	786.61	776.27	785.31	777.45	784.91	777.17
30	0	0			0	0	786.11	778.58	786.01	778.89	786.41	778.73	785.71	778.89	785.91	778.89	786.91	778.48	787.61	776.27	785.31	777.45	784.91	777.17
31	0	0			0	0			786.11	778.89			786.51	778.89	786.11	778.89			787.51	776.27			784.91	777.17

Table 4 Sheet 5 of 10

Year 2010

Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	785	777	0	0	0	0	785.91	777.45	785.21	777.60	786.11	778.71	786.11	778.89	786.91	778.85	786.11	778.75	786.61	778.75	787.01	777.17	786.61	777.69
2	785	777	0	0	787	777	786.91	777.45	785.21	777.60	786.11	778.71	785.81	778.89	786.91	778.85	786.11	778.75	786.61	778.75	786.61	778.07	786.61	777.69
3	785	777	783.91	775.35	785	777	787.61	777.45	785.11	777.60	786.11	778.71	785.81	778.89	787.41	778.85	786.11	778.63	786.51	778.75	786.91	778.07	786.61	777.69
4	785	777	784.21	775.00	787	777	787.61	777.45	785.11	777.60	786.11	778.71	785.81	778.89	786.71	778.85	786.11	778.75	786.61	778.75	786.61	778.07	786.61	777.69
5	785	777	784.21	775.35	787	777	787.61	777.45	785.11	777.60	786.11	778.71	785.91	778.89	786.51	778.85	786.11	778.75	786.61	778.63	786.61	778.07	786.11	777.87
6	785	777	784.21	775.35	787	777	787.61	777.45	785.01	778.44	786.11	778.71	786.01	778.89	786.21	778.85	787.11	778.75	786.61	778.63	786.61	778.07	785.61	777.87
7	785	777	784.31	775.35	787	777	787.61	777.45	784.61	778.44	786.11	778.71	786.61	778.89	786.61	777.57	786.31	778.75	786.61	778.63	786.61	778.07	785.51	777.87
8	785	777	784.41	775.55	787	777	787.91	777.45	784.41	778.44	786.11	778.71	787.21	778.89	786.41	777.57	786.31	778.75	786.61	778.63	786.61	778.07	785.51	777.87
9	785	777	784.81	775.55	787	777	787.81	777.45	784.61	778.44	786.11	778.71	785.91	778.89	786.31	777.57	786.11	778.75	786.71	778.63	786.91	778.07	785.51	777.87
10	785	777	785.91	775.55	787	777	787.81	777.45	784.71	778.44	786.61	778.71	786.11	778.89	785.71	778.08	786.11	779	786.61	778.63	786.61	778.07	785.91	777.87
11	0	0	787.13	775.55	787	777	787.71	777.45	784.81	778.44	786.61	778.71	787.71	778.89	787.11	778.48	785.71	778.75	786.61	778.63	786.61	778.07	785.31	777.87
12	0	0	786.31	777.17	787	777	787.71	777.45	785.01	778.44	786.51	777.99	785.61	778.89	786.41	778.48	786.11	778.75	786.61	778.63	786.61	778.07	786.11	777.87
13	0	0	786.11	777.17	787	777	787.61	777.45	786.11	778.44	786.51	777.99	786.71	778.89	786.11	778.48	786.11	778.75	786.61	778.63	786.61	778.07	785.71	777.87
14	0	0	786.61	777.17	786	777	787.81	777.45	786.11	778.44	786.51	777.99	785.01	778.89	786.11	778.48	786.11	778.75	786.61	778.63	786.61	778.07	785.91	777.87
15	0	0	786.61	777.17	786	777	787.61	777.45	786.11	778.44	786.61	778.37	785.01	778.89	785.61	778.48	786.61	778.75	786.61	778.63	786.61	778.07	786.01	777.87
16	0	0	786.61	777.17	786	777	0	0	786.11	778.08	786.61	778.37	785.11	778.89	786.11	778.48	786.41	778.75	786.61	778.75	786.51	778.07	786.01	777.87
17	0	0	786.61	777.17	787	777	0	0	786.11	778.08	786.11	778.37	785.61	778.89	785.61	778.48	786.41	778.75	786.61	778.75	786.51	778.07	786.01	777.87
18	0	0	786.61	777.17	787	777	0	0	786.11	778.08	786.11	778.22	786.01	778.17	787.61	778.48	788.01	778.75	786.61	778.75	786.51	778.07	786.01	777.87
19	0	0	786.61	777.17	787	777	0	0	786.11	778.08	786.11	778.22	788.11	778.89	787.41	778.62	786.81	778.75	786.71	778.75	786.51	778.07	786.01	777.87
20	0	0	786.61	777.17	787	777	0	0	786.11	778.08	786.11	778.22	785.91	778.89	786.61	778.62	786.31	778.75	786.81	778.75	786.61	778.07	786.11	777.87
21	0	0	786.61	777.17	787	777	0	0	786.11	778.08	786.11	778.22	786.41	778.89	786.11	778.62	786.21	778.75	786.61	778.75	786.61	778.07	786.11	777.87
22	0	0	786.61	777.17	787	777	0	0	786.11	778.08	786.11	778.22	785.91	778.89	786.61	778.62	786.61	778.75	786.61	778.75	786.61	778.07	786.11	777.87
23	0	0	786.61	776.61	787	777	0	0	786.11	778.08	786.11	778.89	785.71	778.17	786.41	778.62	787.61	778.75	786.91	778.75	786.61	777.96	786.11	777.87
24	0	0	786.61	776.61	787	777	0	0	786.11	778.08	786.11	778.89	787.11	778.55	787.61	778.62	786.91	778.75	787.11	778.75	786.61	777.96	786.11	777.87
25	0	0	786.11	776.61	787	777	0	0	786.11	778.08	786.11	778.89	786.61	778.71	785.61	778.33	786.61	778.75	786.71	778.75	787.11	777.69	784.61	777.87
26	0	0	0	0	787	777	0	0	786.11	778.29	786.11	778.89	785.91	778.71	785.91	778.33	787.01	778.75	787.01	777.17	787.11	777.69	786.11	777.87
27	0	0	0	0	787	777	0	0	786.11	778.29	786.11	778.89	786.21	778.71	786.01	778.33	787.01	778.75	786.61	777.17	787.11	777.69	786.11	777.87
28	0	0	0	0	787	777	0	0	786.11	778.29	787.51	778.89	786.31	778.71	786.31	778.33	786.81	778.75	786.91	777.17	786.61	777.69	786.11	777.87
29	0	0			788	777	785.01	777.45	786.11	778.71	786.11	778.89	786.41	778.85	786.41	778.33	786.61	778.75	787.01	777.17	786.61	777.69	786.11	777.87
30	0	0			787	777	784.81	777.60	786.11	778.71	785.81	778.89	785.01	778.85	786.31	778.33	786.61	778.75	787.01	777.17	786.61	777.69	786.11	777.87
31	0	0			787	777			786.11	778.71			785.61	778.85	786.11	778.75			787.01	777.17			786.11	777.87

Table 4 Sheet 6 of 10
Year 2011
Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	786.01	777.83	0	0	786	776	786.61	778.02	786.61	778.68	786.61	778.83	786.61	778.74	783.11	778.75	783.91	778.52	784.51	778.40	784.61	778.02	785.91	777.73
2	786.01	777.83	0	0	786	776	786.61	778.02	786.61	778.68	786.61	778.83	787.61	778.74	783.61	778.75	784.31	778.03	784.51	778.40	784.61	778.02	785.91	777.73
3	785.91	777.83	0	0	786	776	786.61	777.84	786.61	778.68	786.61	778.83	787.11	778.74	783.71	778.83	784.41	778.03	784.61	778.40	784.61	778.02	785.91	777.73
4	785.91	777.83	0	0	786	776	786.61	777.84	786.61	778.68	786.61	778.83	786.41	778.74	783.71	778.83	784.41	778.03	784.51	778.40	784.61	778.02	785.91	777.73
5	786.01	777.83	0	0	787	776	786.61	777.84	786.61	778.68	786.61	778.83	785.81	778.74	783.71	778.83	784.31	778.03	784.41	778.40	784.61	778.02	785.91	777.73
6	785.91	777.83	0	0	787	776	786.61	777.84	786.61	778.68	786.61	778.83	785.61	778.74	783.71	778.83	784.61	778.28	784.41	778.40	784.61	778.02	785.91	777.73
7	785.81	777.83	0	0	787	776	786.61	776.93	786.61	778.68	786.41	778.83	785.61	778.74	783.71	778.83	784.41	778.52	784.31	778.40	784.61	778.02	785.91	777.73
8	785.81	777.83	783.81	775.45	787	776	786.61	776.93	786.61	778.68	785.61	778.83	787.11	778.60	783.11	778.83	785.11	778.52	784.31	778.63	784.61	778.02	785.91	777.73
9	785.81	777.83	786.61	776.41	787	777	786.61	776.93	786.61	778.68	785.81	778.83	786.61	778.60	784.11	778.83	785.31	778.52	784.31	778.63	784.11	778.02	785.91	777.73
10	785.81	777.83	785.71	776.41	787	777	786.61	776.93	786.61	778.73	785.91	778.83	787.21	778.60	784.21	778.83	786.61	778.52	784.31	778.63	784.61	778.02	785.91	777.73
11	785.81	777.83	785.71	777.78	787	778	786.61	776.93	786.91	778.73	0	0	786.11	778.60	783.61	778.83	785.31	778.52	784.31	778.63	784.61	778.02	785.91	777.73
12	0	0	785.91	777.78	787	778	786.61	776.89	786.61	778.73	785.61	778.83	785.61	778.60	783.61	778.83	784.41	778.52	784.21	778.63	784.61	778.02	785.91	777.73
13	0	0	786.31	777.78	787	778	786.61	776.89	786.61	778.73	785.61	778.83	785.61	778.83	786.11	778.83	784.21	778.52	784.21	778.63	785.11	778.02	785.91	777.73
14	0	0	786.11	777.78	787	778	786.61	776.89	786.91	778.73	785.61	778.73	785.61	778.83	784.11	778.83	784.21	778.52	784.21	778.63	785.61	778.02	785.91	777.73
15	785.51	777.67	786.31	777.25	787	778	786.61	778.45	786.61	778.73	785.61	778.73	787.61	778.37	786.41	778.83	784.11	778.52	784.31	778.63	785.71	778.02	785.91	777.73
16	785.81	777.67	786.31	777.25	787	778	786.61	778.45	786.61	778.73	786.01	778.73	786.01	778.61	783.71	778.83	784.21	778.52	784.21	777.14	785.81	778.02	785.91	777.73
17	785.61	777.67	786.31	777.25	787	778	786.61	778.45	786.61	778.73	786.11	778.73	785.61	778.61	783.71	778.83	786.21	778.52	784.11	777.14	786.01	778.02	785.91	777.73
18	784.91	777.67	786.61	777.25	787	778	786.61	778.45	786.61	778.73	785.81	778.83	785.61	778.61	783.71	778.83	785.01	778.52	784.31	777.14	786.11	778.02	785.91	777.73
19	0	0	786.61	777.25	787	778	786.61	778.45	786.61	778.73	785.81	778.83	785.61	778.61	785.41	778.83	784.61	778.52	784.21	777.14	786.11	778.02	785.91	777.73
20	0	0	786.61	777.25	787	778	786.61	778.45	786.61	778.83	785.81	778.83	785.41	778.79	784.61	778.83	784.11	778.52	784.11	777.14	786.01	778.02	785.91	777.73
21	0	0	786.61	777.25	787	778	786.61	778.45	786.61	778.83	785.61	778.83	785.31	778.79	784.51	778.83	784.11	778.52	784.31	777.14	786.01	778.02	785.91	777.73
22	0	0	786.91	777.25	787	778	786.61	778.45	786.61	778.83	785.61	778.83	785.41	778.79	784.11	778.83	784.21	778.40	784.61	777.14	786.01	778.02	785.91	777.73
23	0	0	787.11	776.83	787	778	786.61	778.45	786.61	778.83	785.61	778.83	787.21	778.79	784.21	778.83	784.41	778.40	785.11	777.14	785.91	777.64	785.91	777.73
24	0	0	787.31	776.53	787	778	786.61	778.45	786.61	778.83	785.61	778.83	786.91	778.83	784.11	778.83	784.31	778.40	785.21	777.14	785.91	777.64	785.91	777.73
25	0	0	786.81	776.53	787	778	786.61	778.45	786.61	778.83	785.61	778.83	787.91	778.83	784.11	778.83	784.31	778.40	785.21	777.14	785.91	777.64	785.91	777.73
26	0	0	786.61	776.53	787	778	786.61	778.57	786.61	778.83	785.91	778.83	0	0	785.81	778.12	784.41	778.40	785.21	777.14	785.91	777.52	785.91	777.73
27	0	0	785.91	776.05	787	778	786.61	778.57	786.61	778.83	786.01	778.83	781.01	777.25	784.41	778.75	784.31	778.40	784.91	777.14	785.91	777.52	785.91	777.73
28	0	0	786.01	776.05	787	778	786.61	778.57	786.61	778.83	786.71	778.83	780.81	776.75	784.31	778.75	784.31	778.40	785.41	777.14	785.91	777.52	785.91	777.73
29	0	0			787	778	786.61	778.57	786.61	778.83	786.01	778.83	782.21	778.83	783.81	778.75	784.31	778.40	785.41	777.14	785.91	777.52	785.91	777.73
30	0	0			787	778	786.61	778.68	786.61	778.83	785.61	778.83	782.61	778.83	783.81	778.75	784.51	778.40	785.11	778.02	785.91	777.60	785.91	777.73
31	0	0			787	778			786.41	778.83			782.41	778.75	783.91	778.52			784.61	778.02			785.91	777.73

Table 4 Sheet 7 of 10
Year 2012
Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	786	778	0	0	786	777	785.91	777.14	784.81	778.63	785.81	778.01	785.11	778.68	785.11	778.68	784.01	778.68	785.31	776.38	786.11	777.77	786.31	777.51
2	786	778	0	0	786	777	785.91	777.14	784.61	778.63	785.81	778.75	784.71	778.68	785.61	778.68	784.01	778.68	785.31	776.97	786.11	777.77	786.31	777.51
3	785.91	777.73	0	0	785.71	777.40	785.91	777.14	784.61	778.63	785.81	778.75	784.61	778.68	785.81	778.68	784.11	778.68	785.91	778.40	786.11	777.77	786.31	777.51
4	785.91	777.73	787.11	776.05	785.71	777.40	785.91	777.14	784.61	778.63	785.81	778.75	784.71	778.68	785.61	778.68	784.41	778.68	785.71	778.63	786.21	777.77	786.31	777.51
5	785.91	777.73	786.81	776.05	785.71	777.40	785.91	777.14	784.61	778.63	785.91	778.68	784.91	778.68	787.11	778.68	784.41	777.25	785.61	778.63	786.11	778.03	786.31	777.51
6	785.91	777.73	787.11	776.05	785.61	777.40	785.91	777.14	784.61	778.63	785.81	778.68	784.91	778.68	785.01	778.68	784.21	777.25	785.81	778.16	786.11	778.03	786.31	777.51
7	785.81	777.65	786.71	776.05	785.61	777.40	785.11	777.14	784.61	778.63	786.11	778.33	784.91	778.68	785.21	778.68	784.41	776.97	785.91	778.16	786.01	778.03	785.91	777.51
8	785.71	777.60	786.61	776.05	785.61	777.40	785.61	777.14	784.61	777.77	785.61	778.68	786.11	778.68	784.11	778.68	784.21	776.97	785.91	778.16	786.01	778.03	786.21	777.51
9	785.61	777.60	786.61	776.05	785.71	777.40	785.51	777.14	785.01	777.77	785.61	778.45	784.11	778.68	784.51	778.68	784.21	776.97	785.91	778.16	786.01	778.03	786.21	777.51
10	785.51	777.60	786.61	776.05	785.71	777.40	785.51	777.14	785.51	777.77	785.51	778.45	783.81	778.68	784.41	778.68	784.21	776.97	785.91	778.16	786.01	778.03	786.21	777.51
11	785.31	777.60	786.61	777.11	784.61	776.97	785.51	777.14	785.51	777.49	785.61	778.45	785.61	778.68	784.11	778.68	784.21	776.97	786.11	777.91	786.11	778.03	786.21	777.25
12	784.01	776.75	786.61	777.11	784.01	776.97	785.51	777.14	785.51	777.35	785.81	778.68	787.41	778.68	784.11	778.68	784.21	776.97	786.11	777.91	786.11	778.03	786.21	777.25
13	0	0	784.71	777.14	784.71	776.97	785.61	777.14	785.51	777.35	785.61	778.68	785.91	778.68	784.11	778.68	784.61	776.97	786.11	777.91	786.11	778.03	786.21	777.25
14	0	0	786.61	777.14	785.11	776.97	785.61	777.14	785.51	777.35	785.81	778.68	785.61	778.68	784.11	778.68	784.61	776.97	786.11	777.91	786.01	778.03	785.71	777.25
15	0	0	786.61	777.14	785.11	776.97	785.51	777.14	785.51	777.35	786.21	778.68	786.01	778.68	784.51	778.68	784.61	776.97	786.11	777.91	786.01	778.03	785.31	777.25
16	0	0	786.41	777.14	785.11	776.97	785.11	778.18	785.51	777.35	786.31	778.68	786.31	778.68	784.61	778.68	784.61	776.97	786.11	777.91	786.01	778.03	785.31	777.25
17	0	0	786.41	777.14	785.11	776.97	785.31	777.88	785.51	777.29	786.31	778.68	786.01	778.68	784.61	778.68	0	0	786.11	778.16	786.01	778.03	785.11	777.51
18	0	0	786.41	777.14	785.61	776.97	785.51	777.88	785.61	777.29	786.31	778.68	786.01	778.68	783.91	778.68	0	0	786.11	778.16	786.11	777.76	785.01	777.51
19	0	0	786.11	777.14	785.61	776.97	785.51	777.88	785.61	777.29	786.31	778.68	786.01	778.68	783.91	778.68	0	0	786.11	778.16	786.21	777.76	785.01	777.51
20	0	0	786.21	777.14	785.61	776.97	785.41	778.18	785.61	777.29	785.61	778.68	785.81	778.68	783.91	778.68	0	0	786.11	778.16	786.21	777.76	785.01	777.25
21	0	0	786.11	777.14	785.61	776.97	785.41	778.52	785.61	777.29	785.61	778.68	785.21	778.68	783.71	778.15	0	0	786.11	777.77	786.21	777.76	785.01	777.25
22	0	0	786.11	777.14	785.61	776.56	785.61	778.52	785.61	777.29	785.91	778.68	784.91	778.68	783.81	778.15	0	0	785.91	777.77	786.21	777.76	785.01	777.25
23	0	0	786.11	777.14	785.61	777.14	785.61	778.52	785.61	777.29	784.11	778.68	784.61	778.68	783.81	778.68	0	0	785.91	777.77	786.21	777.76	785.01	777.25
24	0	0	786.11	777.14	785.61	777.14	785.41	778.52	785.61	774.65	784.11	778.68	784.61	778.68	784.41	778.68	0	0	785.91	777.77	786.21	777.76	785.01	777.25
25	0	0	786.11	777.14	786.11	777.14	785.51	778.63	0	0	784.01	778.68	784.61	778.68	784.11	778.68	0	0	785.91	777.77	786.21	777.76	785.01	777.25
26	0	0	786.11	777.14	786.11	777.14	785.41	778.63	0	0	784.01	778.68	786.31	778.68	784.01	778.68	0	0	785.91	777.77	786.21	777.76	786.31	777.25
27	0	0	786.01	777.14	786.11	777.14	785.61	778.63	0	0	784.11	778.68	785.11	778.68	784.31	778.68	0	0	785.11	777.77	786.21	777.76	786.31	777.25
28	0	0	785.91	777.14	786.11	777.14	785.11	778.63	0	0	784.01	778.68	785.11	778.68	784.01	778.68	0	0	785.11	777.77	786.21	777.61	786.21	777.25
29	0	0	785.61	777.14	786.11	777.14	785.11	778.63	0	0	784.01	778.68	785.11	778.68	783.91	778.68	0	0	785.11	777.77	786.31	777.61	786.21	777.25
30	0	0			785.91	777.14	784.81	778.63	0	0	785.01	778.68	785.11	778.68	783.91	778.68	785.31	776.38	785.81	777.77	786.31	777.51	786.21	777.25
31	0	0			785.91	777.14			0	0			785.11	778.68	784.01	778.68			786.21	777.77			786.51	777.25

Table 4 Sheet 8 of 10

Year 2013

Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	786.21	777.25	0	0	0	0	786.11	777.14	784.61	778.39	785.81	778.03	785.31	778.03	787.31	778.75	786.91	778.83	786.61	778.70	786.61	778.02	787.11	777.38
2	786.01	777.25	0	0	0	0	784.61	777.14	784.61	778.39	785.81	778.03	785.01	778.52	787.31	778.75	786.91	778.83	786.41	778.70	786.61	778.02	787.11	777.38
3	786.01	777.25	0	0	0	0	784.41	777.14	784.61	778.26	785.61	778.52	786.51	778.52	786.91	778.40	787.11	778.83	786.51	778.70	786.61	778.02	787.11	777.38
4	786.01	777.25	0	0	785.21	776.05	784.41	777.14	784.61	778.26	785.61	778.52	786.31	778.52	787.61	778.63	786.61	778.83	786.61	778.70	786.61	778.02	787.11	777.38
5	785.91	777.25	0	0	785.11	777.25	784.61	777.14	784.61	778.26	785.61	778.52	786.31	778.52	787.61	778.63	786.91	778.83	786.61	778.70	786.61	778.02	787.11	777.38
6	785.91	777.25	0	0	785.31	777.25	784.61	777.14	784.71	778.26	785.61	778.52	785.61	778.52	787.31	778.75	787.11	778.83	786.61	778.70	786.61	778.02	787.11	777.38
7	785.91	777.25	0	0	785.11	777.25	784.61	777.14	784.71	778.26	785.61	778.52	785.21	778.52	787.11	778.75	787.11	778.83	786.61	778.70	786.61	778.02	787.11	777.38
8	785.91	777.25	0	0	785.11	777.25	784.61	777.14	784.81	778.23	785.61	778.63	785.71	778.52	787.61	778.75	787.11	778.83	786.61	778.70	786.61	777.51	787.11	777.38
9	785.91	777.25	0	0	784.91	777.51	784.61	777.14	784.81	778.23	785.61	778.63	785.71	778.52	787.21	778.75	787.11	778.83	786.61	778.70	786.61	777.25	787.11	777.38
10	786.01	777.25	0	0	784.91	777.51	784.61	777.14	784.71	778.23	785.61	778.63	786.71	778.52	787.31	778.75	787.11	778.83	786.61	778.70	786.61	777.25	787.11	777.60
11	786.01	777.25	0	0	784.91	777.51	784.71	777.14	784.71	778.23	785.61	778.63	786.61	778.03	787.11	778.75	787.11	778.83	786.61	778.70	786.61	776.97	787.11	777.60
12	783.11	775.55	0	0	784.91	777.51	784.71	777.14	784.71	778.23	785.61	778.63	786.41	778.03	787.11	778.75	787.11	778.83	786.61	778.70	786.61	776.97	787.01	777.60
13	0	0	0	0	784.91	777.51	784.71	777.14	784.61	778.23	785.61	778.34	786.41	778.03	787.11	778.75	787.11	778.83	786.61	778.70	786.61	777.38	787.01	777.60
14	0	0	785.21	775.53	785.61	777.51	784.71	777.14	784.71	778.23	785.61	778.34	786.11	778.03	787.11	778.40	787.11	778.83	786.61	778.70	786.61	777.38	787.01	777.60
15	0	0	785.21	775.53	786.31	777.51	784.71	777.14	784.71	778.23	785.61	778.46	786.31	778.03	787.51	778.03	787.11	778.83	786.61	778.57	786.61	777.38	787.01	777.60
16	0	0	785.21	775.13	786.31	777.51	784.81	778.42	784.81	777.96	785.11	778.46	786.41	778.83	787.11	778.03	787.11	778.83	786.61	778.02	786.61	777.38	787.01	777.60
17	0	0	0	0	786.41	777.51	784.81	778.42	784.81	777.96	785.11	778.46	786.61	778.83	787.21	778.03	787.11	778.83	786.61	778.02	786.61	777.38	787.01	777.60
18	0	0	0	0	786.41	777.51	784.81	778.42	784.81	777.96	784.81	778.46	786.61	778.83	787.21	778.03	787.31	778.75	786.61	778.02	786.61	777.38	787.01	777.60
19	0	0	0	0	785.71	777.51	784.81	778.42	784.81	777.96	784.81	778.46	787.11	778.63	787.61	778.03	787.31	778.75	786.61	778.02	786.61	777.38	786.91	777.60
20	0	0	0	0	785.61	777.51	784.81	778.42	784.81	777.96	785.61	778.46	787.31	778.63	787.31	778.03	787.61	778.75	786.61	778.02	786.91	777.38	787.01	777.60
21	0	0	0	0	785.61	777.51	784.81	778.42	785.21	778.52	785.61	778.46	787.41	778.63	787.61	778.03	787.31	778.75	786.61	778.02	787.11	777.38	787.11	777.60
22	0	0	0	0	785.61	777.14	784.81	778.42	785.21	778.52	785.61	778.46	787.11	778.63	787.61	778.03	787.21	778.75	786.61	777.30	787.11	777.38	787.11	777.60
23	0	0	0	0	786.11	777.14	784.61	778.42	785.21	778.52	785.61	778.46	787.61	778.63	787.61	778.03	787.11	778.75	787.01	777.23	787.11	777.38	787.11	777.60
24	0	0	0	0	786.11	777.14	784.61	778.42	785.61	778.52	785.61	778.46	787.61	778.63	787.61	778.03	787.01	778.75	787.01	777.23	787.11	777.38	787.11	777.60
25	0	0	0	0	786.11	777.14	784.61	778.42	785.61	778.52	785.61	778.63	787.61	778.40	787.61	778.03	787.11	778.52	787.01	777.23	787.11	777.38	787.11	777.60
26	0	0	0	0	786.11	777.14	784.61	778.42	785.61	778.52	785.61	778.75	786.91	778.75	787.61	778.03	787.11	778.52	786.61	777.23	787.11	777.38	784.61	777.60
27	0	0	0	0	786.11	777.14	784.71	778.08	785.81	778.52	785.61	778.75	787.31	778.75	787.61	778.52	786.81	778.52	786.61	777.23	787.11	777.38	784.61	777.60
28	0	0	0	0	786.11	777.14	784.71	778.08	785.61	778.52	785.11	778.75	787.31	778.75	786.61	778.83	786.61	778.70	786.61	777.23	787.11	777.38	784.61	777.60
29	0	0			786.11	777.14	784.71	778.08	785.61	778.52	784.51	778.75	787.31	778.75	787.21	778.83	786.61	778.70	786.61	777.23	787.11	777.38	784.61	777.60
30	0	0			786.11	777.14	784.61	778.39	785.61	778.52	785.51	778.75	787.41	778.75	787.21	778.83	786.61	778.70	786.61	777.23	787.11	777.38	784.61	777.60
31	0	0			786.11	777.14			785.81	778.03			787.31	778.75	785.11	778.83			786.61	777.23			784.61	777.60

Table 4 Sheet 9 of 10
Year 2014
Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	784.61	777.60	0	0	787.11	777.68	787.11	777.00	786.61	778.26	786.61	778.68	786.61	778.48	784.61	778.48	787.11	778.32	787.11	778.56	787.11	778.06	787.11	777.56
2	784.61	777.60	0	0	786.91	777.68	787.11	777.00	786.61	778.26	786.61	778.68	786.61	778.48	784.61	778.48	787.11	778.32	787.11	778.56	787.11	778.06	787.11	777.56
3	784.61	777.60	783.11	775.34	786.91	777.68	787.11	777.00	786.61	778.45	786.61	778.68	786.61	778.48	785.11	778.48	787.21	778.32	787.11	778.56	787.11	778.06	787.11	777.56
4	784.61	777.60	782.81	776.36	787.11	777.68	787.11	777.56	786.61	778.45	786.61	778.68	786.61	778.48	785.61	778.48	787.11	778.32	787.11	778.56	787.11	778.06	787.11	777.56
5	784.61	777.60	785.11	776.36	787.11	777.68	787.11	777.56	786.61	778.45	786.61	778.68	786.81	778.48	785.61	778.48	0	0	787.11	778.56	787.11	778.06	787.11	777.56
6	784.61	777.60	785.11	777.51	787.11	777.68	787.11	777.56	786.61	778.45	786.61	778.68	786.91	778.48	785.61	778.48	0	0	787.11	778.56	787.11	778.06	787.11	777.72
7	784.61	777.60	0	0	787.11	777.68	787.11	776.86	786.61	778.45	786.61	778.68	786.91	778.48	785.61	778.48	0	0	787.11	778.56	787.11	778.06	787.11	777.72
8	784.61	777.60	0	0	787.01	777.68	0	0	786.61	778.45	786.61	778.68	786.91	778.48	785.61	778.48	0	0	787.11	778.56	787.11	777.54	787.11	777.72
9	784.61	777.60	0	0	787.01	777.68	0	0	786.61	778.45	786.61	778.68	786.91	778.48	785.61	778.48	0	0	787.11	778.56	787.11	777.54	787.11	777.72
10	784.61	777.60	0	0	787.11	777.68	0	0	786.61	778.45	786.61	778.68	786.91	778.48	785.61	778.48	0	0	787.11	778.66	787.11	777.54	787.11	777.72
11	784.61	777.60	0	0	787.11	777.68	0	0	786.61	778.45	786.61	778.68	786.91	778.48	785.61	778.48	0	0	787.11	778.66	787.11	777.15	787.11	777.72
12	783.91	777.60	0	0	0	0	0	0	786.61	778.45	786.61	778.68	786.91	778.48	785.11	778.48	0	0	787.11	778.66	787.11	777.15	787.11	777.72
13	782.11	775.55	787.11	776.05	0	0	0	0	786.61	778.56	786.61	778.68	786.91	778.48	785.11	778.48	0	0	787.11	778.66	787.11	777.15	785.71	777.45
14	0	0	787.11	776.05	0	0	0	0	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	778.66	787.11	777.15	787.11	777.72
15	0	0	787.21	777.51	0	0	787.11	775.35	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	778.66	787.11	777.15	787.11	777.72
16	0	0	787.11	777.51	0	0	787.11	776.71	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	778.66	787.11	777.15	787.11	777.72
17	0	0	787.11	777.51	0	0	787.11	777.56	786.61	778.56	786.61	778.68	787.11	778.48	785.11	778.62	0	0	787.11	778.66	787.11	777.15	787.11	777.72
18	0	0	787.11	777.82	0	0	787.11	777.56	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	778.66	787.11	777.15	787.11	777.72
19	0	0	787.11	777.82	0	0	787.11	777.29	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	778.66	787.11	777.15	787.11	777.72
20	0	0	787.11	777.82	0	0	787.11	777.29	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.44	0	0	787.11	778.66	787.11	777.15	787.11	777.72
21	0	0	787.11	777.68	0	0	787.11	777.29	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.31	777.29	787.11	777.15	787.11	777.72
22	0	0	787.11	777.68	0	0	787.11	778.08	786.61	778.56	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	777.29	787.11	777.15	787.11	777.72
23	0	0	787.11	777.68	0	0	786.61	778.08	786.61	778.68	786.61	778.68	786.91	778.48	785.61	778.62	0	0	787.11	777.29	787.11	777.15	787.11	777.72
24	0	0	787.11	777.68	0	0	786.61	778.45	786.61	778.68	786.61	778.68	786.91	778.48	787.21	778.32	783.61	776.40	787.11	777.29	787.21	777.15	787.11	777.87
25	0	0	787.11	777.68	0	0	786.61	778.45	786.61	778.68	786.61	778.68	785.91	778.48	787.21	778.32	785.61	777.56	787.11	777.29	787.11	777.15	785.61	777.87
26	0	0	787.11	777.68	0	0	786.61	778.45	786.91	778.68	786.61	778.68	786.11	778.48	787.21	778.32	787.11	777.56	787.11	777.29	787.11	777.56	783.71	777.87
27	0	0	787.11	777.68	0	0	786.61	778.26	786.61	778.68	786.61	778.68	786.11	778.48	787.21	778.32	787.31	777.56	787.11	777.29	787.11	777.56	783.81	777.74
28	0	0	787.11	777.68	0	0	786.61	778.26	786.61	778.68	786.61	778.68	786.11	778.48	787.21	778.32	787.61	777.56	787.11	777.29	787.11	777.56	783.81	777.74
29	0	0			0	0	786.61	778.26	786.61	778.68	786.61	778.68	786.11	778.48	787.21	778.32	787.61	777.56	787.11	777.29	787.11	777.56	783.91	777.48
30	0	0			0	0	786.61	778.26	786.61	778.68	786.61	778.68	785.11	778.48	787.11	778.32	787.61	777.56	787.11	777.29	787.11	777.56	783.91	777.48
31	0	0			787	776			786.61	778.68			785.11	778.48	787.11	778.32			787.11	777.29			783.91	777.48

Table 4 Sheet 10 of 10

Year 2015

Water Level Elevation AMSL of UJC & Gujrat Br (Ft)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	UJC Level	Gujrat Br Level	Guage UJC	Guage Gujrat	Guage UJC	Guage Gujrat
1	783.91	777.48	0	0	0	0	0	0	786.61	777.61	786.51	778.73	785.41	778.68	785.01	778.80	785.51	778.78	786.91	778.56	786.11	777.56	786.61	777.29
2	783.91	777.48	0	0	0	0	0	0	786.61	777.61	786.51	778.73	785.41	778.68	785.11	778.80	786.11	778.78	786.61	778.68	785.91	777.56	787.01	777.29
3	783.91	777.48	0	0	0	0	0	0	786.61	777.61	786.51	778.73	785.41	778.68	785.11	778.80	785.71	778.89	787.01	778.80	785.61	777.72	787.01	777.29
4	784.01	777.48	0	0	0	0	0	0	786.61	777.61	786.51	778.73	785.21	778.80	785.31	778.80	784.91	778.89	787.01	778.80	785.61	777.72	786.91	777.29
5	784.01	777.48	0	0	0	0	0	0	786.61	778.20	786.61	778.73	785.11	778.89	785.11	778.80	786.21	778.89	787.01	778.80	786.61	777.43	787.01	776.94
6	784.01	777.48	0	0	0	0	0	0	786.51	778.20	786.51	778.73	785.11	778.89	784.71	778.80	785.61	778.65	787.31	778.80	786.61	777.43	786.91	777.29
7	784.01	777.48	0	0	0	0	0	0	786.51	778.56	786.51	778.73	785.11	778.89	785.01	778.80	786.01	778.65	786.61	778.73	786.61	777.43	787.31	777.29
8	783.91	777.48	0	0	0	0	0	0	786.61	778.56	786.61	778.73	785.11	778.89	784.91	778.80	786.01	778.80	786.91	778.73	786.41	777.43	786.91	777.29
9	783.91	777.48	0	0	0	0	0	0	786.61	778.56	786.61	778.73	785.21	778.89	784.71	778.63	785.91	778.80	786.61	778.73	786.41	777.43	787.01	777.29
10	783.91	777.48	787.11	775.35	0	0	0	0	786.61	778.56	786.51	778.73	785.11	778.89	785.11	778.63	786.01	778.80	786.61	778.73	786.41	777.43	787.01	777.29
11	783.91	777.48	787.11	775.35	0	0	0	0	786.61	778.56	786.11	778.73	786.61	778.52	785.11	778.63	786.61	778.80	785.91	778.73	786.41	777.43	786.91	777.29
12	781.91	775.15	787.11	775.35	0	0	0	0	786.61	778.56	786.41	778.80	786.61	778.52	786.11	778.40	786.81	778.80	785.61	778.73	786.61	777.43	786.91	777.29
13	0	0	787.11	775.90	0	0	786.91	776.40	786.61	778.56	786.41	778.80	786.61	778.52	786.81	778.40	786.81	778.80	785.31	778.73	786.51	777.43	787.01	777.29
14	0	0	787.11	775.90	0	0	786.91	776.40	786.61	778.56	786.41	778.80	786.41	778.80	786.61	778.40	786.81	778.80	785.31	778.73	786.61	777.43	786.91	777.29
15	0	0	787.11	775.90	0	0	786.91	776.40	786.61	778.56	786.41	778.80	786.41	778.80	786.61	778.40	786.81	778.80	784.91	778.73	786.61	777.43	787.11	777.00
16	0	0	787.11	775.90	0	0	786.81	776.40	786.61	778.56	786.51	778.56	786.31	778.80	786.61	778.40	786.81	778.80	785.11	777.17	786.61	777.43	787.11	777.00
17	0	0	787.11	775.90	0	0	786.81	777.82	786.61	778.56	786.51	778.56	786.41	778.80	786.61	778.40	786.31	778.80	786.51	777.17	786.61	777.43	786.91	777.43
18	0	0	787.11	776.86	0	0	786.61	777.82	786.61	778.56	786.51	778.56	785.91	778.33	786.81	778.56	786.11	778.80	786.51	777.17	786.61	777.43	786.91	777.43
19	0	0	787.11	776.86	0	0	786.61	777.82	786.61	778.56	786.41	778.80	786.41	778.33	786.91	778.56	786.11	778.80	786.61	777.17	786.61	777.43	786.91	777.43
20	0	0	786.91	776.86	0	0	786.61	777.61	786.61	778.56	786.41	778.68	786.11	778.33	787.11	778.56	786.01	778.80	786.61	777.17	786.61	777.43	786.91	777.43
21	0	0	0	0	0	0	786.61	777.61	786.61	778.56	786.41	778.68	785.61	778.33	787.11	778.80	785.81	778.80	786.51	777.17	786.61	777.43	786.91	777.43
22	0	0	0	0	0	0	786.61	777.61	786.61	778.56	786.41	778.68	786.11	778.33	787.11	778.80	786.51	778.68	785.91	777.17	786.61	777.43	786.91	777.43
23	0	0	0	0	0	0	786.61	777.61	786.61	778.56	786.41	778.68	786.11	778.80	787.11	778.80	0	0	785.91	777.17	786.81	777.43	786.91	777.43
24	0	0	0	0	0	0	786.61	777.61	786.61	778.73	786.41	778.68	785.21	778.80	787.11	778.80	0	0	785.91	777.17	786.61	777.43	786.91	777.43
25	0	0	0	0	0	0	786.61	777.61	786.51	778.73	786.41	778.68	785.21	778.80	787.11	778.89	0	0	785.91	777.17	786.61	777.43	786.91	777.43
26	0	0	0	0	0	0	786.61	777.61	786.51	778.73	785.91	778.68	785.21	778.80	787.01	778.89	0	0	785.81	777.17	786.61	777.43	783.11	777.43
27	0	0	0	0	0	0	786.61	777.61	786.51	778.73	785.61	778.80	785.11	778.80	787.11	778.89	0	0	785.81	777.17	786.61	777.43	783.31	777.43
28	0	0	0	0	0	0	786.61	777.61	786.51	778.73	786.21	778.08	785.11	778.80	787.11	778.89	0	0	786.11	777.17	786.61	777.43	783.61	777.59
29	0	0			0	0	786.61	777.61	786.51	778.73	785.91	778.08	784.91	778.80	787.11	778.89	787.11	777.01	786.11	777.17	786.61	777.29	783.61	777.59
30	0	0			0	0	786.61	777.61	786.61	778.73	785.21	778.68	785.01	778.80	787.11	778.89	787.11	777.01	786.61	777.17	786.61	777.29	783.61	777.64
31	0	0			0	0			786.41	778.73			785.01	778.80	786.41	778.89			786.31	777.17			783.61	777.72

Table 5 Sheet 1 of 10

Year 2006

Tall Water Elevation (TWE) & Gross Head (Ft)

	January		February		March		April		May		June		July		August		September		October		November		December	
Date	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	756.65	29.76	0	0	756.65	29.66	756.65	29.96	757.21	27.30	757.23	28.58	757.36	29.05	756.45	30.16	756.91	30.70	757.47	28.64	756.65	28.36	756.53	29.58
2	756.65	29.76	0	0	756.65	29.66	756.65	29.96	757.21	27.30	757.23	28.58	757.36	29.65	757.47	29.14	756.53	31.08	757.47	28.64	756.65	27.96	756.53	29.58
3	756.65	29.76	0	0	756.65	29.66	756.65	29.96	757.21	27.30	757.23	28.58	757.36	29.25	757.47	29.14	0	0	757.47	28.64	756.65	27.96	756.53	29.58
4	756.65	29.76	0	0	756.65	29.66	756.65	29.96	757.33	27.18	757.23	28.98	757.36	29.75	757.47	28.54	0	0	757.47	28.64	756.65	27.66	756.10	30.01
5	756.65	29.76	754.53	30.78	756.65	29.66	756.65	29.96	757.33	27.18	757.23	29.38	757.47	28.84	756.93	29.68	0	0	757.47	29.34	756.65	27.86	755.81	30.30
6	756.65	29.76	755.87	29.24	756.65	29.76	756.65	29.96	757.33	27.18	757.23	29.38	757.47	29.64	756.93	29.88	0	0	757.47	28.64	756.65	28.06	754.82	32.79
7	756.65	29.66	756.65	28.26	756.65	29.76	756.65	29.96	757.33	27.18	757.23	28.78	757.47	28.14	756.93	28.68	0	0	757.47	28.64	756.65	29.26	754.82	30.79
8	756.65	29.76	756.65	28.96	756.65	29.76	756.65	29.96	757.33	27.18	757.23	28.58	757.47	28.14	756.53	29.28	0	0	757.47	28.64	756.65	29.86	754.82	31.19
9	756.65	29.76	756.65	29.06	756.47	29.94	756.65	29.96	757.33	27.18	757.33	28.48	757.47	27.84	756.53	28.58	0	0	757.47	28.64	756.65	29.66	754.82	31.79
10	756.65	29.76	756.65	29.16	756.47	29.94	756.65	29.96	757.33	27.18	757.33	27.58	757.47	27.64	757.03	27.18	0	0	757.47	28.64	756.65	29.66	754.82	31.79
11	756.65	29.76	756.65	29.36	756.65	29.66	756.52	30.09	757.33	27.18	757.47	27.14	757.47	28.64	757.03	26.88	757.47	28.74	757.47	28.64	756.65	29.56	754.82	31.79
12	0	0	756.89	27.82	756.65	29.66	756.52	30.09	757.33	27.18	757.47	27.04	757.47	28.94	757.03	26.68	757.47	28.44	757.47	28.64	756.65	29.66	0	0
13	0	0	757.14	27.57	756.65	29.76	756.52	30.09	757.33	27.18	757.47	27.04	757.47	30.54	757.03	26.68	757.47	28.64	757.47	28.64	756.65	29.86	0	0
14	0	0	757.35	28.26	756.65	29.76	756.52	29.59	757.33	27.18	757.47	26.94	0	0	757.03	26.68	757.47	28.24	757.47	28.64	756.65	29.96	0	0
15	0	0	757.35	28.36	756.65	29.56	756.52	29.59	757.33	27.18	757.07	27.54	0	0	757.03	26.68	757.47	28.24	757.47	28.64	756.65	29.96	0	0
16	0	0	757.35	28.26	754.33	31.38	756.97	29.44	757.33	27.18	757.07	27.54	0	0	757.39	26.22	757.47	28.24	757.47	28.64	756.65	30.06	0	0
17	0	0	757.35	28.56	756.65	29.96	756.97	29.44	757.33	27.28	757.07	28.34	756.53	28.08	757.39	27.12	757.47	28.24	757.47	28.64	756.65	30.06	0	0
18	0	0	757.35	28.76	756.65	29.96	756.97	29.34	757.33	30.28	757.07	28.54	756.53	29.08	757.39	27.22	757.47	28.24	757.47	28.64	756.65	29.96	0	0
19	0	0	757.35	28.76	756.65	29.96	756.97	29.54	757.33	29.78	757.07	28.54	756.53	28.78	757.39	27.22	757.47	28.24	757.47	28.14	756.65	29.96	0	0
20	0	0	757.35	28.76	756.65	29.96	757.09	29.22	757.33	29.28	757.07	28.54	756.53	28.68	757.39	27.42	757.47	28.14	757.47	26.64	756.65	29.46	0	0
21	0	0	757.35	28.76	756.65	29.96	757.09	29.02	757.23	28.18	757.07	28.44	756.53	29.38	757.39	27.42	757.47	28.04	0	0	756.65	29.46	0	0
22	0	0	756.65	29.56	756.65	28.76	757.09	29.02	757.23	27.38	757.07	28.34	757.47	28.54	757.39	27.32	757.00	29.01	0	0	756.65	29.46	0	0
23	0	0	756.65	29.56	756.65	28.46	757.21	28.90	757.23	27.18	757.07	28.34	757.47	28.14	757.39	27.32	757.00	29.01	0	0	756.39	29.72	0	0
24	0	0	756.65	29.66	756.65	28.36	757.21	28.90	757.23	27.38	757.07	28.44	757.47	28.14	757.39	27.22	757.47	28.64	0	0	756.39	29.72	0	0
25	0	0	756.65	29.66	756.65	28.36	757.21	28.90	757.23	27.38	757.07	28.44	757.36	28.25	757.39	27.22	755.73	26.88	0	0	756.39	29.72	0	0
26	0	0	756.65	29.66	756.65	28.36	757.21	28.90	757.23	27.38	757.07	28.34	756.45	30.16	757.39	27.22	757.47	28.64	0	0	756.39	29.72	0	0
27	0	0	756.65	29.66	756.65	28.36	757.21	28.70	757.23	28.58	757.40	27.91	756.45	30.56	757.39	27.22	757.47	28.64	0	0	755.99	30.12	0	0
28	0	0	756.65	29.66	756.65	28.36	757.21	28.60	757.23	28.68	757.40	29.71	756.45	29.96	756.47	28.34	757.47	28.64	0	0	755.99	30.12	0	0
29	0	0			756.65	28.36	757.21	28.60	757.23	28.68	757.40	30.01	756.45	29.76	757.39	28.92	757.47	28.64	0	0	755.99	30.12	0	0
30	0	0			756.65	29.96	757.21	27.30	757.23	28.58	757.40	29.71	756.45	29.46	757.39	29.72	757.47	28.64	0	0	755.99	30.12	0	0
31	0	0			756.65	29.96			757.23	28.58			756.45	29.96	756.91	30.70			0	0			0	0

Table 5 Sheet 2 of 10
Year 2007
Tail Water Elevation (TWE) & Gross Head (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	0	0	0	0	0	0	754.31	32.30	757.23	29.58	757.47	27.64	756.23	28.78	757.47	27.34	757.47	28.14	757.23	29.38	756.65	27.36	756.26	30.75
2	0	0	756.65	27.96	0	0	755.58	31.03	757.47	29.34	757.47	27.64	756.23	28.78	757.47	29.84	757.47	28.14	757.36	29.25	756.65	30.26	756.26	30.75
3	0	0	756.65	27.96	0	0	756.65	29.96	757.47	29.34	757.47	27.64	756.23	29.48	757.47	28.64	757	28.14	757.47	29.14	756.65	30.46	756.26	30.75
4	0	0	756.65	28.06	0	0	756.65	29.96	757.47	29.34	757.47	27.64	756.75	29.26	757.47	27.84	757	28.14	757.47	29.04	756.65	30.46	756.26	30.75
5	0	0	756.65	28.06	0	0	756.39	30.22	757.23	29.58	757.47	27.64	757.47	28.24	757.47	29.64	757	28.14	757.47	29.14	756.65	30.46	756.26	30.75
6	0	0	756.65	28.06	0	0	756.39	30.22	757.47	29.34	757.47	27.64	757.47	27.14	757.47	29.84	757	28.24	757.47	29.04	756.65	30.46	756.26	30.75
7	0	0	756.65	28.16	0	0	756.39	30.22	757.47	29.34	757.47	27.64	757.47	30.14	756.88	30.03	757	29.01	757.47	29.04	756.65	30.16	756.26	30.75
8	0	0	756.65	28.46	0	0	756.39	30.22	757.47	29.34	757.47	27.74	757.23	28.88	757.47	28.84	757	28.61	757.47	29.04	756.65	30.46	756.26	30.75
9	0	0	756.65	28.86	0	0	756.39	30.22	757.47	29.34	757.47	27.74	757.23	28.38	757.47	29.14	757	28.61	757.47	29.14	756.65	30.36	756.26	30.75
10	0	0	756.65	29.16	0	0	756.39	30.22	757.47	29.34	757.47	27.74	757.23	27.38	757.47	29.14	757	28.61	757.47	29.14	756.65	30.46	756.26	30.75
11	0	0	754.98	30.43	0	0	756.39	30.22	757.47	29.34	757.47	27.94	757.47	28.34	757.47	29.14	757.00	28.61	757.47	29.14	756.65	30.46	756.14	30.97
12	0	0	0	0	0	0	756.39	30.22	757.47	29.34	757.47	28.14	757.47	26.84	757.47	29.14	757.00	28.61	757.47	29.14	756.65	30.46	756.14	30.97
13	0	0	0	0	0	0	756.39	30.22	757.47	29.34	757.47	28.14	757.47	26.84	757.47	29.14	757.47	28.14	757.47	29.14	756.65	30.46	756.14	30.97
14	0	0	0	0	0	0	756.39	30.22	757.47	29.34	757.47	27.84	757.47	26.84	757.47	29.34	757.47	28.14	756.92	29.59	756.65	30.46	756.14	30.97
15	0	0	0	0	0	0	756.64	29.97	757.47	29.34	757.47	28.94	757.47	27.04	756.73	29.78	757.47	28.14	756.92	29.59	756.65	30.46	756.14	30.97
16	0	0	0	0	0	0	756.93	29.68	757.47	29.34	757.47	28.24	757.47	27.04	756.73	29.28	757.47	28.14	756.92	29.49	756.65	30.46	756.14	30.87
17	0	0	0	0	0	0	757.47	29.14	757.47	29.34	757.47	28.14	757.47	27.04	757.47	28.64	757.47	28.14	756.92	29.49	756.65	30.46	756.14	30.87
18	0	0	0	0	0	0	757.47	29.14	757.47	29.34	757.47	28.04	757.47	26.84	757.47	28.44	757.47	28.14	756.65	30.26	756.65	30.46	756.39	30.62
19	0	0	0	0	0	0	757.47	29.14	757.47	28.64	757.47	28.24	757.47	26.84	757.47	28.54	757.47	28.14	756.65	29.86	756.65	30.46	756.39	30.62
20	0	0	0	0	0	0	757.23	29.58	757.47	29.14	757.47	27.84	757.47	27.04	757.47	28.54	757.47	28.14	756.65	29.36	756.65	30.46	756.26	30.75
21	0	0	0	0	0	0	757.23	29.58	757.47	28.94	757.47	27.84	757.47	26.84	757.47	28.54	757.47	28.14	0	0	756.65	30.46	756.26	30.75
22	0	0	0	0	0	0	757.23	29.38	757.47	28.54	757.47	27.74	757.47	29.84	757.47	28.44	757.47	28.14	0	0	756.65	30.46	756.26	30.75
23	0	0	0	0	0	0	757.23	29.38	757.47	28.24	757.47	27.64	757.47	30.24	757.47	28.44	757.47	28.14	0	0	756.65	30.46	756.26	30.75
24	0	0	0	0	0	0	757.23	29.38	757.47	28.64	757.47	27.64	757.47	30.24	757.47	28.44	757.47	28.14	0	0	756.65	30.46	756.26	30.75
25	0	0	0	0	0	0	757.23	29.38	757.47	28.24	757.47	26.44	757.47	29.14	757.47	28.44	757.23	28.38	0	0	756.65	30.46	756.26	30.25
26	0	0	0	0	0	0	757.23	29.38	757.47	28.24	757.47	28.14	757.47	28.64	757.47	28.44	757.23	28.38	0	0	756.65	30.46	756.26	30.35
27	0	0	0	0	0	0	757.23	29.58	757.47	28.24	757.47	28.34	757.47	28.24	757.47	28.44	757.23	28.38	0	0	756.65	30.46	756.03	30.28
28	0	0	0	0	0	0	757.23	29.58	757.47	28.24	757.47	28.04	757.47	27.84	757.47	28.44	757.23	28.38	0	0	756.65	30.46	756.03	30.78
29	0	0			0	0	757.23	29.58	757.47	28.04	756.88	28.53	757.47	27.84	757.47	28.44	757.23	28.38	0	0	756.65	30.46	756.03	30.78
30	0	0			0	0	757.23	29.58	757.47	27.94	756.23	29.18	757.47	27.34	757.47	28.44	757.23	28.38	0	0	756.26	30.75	756.65	30.16
31	0	0			0	0			757.47	27.64			757.47	27.34	757.47	28.44			0	0			756.65	30.16

Year 2008

Tail Water Elevation (TWE) & Gross Head (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	756.65	30.06	0	0	756.39	29.62	755.48	30.43	756.81	28.50	757.47	27.84	757.47	29.34	757.47	27.64	757.47	28.14	757.47	27.64	756.65	29.96	755.95	30.26
2	756.65	29.96	0	0	756.39	29.62	755.48	31.03	756.81	28.50	757.47	27.64	757.47	28.14	757.47	28.64	757.47	27.94	757.47	27.64	756.65	29.46	755.95	30.66
3	756.65	29.96	0	0	756.65	29.26	755.48	31.13	756.81	28.50	757.47	27.64	757.47	27.54	757.47	29.64	757	29	757.47	27.64	756.65	29.16	755.95	30.66
4	756.65	29.96	0	0	756.65	29.26	755.48	31.13	756.31	29.10	757.47	27.64	757.47	27.54	757.47	29.14	757	28	757.47	27.64	756.65	29.16	755.95	30.96
5	756.65	29.96	0	0	756.65	29.26	755.48	31.13	756.31	29.10	757.47	27.54	757.47	27.84	757.47	28.84	757	28	757.47	27.64	756.65	29.16	755.95	30.76
6	756.65	29.96	0	0	756.65	29.26	0	0	756.00	29.51	757.47	27.54	757.47	27.54	757.47	27.74	757	29	757.47	27.54	756.65	29.16	755.95	30.76
7	756.65	29.96	0	0	756.65	29.26	0	0	757.03	28.28	757.47	27.54	757.47	27.84	757.47	27.44	757	29	757.47	27.64	756.65	29.46	755.95	30.76
8	756.65	29.96	0	0	756.65	29.26	0	0	756.96	28.25	757.47	27.54	757.47	27.54	757.47	26.64	757	28	757.47	27.54	756.65	29.46	755.95	30.56
9	756.03	30.18	0	0	756.65	29.26	0	0	756.96	28.15	756.75	28.66	757.47	27.44	757.47	26.44	757	28	757.47	27.54	756.65	29.46	755.95	30.36
10	756.03	30.18	0	0	756.65	29.26	0	0	756.96	28.25	756.75	31.86	757.47	27.44	757.47	26.54	757	28	757.47	27.54	756.65	29.46	755.95	30.26
11	756.03	29.68	0	0	756.65	29.26	0	0	756.96	28.25	757.23	28.78	757.47	27.44	757.47	27.64	757.47	28.54	757.47	27.54	756.65	29.46	755.95	30.26
12	0	0	754.66	30.75	756.65	29.26	0	0	756.96	28.25	757.47	28.64	757.47	27.44	757.47	27.64	757.47	28.64	757.47	27.54	756.65	29.46	755.95	30.56
13	0	0	754.66	30.45	756.65	29.36	0	0	756.96	28.25	757.47	27.64	757.47	27.64	757.47	27.94	757.47	28.64	757.47	27.54	756.65	29.46	755.95	30.56
14	0	0	754.66	30.85	756.65	29.36	0	0	756.96	28.25	757.47	27.64	757	27	757.47	28.14	757.47	28.34	757.47	27.54	756.65	29.46	755.95	30.56
15	0	0	754.66	30.85	756.65	29.16	0	0	756.96	28.25	757.47	27.64	757	27	757.47	28.34	757.47	28.24	757.47	27.54	756.65	29.46	755.95	30.56
16	0	0	754.66	30.95	756.65	29.36	0	0	756.48	28.83	757.47	27.64	757	27	757.47	28.34	757.47	28.64	757.47	27.64	756.65	29.46	755.95	30.56
17	0	0	754.66	30.95	756.65	29.36	0	0	756.48	28.93	757.47	27.54	757.47	27.64	757.47	28.24	757.47	28.34	757.47	27.54	756.65	29.46	755.95	30.56
18	0	0	754.66	30.95	756.65	29.26	0	0	756.48	28.93	757.47	27.54	757.47	27.54	757.47	28.54	757.47	27.54	757.47	27.54	756.65	29.26	755.95	30.66
19	0	0	754.66	30.95	756.65	29.36	0	0	756.48	28.93	757.47	27.54	757.47	27.54	757.47	28.44	757.47	27.64	757.47	27.54	756.65	29.36	755.95	30.66
20	0	0	755.75	29.66	756.65	29.26	756.91	29.20	756.48	28.93	756.75	28.66	757.47	27.64	757.47	28.44	757.47	27.64	757.47	26.14	756.65	29.36	755.95	30.66
21	0	0	755.75	29.46	756.65	29.76	756.91	29.20	756.48	29.03	757.13	28.08	757.47	27.44	757.47	28.64	757.47	27.64	0	0	756.65	29.36	755.95	30.66
22	0	0	755.75	29.46	756.65	29.26	756.91	28.80	757.47	27.74	757.47	27.64	757.47	27.34	757.47	28.64	757.47	27.54	0	0	756.65	29.36	755.95	30.46
23	0	0	755.75	29.76	756.65	29.26	756.91	28.70	757.47	27.64	757.47	27.54	757.47	27.34	757.47	28.84	757.47	27.54	0	0	756.65	29.36	755.95	30.06
24	0	0	755.75	29.76	756.65	29.26	756.91	29.70	757.47	27.64	757.47	27.54	757.47	27.34	757.47	28.94	756.63	28.88	0	0	756.65	29.36	755.95	30.16
25	0	0	755.75	29.76	756.65	29.16	756.91	28.60	756.63	28.48	757.47	27.44	757.47	27.34	757.47	28.94	757.47	27.74	0	0	756.65	29.36	755.95	28.56
26	0	0	755.75	29.76	756.65	28.56	756.81	28.80	756.63	29.38	757.47	27.54	757.47	27.34	757.47	29.14	757.47	27.64	754	30	756.65	29.26	755.95	28.86
27	0	0	755.75	29.76	756.65	29.16	756.81	29.00	757.47	27.64	757.47	27.64	757.47	27.54	757.47	28.14	757.47	27.64	756	29	756.65	29.26	755.95	29.16
28	0	0	756.65	29.26	756.65	29.26	756.81	28.60	757.47	27.64	757.47	27.54	757.47	27.54	757.47	28.14	757.47	27.64	756	29	756.65	29.26	755.95	28.96
29	0	0	756.39	29.62	756.65	29.26	756.56	28.85	757.47	27.64	757.47	27.94	757.47	27.54	757.47	28.14	757.47	27.64	756	31	756.65	29.26	755.95	28.96
30	0	0			756.65	29.26	756.56	28.85	757.47	27.64	757.47	28.64	757.47	27.54	757.47	28.14	757.47	27.64	756	31	756.65	29.26	755.95	28.86
31	0	0			756.65	29.26			757.47	27.64			757.47	27.44	757.47	27.84			757	30			755.95	28.86

Year 2010
Tail Water Elevation (TWE) & Gross Head (Ft)

Date	Jan TWE	Jan Gross Head	Feb TWE	Feb Gross Head	Mar TWE	Mar Gross Head	Apr TWE	Apr Gross Head	May TWE	May Gross Head	Jun TWE	Jun Gross Head	Jul TWE	Jul Gross Head	Aug TWE	Aug Gross Head	Sep TWE	Sep Gross Head	Oct TWE	Oct Gross Head	Nov TWE	Nov Gross Head	Dec TWE	Dec Gross Head
1	755.75	28.96	0	0	0	0	756.03	29.88	756.18	29.03	757.29	28.82	757.47	28.64	757.43	29.48	757.33	28.78	757.33	29.28	755.75	31.26	756.27	30.34
2	755.75	28.96	0	0	755.75	31.06	756.03	30.88	756.18	29.03	757.29	28.82	757.47	28.34	757.43	29.48	757.33	28.78	757.33	29.28	756.65	29.96	756.27	30.34
3	755.75	29.06	753.93	29.98	755.75	28.96	756.03	31.58	756.18	28.93	757.29	28.82	757.47	28.34	757.43	29.98	757.21	28.90	757.33	29.18	756.65	30.26	756.27	30.34
4	755.75	28.96	753.58	30.63	755.75	30.86	756.03	31.58	756.18	28.93	757.29	28.82	757.47	28.34	757.43	29.28	757.33	28.78	757.33	29.28	756.65	29.96	756.27	30.34
5	755.75	28.96	753.93	30.28	756.03	30.58	756.03	31.58	756.18	28.93	757.29	28.82	757.47	28.44	757.43	29.08	757.33	28.78	757.21	29.40	756.65	29.96	756.45	29.66
6	755.75	28.96	753.93	30.28	756.03	30.58	756.03	31.58	757.02	27.99	757.29	28.82	757.47	28.54	757.43	28.78	757.33	29.78	757.21	29.40	756.65	29.96	756.45	29.16
7	755.75	28.96	753.93	30.38	756.03	30.58	756.03	31.58	757.02	27.59	757.29	28.82	757.47	29.14	756.15	30.46	757.33	28.98	757.21	29.40	756.65	29.96	756.45	29.06
8	755.75	28.96	754.13	30.28	756.03	30.58	756.03	31.88	757.02	27.39	757.29	28.82	757.47	29.74	756.15	30.26	757.33	28.98	757.21	29.40	756.65	29.96	756.45	29.06
9	755.75	28.96	754.13	30.68	756.03	30.58	756.03	31.78	757.02	27.59	757.29	28.82	757.47	28.44	756.15	30.16	757.33	28.78	757.21	29.50	756.65	30.26	756.45	29.06
10	755.75	28.96	754.13	31.78	756.03	30.58	756.03	31.78	757.02	27.69	757.29	29.32	757.47	28.64	756.66	29.05	757.33	28.78	757.21	29.40	756.65	29.96	756.45	29.46
11	0	0	754.13	33.00	756.03	30.58	756.03	31.68	757.02	27.79	757.29	29.32	757.47	30.24	757.06	30.05	757.33	28.38	757.21	29.40	756.65	29.96	756.45	28.86
12	0	0	755.75	30.56	756.03	30.58	756.03	31.68	757.02	27.99	756.57	29.94	757.47	28.14	757.06	29.35	757.33	28.78	757.21	29.40	756.65	29.96	756.45	29.66
13	0	0	755.75	30.36	756.03	30.58	756.03	31.58	757.02	29.09	756.57	29.94	757.47	29.24	757.06	29.05	757.33	28.78	757.21	29.40	756.65	29.96	756.45	29.26
14	0	0	755.75	30.86	756.03	30.08	756.03	31.78	757.02	29.09	756.57	29.94	757.47	27.54	757.06	29.05	757.33	28.78	757.21	29.40	756.65	29.96	756.45	29.46
15	0	0	755.75	30.86	756.03	30.08	756.03	31.58	757.02	29.09	756.95	29.66	757.47	27.54	757.06	28.55	757.33	29.28	757.21	29.40	756.65	29.96	756.45	29.56
16	0	0	755.75	30.86	756.03	30.08	0	0	756.66	29.45	756.95	29.66	757.47	27.64	757.06	29.05	757.33	29.08	757.33	29.28	756.65	29.86	756.45	29.56
17	0	0	755.75	30.86	756.03	30.48	0	0	756.66	29.45	756.95	29.16	757.47	28.14	757.06	28.55	757.33	29.08	757.33	29.28	756.65	29.86	756.45	29.56
18	0	0	755.75	30.86	756.03	30.48	0	0	756.66	29.45	756.80	29.31	756.75	29.26	757.06	30.55	757.33	30.68	757.33	29.28	756.65	29.86	756.45	29.56
19	0	0	755.75	30.86	756.03	30.48	0	0	756.66	29.45	756.80	29.31	757.47	30.64	757.20	30.21	757.33	29.48	757.33	29.38	756.65	29.86	756.45	29.56
20	0	0	755.75	30.86	756.03	31.08	0	0	756.66	29.45	756.80	29.31	757.47	28.44	757.20	29.41	757.33	28.98	757.33	29.48	756.65	29.96	756.45	29.66
21	0	0	755.75	30.86	756.03	31.18	0	0	756.66	29.45	756.80	29.31	757.47	28.94	757.20	28.91	757.33	28.88	757.33	29.28	756.65	29.96	756.45	29.66
22	0	0	755.75	30.86	756.03	31.18	0	0	756.66	29.45	756.80	29.31	757.47	28.44	757.20	29.41	757.33	29.28	757.33	29.28	756.65	29.96	756.45	29.66
23	0	0	755.19	31.42	756.03	31.18	0	0	756.66	29.45	757.47	28.64	756.75	28.96	757.20	29.21	757.33	30.28	757.33	29.58	756.54	30.07	756.45	29.66
24	0	0	755.19	31.42	756.03	31.18	0	0	756.66	29.45	757.47	28.64	757.13	29.98	757.20	30.41	757.33	29.58	757.33	29.78	756.54	30.07	756.45	29.66
25	0	0	755.19	30.92	756.03	31.18	0	0	756.66	29.45	757.47	28.64	757.29	29.32	756.91	28.70	757.33	29.28	757.33	29.38	756.27	30.84	756.45	28.16
26	0	0	0	0	756.03	31.18	0	0	756.87	29.24	757.47	28.64	757.29	28.62	756.91	29.00	757.33	29.68	755.75	31.26	756.27	30.84	756.45	29.66
27	0	0	0	0	756.03	31.18	0	0	756.87	29.24	757.47	28.64	757.29	28.92	756.91	29.10	757.33	29.68	755.75	30.86	756.27	30.84	756.45	29.66
28	0	0	0	0	756.03	31.38	0	0	756.87	29.24	757.47	30.04	757.29	29.02	756.91	29.40	757.33	29.48	755.75	31.16	756.27	30.34	756.45	29.66
29	0	0			756.03	31.48	756.03	28.98	757.29	28.82	757.47	28.64	757.43	28.98	756.91	29.50	757.33	29.28	755.75	31.26	756.27	30.34	756.45	29.66
30	0	0			756.03	31.28	756.18	28.63	757.29	28.82	757.47	28.34	757.43	27.58	756.91	29.40	757.33	29.28	755.75	31.26	756.27	30.34	756.45	29.66
31	0	0			756.03	30.88			757.29	28.82			757.43	28.18	757.33	28.78			755.75	31.26			756.45	29.66

Table 5 Sheet 6 of 10

Year 2011

Tail Water Elevation (TWE) & Gross Head (Ft)

Date	Jan TWE	Jan Gross Head	Feb TWE	Feb Gross Head	Mar TWE	Mar Gross Head	Apr TWE	Apr Gross Head	May TWE	May Gross Head	Jun TWE	Jun Gross Head	Jul TWE	Jul Gross Head	Aug TWE	Aug Gross Head	Sep TWE	Sep Gross Head	Oct TWE	Oct Gross Head	Nov TWE	Nov Gross Head	Dec TWE	Dec Gross Head
1	756.41	29.60	0	0	754.63	31.48	756.60	30.01	757.26	29.35	757.41	29.20	757.32	29.29	757.33	25.78	757.10	26.81	756.98	27.53	756.60	28.01	756.31	29.60
2	756.41	29.60	0	0	754.28	31.83	756.60	30.01	757.26	29.35	757.41	29.20	757.32	30.29	757.33	26.28	756.61	27.70	756.98	27.53	756.60	28.01	756.31	29.60
3	756.41	29.50	0	0	754.28	31.83	756.42	30.19	757.26	29.35	757.41	29.20	757.32	29.79	757.41	26.30	756.61	27.80	756.98	27.63	756.60	28.01	756.31	29.60
4	756.41	29.50	0	0	754.28	32.03	756.42	30.19	757.26	29.35	757.41	29.20	757.32	29.09	757.41	26.30	756.61	27.80	756.98	27.53	756.60	28.01	756.31	29.60
5	756.41	29.60	0	0	754.28	32.33	756.42	30.19	757.26	29.35	757.41	29.20	757.32	28.49	757.41	26.30	756.61	27.70	756.98	27.43	756.60	28.01	756.31	29.60
6	756.41	29.50	0	0	754.28	32.33	756.42	30.19	757.26	29.35	757.41	29.20	757.32	28.29	757.41	26.30	756.86	27.75	756.98	27.43	756.60	28.01	756.31	29.60
7	756.41	29.40	0	0	754.28	32.33	755.51	31.10	757.26	29.35	757.41	29.00	757.32	28.29	757.41	26.30	757.10	27.31	756.98	27.33	756.60	28.01	756.31	29.60
8	756.41	29.40	754.03	29.78	754.28	32.33	755.51	31.10	757.26	29.35	757.41	28.20	757.18	29.93	757.41	25.70	757.10	28.01	757.21	27.10	756.60	28.01	756.31	29.60
9	756.41	29.40	754.99	31.62	755.41	31.20	755.51	31.10	757.26	29.35	757.41	28.40	757.18	29.43	757.41	26.70	757.10	28.21	757.21	27.10	756.60	27.51	756.31	29.60
10	756.41	29.40	754.99	30.72	755.41	31.20	755.51	31.10	757.31	29.30	757.41	28.50	757.18	30.03	757.41	26.80	757.10	29.51	757.21	27.10	756.60	28.01	756.31	29.60
11	756.41	29.40	756.36	29.35	756.36	30.25	755.51	31.10	757.31	29.60	0	0	757.18	28.93	757.41	26.20	757.10	28.21	757.21	27.10	756.60	28.01	756.31	29.60
12	0	0	756.36	29.55	756.36	30.25	755.47	31.14	757.31	29.30	757.41	28.20	757.18	28.43	757.41	26.20	757.10	27.31	757.21	27.00	756.60	28.01	756.31	29.60
13	0	0	756.36	29.95	756.36	30.25	755.47	31.14	757.31	29.30	757.41	28.20	757.41	28.20	757.41	28.70	757.10	27.11	757.21	27.00	756.60	28.51	756.31	29.60
14	0	0	756.36	29.75	756.36	30.25	755.47	31.14	757.31	29.60	757.31	28.30	757.41	28.20	757.41	26.70	757.10	27.11	757.21	27.00	756.60	29.01	756.31	29.60
15	756.25	29.26	755.83	30.48	756.36	30.25	757.03	29.58	757.31	29.30	757.31	28.30	756.95	30.66	757.41	29.00	757.10	27.01	757.21	27.10	756.60	29.11	756.31	29.60
16	756.25	29.56	755.83	30.48	756.36	30.25	757.03	29.58	757.31	29.30	757.31	28.70	757.19	28.82	757.41	26.30	757.10	27.11	755.72	28.49	756.60	29.21	756.31	29.60
17	756.25	29.36	755.83	30.48	756.36	30.25	757.03	29.58	757.31	29.30	757.31	28.80	757.19	28.42	757.41	26.30	757.10	29.11	755.72	28.39	756.60	29.41	756.31	29.60
18	756.25	28.66	755.83	30.78	756.60	30.01	757.03	29.58	757.31	29.30	757.41	28.40	757.19	28.42	757.41	26.30	757.10	27.91	755.72	28.59	756.60	29.51	756.31	29.60
19	0	0	755.83	30.78	756.60	30.01	757.03	29.58	757.31	29.30	757.41	28.40	757.19	28.42	757.41	28.00	757.10	27.51	755.72	28.49	756.60	29.51	756.31	29.60
20	0	0	755.83	30.78	756.60	30.51	757.03	29.58	757.41	29.20	757.41	28.40	757.37	28.04	757.41	27.20	757.10	27.01	755.72	28.39	756.60	29.41	756.31	29.60
21	0	0	755.83	30.78	756.60	30.51	757.03	29.58	757.41	29.20	757.41	28.20	757.37	27.94	757.41	27.10	757.10	27.01	755.72	28.59	756.60	29.41	756.31	29.60
22	0	0	755.83	31.08	756.60	30.51	757.03	29.58	757.41	29.20	757.41	28.20	757.37	28.04	757.41	26.70	756.98	27.23	755.72	28.89	756.60	29.41	756.31	29.60
23	0	0	755.41	31.70	756.60	30.51	757.03	29.58	757.41	29.20	757.41	28.20	757.37	29.84	757.41	26.80	756.98	27.43	755.72	29.39	756.22	29.69	756.31	29.60
24	0	0	755.11	32.20	756.60	30.51	757.03	29.58	757.41	29.20	757.41	28.20	757.41	29.50	757.41	26.70	756.98	27.33	755.72	29.49	756.22	29.69	756.31	29.60
25	0	0	755.11	31.70	756.60	30.01	757.03	29.58	757.41	29.20	757.41	28.20	757.41	30.50	757.41	26.70	756.98	27.33	755.72	29.49	756.22	29.69	756.31	29.60
26	0	0	755.11	31.50	756.60	30.01	757.15	29.46	757.41	29.20	757.41	28.50	0	0	756.70	29.11	756.98	27.43	755.72	29.49	756.10	29.81	756.31	29.60
27	0	0	754.63	31.28	756.60	30.71	757.15	29.46	757.41	29.20	757.41	28.60	755.83	25.18	757.33	27.08	756.98	27.33	755.72	29.19	756.10	29.81	756.31	29.60
28	0	0	754.63	31.38	756.60	30.01	757.15	29.46	757.41	29.20	757.41	29.30	755.33	25.48	757.33	26.98	756.98	27.33	755.72	29.69	756.10	29.81	756.31	29.60
29	0	0			756.60	30.01	757.15	29.46	757.41	29.20	757.41	28.60	757.41	24.80	757.33	26.48	756.98	27.33	755.72	29.69	756.10	29.81	756.31	29.60
30	0	0			756.60	30.01	757.26	29.35	757.41	29.20	757.41	28.20	757.41	25.20	757.33	26.48	756.98	27.53	756.60	28.51	756.18	29.73	756.31	29.60
31	0	0			756.60	30.01			757.41	29.00			757.33	25.08	757.10	26.81			756.60	28.01			756.31	29.60

Table 5 Sheet 7 of 10

Year 2012

Tail Water Elevation (TWE) & Gross Head (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	756.31	29.60	0	0	755.98	29.63	755.72	30.19	757.21	27.60	756.59	29.22	757.26	27.85	757.26	27.85	757.26	26.75	754.96	30.35	756.35	29.76	756.09	30.22
2	756.31	29.60	0	0	755.98	29.73	755.72	30.19	757.21	27.40	757.33	28.48	757.26	27.45	757.26	28.35	757.26	26.75	755.55	29.76	756.35	29.76	756.09	30.22
3	756.31	29.60	0	0	755.98	29.73	755.72	30.19	757.21	27.40	757.33	28.48	757.26	27.35	757.26	28.55	757.26	26.85	756.98	28.93	756.35	29.76	756.09	30.22
4	756.31	29.60	754.63	32.48	755.98	29.73	755.72	30.19	757.21	27.40	757.33	28.48	757.26	27.45	757.26	28.35	757.26	27.15	757.21	28.50	756.35	29.86	756.09	30.22
5	756.31	29.60	754.63	32.18	755.98	29.73	755.72	30.19	757.21	27.40	757.26	28.65	757.26	27.65	757.26	29.85	755.83	28.58	757.21	28.40	756.61	29.50	756.09	30.22
6	756.31	29.60	754.63	32.48	755.98	29.63	755.72	30.19	757.21	27.40	757.26	28.55	757.26	27.65	757.26	27.75	755.83	28.38	756.74	29.07	756.61	29.50	756.09	30.22
7	756.23	29.58	754.63	32.08	755.98	29.63	755.72	29.39	757.21	27.40	756.91	29.20	757.26	27.65	757.26	27.95	755.55	28.86	756.74	29.17	756.61	29.40	756.09	29.82
8	756.18	29.53	754.63	31.98	755.98	29.63	755.72	29.89	756.35	28.26	757.26	28.35	757.26	28.85	757.26	26.85	755.55	28.66	756.74	29.17	756.61	29.40	756.09	30.12
9	756.18	29.43	754.63	31.98	755.98	29.73	755.72	29.79	756.35	28.66	757.03	28.58	757.26	26.85	757.26	27.25	755.55	28.66	756.74	29.17	756.61	29.40	756.09	30.12
10	756.18	29.33	754.63	31.98	755.98	29.73	755.72	29.79	756.35	29.16	757.03	28.48	757.26	26.55	757.26	27.15	755.55	28.66	756.74	29.17	756.61	29.40	756.09	30.12
11	756.18	29.13	755.69	30.92	755.55	29.06	755.72	29.79	756.07	29.44	757.03	28.58	757.26	28.35	757.26	26.85	755.55	28.66	756.49	29.62	756.61	29.50	755.83	30.38
12	755.33	28.68	755.69	30.92	755.55	28.46	755.72	29.79	755.93	29.58	757.26	28.55	757.26	30.15	757.26	26.85	755.55	28.66	756.49	29.62	756.61	29.50	755.83	30.38
13	0	0	755.72	28.99	755.55	29.16	755.72	29.89	755.93	29.58	757.26	28.35	757.26	28.65	757.26	26.85	755.55	29.06	756.49	29.62	756.61	29.50	755.83	30.38
14	0	0	755.72	30.89	755.55	29.56	755.72	29.89	755.93	29.58	757.26	28.55	757.26	28.35	757.26	26.85	755.55	29.06	756.49	29.62	756.61	29.40	755.83	29.88
15	0	0	755.72	30.89	755.55	29.56	755.72	29.79	755.93	29.58	757.26	28.95	757.26	28.75	757.26	27.25	755.55	29.06	756.49	29.62	756.61	29.40	755.83	29.48
16	0	0	755.72	30.69	755.55	29.56	756.76	28.35	755.93	29.58	757.26	29.05	757.26	29.05	757.26	27.35	755.55	29.06	756.49	29.62	756.61	29.40	755.83	29.48
17	0	0	755.72	30.69	755.55	29.56	756.46	28.85	755.87	29.64	757.26	29.05	757.26	28.75	757.26	27.35	0	0	756.74	29.37	756.61	29.40	756.09	29.02
18	0	0	755.72	30.69	755.55	30.06	756.46	29.05	755.87	29.74	757.26	29.05	757.26	28.75	757.26	26.65	0	0	756.74	29.37	756.34	29.77	756.09	28.92
19	0	0	755.72	30.39	755.55	30.06	756.46	29.05	755.87	29.74	757.26	29.05	757.26	28.75	757.26	26.65	0	0	756.74	29.37	756.34	29.87	756.09	28.92
20	0	0	755.72	30.49	755.55	30.06	756.76	28.65	755.87	29.74	757.26	28.35	757.26	28.55	757.26	26.65	0	0	756.74	29.37	756.34	29.87	755.83	29.18
21	0	0	755.72	30.39	755.55	30.06	757.10	28.31	755.87	29.74	757.26	28.35	757.26	27.95	756.73	26.98	0	0	756.35	29.76	756.34	29.87	755.83	29.18
22	0	0	755.72	30.39	755.14	30.47	757.10	28.51	755.87	29.74	757.26	28.65	757.26	27.65	756.73	27.08	0	0	756.35	29.56	756.34	29.87	755.83	29.18
23	0	0	755.72	30.39	755.72	29.89	757.10	28.51	755.87	29.74	757.26	26.85	757.26	27.35	757.26	26.55	0	0	756.35	29.56	756.34	29.87	755.83	29.18
24	0	0	755.72	30.39	755.72	29.89	757.10	28.31	753.23	32.38	757.26	26.85	757.26	27.35	757.26	27.15	0	0	756.35	29.56	756.34	29.87	755.83	29.18
25	0	0	755.72	30.39	755.72	30.39	757.21	28.30	0	0	757.26	26.75	757.26	27.35	757.26	26.85	0	0	756.35	29.56	756.34	29.87	755.83	29.18
26	0	0	755.72	30.39	755.72	30.39	757.21	28.20	0	0	757.26	26.75	757.26	29.05	757.26	26.75	0	0	756.35	29.56	756.34	29.87	755.83	30.48
27	0	0	755.72	30.29	755.72	30.39	757.21	28.40	0	0	757.26	26.85	757.26	27.85	757.26	27.05	0	0	756.35	28.76	756.34	29.87	755.83	30.48
28	0	0	755.72	30.19	755.72	30.39	757.21	27.90	0	0	757.26	26.75	757.26	27.85	757.26	26.75	0	0	756.35	28.76	756.19	30.02	755.83	30.38
29	0	0	755.72	29.89	755.72	30.39	757.21	27.90	0	0	757.26	26.75	757.26	27.85	757.26	26.65	0	0	756.35	28.76	756.19	30.12	755.83	30.38
30	0	0			755.72	30.19	757.21	27.60	0	0	757.26	27.75	757.26	27.85	757.26	26.65	754.96	30.35	756.35	29.46	756.09	30.22	755.83	30.38
31	0	0			755.72	30.19			0	0			757.26	27.85	757.26	26.75			756.35	29.86			755.83	30.68

Table 5 Sheet 8 of 10

Year 2013

Tail Water Elevation (TWE) & Gross Head (Ft)

Date	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	755.83	30.38	0	0	0	0	755.72	30.39	756.97	27.64	756.61	29.20	756.61	28.70	757.33	29.98	757.41	29.50	757.28	29.33	756.60	30.01	755.96	31.15
2	755.83	30.18	0	0	0	0	755.72	28.89	756.97	27.64	756.61	29.20	757.10	27.91	757.33	29.98	757.41	29.50	757.28	29.13	756.60	30.01	755.96	31.15
3	755.83	30.18	0	0	0	0	755.72	28.69	756.84	27.77	757.10	28.51	757.10	29.41	756.98	29.93	757.41	29.70	757.28	29.23	756.60	30.01	755.96	31.15
4	755.83	30.18	0	0	754.63	30.58	755.72	28.69	756.84	27.77	757.10	28.51	757.10	29.21	757.21	30.40	757.41	29.20	757.28	29.33	756.60	30.01	755.96	31.15
5	755.83	30.08	0	0	755.83	29.28	755.72	28.89	756.84	27.77	757.10	28.51	757.10	29.21	757.21	30.40	757.41	29.50	757.28	29.33	756.60	30.01	755.96	31.15
6	755.83	30.08	0	0	755.83	29.48	755.72	28.89	756.84	27.87	757.10	28.51	757.10	28.51	757.33	29.98	757.41	29.70	757.28	29.33	756.60	30.01	755.96	31.15
7	755.83	30.08	0	0	755.83	29.28	755.72	28.89	756.84	27.87	757.10	28.51	757.10	28.11	757.33	29.78	757.41	29.70	757.28	29.33	756.60	30.01	755.96	31.15
8	755.83	30.08	0	0	755.83	29.28	755.72	28.89	756.81	28.00	757.21	28.40	757.10	28.61	757.33	30.28	757.41	29.70	757.28	29.33	756.09	30.52	755.96	31.15
9	755.83	30.08	0	0	756.09	28.82	755.72	28.89	756.81	28.00	757.21	28.40	757.10	28.61	757.33	29.88	757.41	29.70	757.28	29.33	755.83	30.78	755.96	31.15
10	755.83	30.18	0	0	756.09	28.82	755.72	28.89	756.81	27.90	757.21	28.40	757.10	29.61	757.33	29.98	757.41	29.70	757.28	29.33	755.83	30.78	756.18	30.93
11	755.83	30.18	0	0	756.09	28.82	755.72	28.99	756.81	27.90	757.21	28.40	756.61	30.00	757.33	29.78	757.41	29.70	757.28	29.33	755.55	31.06	756.18	30.93
12	754.13	28.98	0	0	756.09	28.82	755.72	28.99	756.81	27.90	757.21	28.40	756.61	29.80	757.33	29.78	757.41	29.70	757.28	29.33	755.55	31.06	756.18	30.83
13	0	0	0	0	756.09	28.82	755.72	28.99	756.81	27.80	756.92	28.69	756.61	29.80	757.33	29.78	757.41	29.70	757.28	29.33	755.96	30.65	756.18	30.83
14	0	0	754.11	31.10	756.09	29.52	755.72	28.99	756.81	27.90	756.92	28.69	756.61	29.50	756.98	30.13	757.41	29.70	757.28	29.33	755.96	30.65	756.18	30.83
15	0	0	754.11	31.10	756.09	30.22	755.72	28.99	756.81	27.90	757.04	28.57	756.61	29.70	756.61	30.90	757.41	29.70	757.15	29.46	755.96	30.65	756.18	30.83
16	0	0	753.71	31.50	756.09	30.22	757.00	27.81	756.54	28.27	757.04	28.07	757.41	29.00	756.61	30.50	757.41	29.70	756.60	30.01	755.96	30.65	756.18	30.83
17	0	0	0	0	756.09	30.32	757.00	27.81	756.54	28.27	757.04	28.07	757.41	29.20	756.61	30.60	757.41	29.70	756.60	30.01	755.96	30.65	756.18	30.83
18	0	0	0	0	756.09	30.32	757.00	27.81	756.54	28.27	757.04	27.77	757.41	29.20	756.61	30.60	757.33	29.98	756.60	30.01	755.96	30.65	756.18	30.83
19	0	0	0	0	756.09	29.62	757.00	27.81	756.54	28.27	757.04	27.77	757.21	29.90	756.61	31.00	757.33	29.98	756.60	30.01	755.96	30.65	756.18	30.73
20	0	0	0	0	756.09	29.52	757.00	27.81	756.54	28.27	757.04	28.57	757.21	30.10	756.61	30.70	757.33	30.28	756.60	30.01	755.96	30.95	756.18	30.83
21	0	0	0	0	756.09	29.52	757.00	27.81	757.10	28.11	757.04	28.57	757.21	30.20	756.61	31.00	757.33	29.98	756.60	30.01	755.96	31.15	756.18	30.93
22	0	0	0	0	755.72	29.89	757.00	27.81	757.10	28.11	757.04	28.57	757.21	29.90	756.61	31.00	757.33	29.88	755.88	30.73	755.96	31.15	756.18	30.93
23	0	0	0	0	755.72	30.39	757.00	27.61	757.10	28.11	757.04	28.57	757.21	30.40	756.61	31.00	757.33	29.78	755.81	31.20	755.96	31.15	756.18	30.93
24	0	0	0	0	755.72	30.39	757.00	27.61	757.10	28.51	757.04	28.57	757.21	30.40	756.61	31.00	757.33	29.68	755.81	31.20	755.96	31.15	756.18	30.93
25	0	0	0	0	755.72	30.39	757.00	27.61	757.10	28.51	757.21	28.40	756.98	30.63	756.61	31.00	757.10	30.01	755.81	31.20	755.96	31.15	756.18	30.93
26	0	0	0	0	755.72	30.39	757.00	27.61	757.10	28.51	757.33	28.28	757.33	29.58	756.61	31.00	757.10	30.01	755.81	30.80	755.96	31.15	756.18	28.43
27	0	0	0	0	755.72	30.39	756.66	28.05	757.10	28.71	757.33	28.28	757.33	29.98	757.10	30.51	757.10	29.71	755.81	30.80	755.96	31.15	756.18	28.43
28	0	0	0	0	755.72	30.39	756.66	28.05	757.10	28.51	757.33	27.78	757.33	29.98	757.41	29.20	757.28	29.33	755.81	30.80	755.96	31.15	756.18	28.43
29	0	0			755.72	30.39	756.66	28.05	757.10	28.51	757.33	27.18	757.33	29.98	757.41	29.80	757.28	29.33	755.81	30.80	755.96	31.15	756.18	28.43
30	0	0			755.72	30.39	756.97	27.64	757.10	28.51	757.33	28.18	757.33	30.08	757.41	29.80	757.28	29.33	755.81	30.80	755.96	31.15	756.18	28.43
31	0	0			755.72	30.39			756.61	29.20			757.33	29.98	757.41	27.70			755.81	30.80			756.18	28.43

Table 5 Sheet 9 of 10

Year 2014

Tail Water Elevation (TWE) & Gross Head (Ft)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	756.18	28.43	0	0	756.26	30.85	755.58	31.53	756.84	29.77	757.26	29.35	757.06	29.55	757.06	27.55	756.90	30.21	757.14	29.97	756.64	30.47	756.14	30.97
2	756.18	28.43	0	0	756.26	30.65	755.58	31.53	756.84	29.77	757.26	29.35	757.06	29.55	757.06	27.55	756.90	30.21	757.14	29.97	756.64	30.47	756.14	30.97
3	756.18	28.43	753.92	29.19	756.26	30.65	755.58	31.53	757.03	29.58	757.26	29.35	757.06	29.55	757.06	28.05	756.90	30.31	757.14	29.97	756.64	30.47	756.14	30.97
4	756.18	28.43	754.94	27.87	756.26	30.85	756.14	30.97	757.03	29.58	757.26	29.35	757.06	29.55	757.06	28.55	756.90	30.21	757.14	29.97	756.64	30.47	756.14	30.97
5	756.18	28.43	754.94	30.17	756.26	30.85	756.14	30.97	757.03	29.58	757.26	29.35	757.06	29.75	757.06	28.55	0	0	757.14	29.97	756.64	30.47	756.14	30.97
6	756.18	28.43	756.09	29.02	756.26	30.85	756.14	30.97	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.55	0	0	757.14	29.97	756.64	30.47	756.30	30.81
7	756.18	28.43	0	0	756.26	30.85	755.44	31.67	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.55	0	0	757.14	29.97	756.64	30.47	756.30	30.81
8	756.18	28.43	0	0	756.26	30.75	0	0	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.55	0	0	757.14	29.97	756.12	30.99	756.30	30.81
9	756.18	28.43	0	0	756.26	30.75	0	0	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.55	0	0	757.14	29.97	756.12	30.99	756.30	30.81
10	756.18	28.43	0	0	756.26	30.85	0	0	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.55	0	0	757.24	29.87	756.12	30.99	756.30	30.81
11	756.18	28.43	0	0	756.26	30.85	0	0	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.55	0	0	757.24	29.87	755.73	31.38	756.30	30.81
12	756.18	27.73	0	0	0	0	0	0	757.03	29.58	757.26	29.35	757.06	29.85	757.06	28.05	0	0	757.24	29.87	755.73	31.38	756.30	30.81
13	754.13	27.98	754.63	32.48	0	0	0	0	757.14	29.47	757.26	29.35	757.06	29.85	757.06	28.05	0	0	757.24	29.87	755.73	31.38	756.03	29.68
14	0	0	754.63	32.48	0	0	0	0	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	757.24	29.87	755.73	31.38	756.30	30.81
15	0	0	756.09	31.12	0	0	753.93	33.18	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	757.24	29.87	755.73	31.38	756.30	30.81
16	0	0	756.09	31.02	0	0	755.29	31.82	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	757.24	29.87	755.73	31.38	756.30	30.81
17	0	0	756.09	31.02	0	0	756.14	30.97	757.14	29.47	757.26	29.35	757.06	30.05	757.20	27.91	0	0	757.24	29.87	755.73	31.38	756.30	30.81
18	0	0	756.40	30.71	0	0	756.14	30.97	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	757.24	29.87	755.73	31.38	756.30	30.81
19	0	0	756.40	30.71	0	0	755.87	31.24	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	757.24	29.87	755.73	31.38	756.30	30.81
20	0	0	756.40	30.71	0	0	755.87	31.24	757.14	29.47	757.26	29.35	757.06	29.85	757.02	28.59	0	0	757.24	29.87	755.73	31.38	756.30	30.81
21	0	0	756.26	30.85	0	0	755.87	31.24	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	755.87	31.44	755.73	31.38	756.30	30.81
22	0	0	756.26	30.85	0	0	756.66	30.45	757.14	29.47	757.26	29.35	757.06	29.85	757.20	28.41	0	0	755.87	31.24	755.73	31.38	756.30	30.81
23	0	0	756.26	30.85	0	0	756.66	29.95	757.26	29.35	757.26	29.35	757.06	29.85	757.20	28.41	0	0	755.87	31.24	755.73	31.38	756.30	30.81
24	0	0	756.26	30.85	0	0	757.03	29.58	757.26	29.35	757.26	29.35	757.06	29.85	756.90	30.31	754.98	28.63	755.87	31.24	755.73	31.48	756.45	30.66
25	0	0	756.26	30.85	0	0	757.03	29.58	757.26	29.35	757.26	29.35	757.06	28.85	756.90	30.31	756.14	29.47	755.87	31.24	755.73	31.38	756.45	29.16
26	0	0	756.26	30.85	0	0	757.03	29.58	757.26	29.65	757.26	29.35	757.06	29.05	756.90	30.31	756.14	30.97	755.87	31.24	756.14	30.97	756.45	27.26
27	0	0	756.26	30.85	0	0	756.84	29.77	757.26	29.35	757.26	29.35	757.06	29.05	756.90	30.31	756.14	31.17	755.87	31.24	756.14	30.97	756.32	27.49
28	0	0	756.26	30.85	0	0	756.84	29.77	757.26	29.35	757.26	29.35	757.06	29.05	756.90	30.31	756.14	31.47	755.87	31.24	756.14	30.97	756.32	27.49
29	0	0			0	0	756.84	29.77	757.26	29.35	757.26	29.35	757.06	29.05	756.90	30.31	756.14	31.47	755.87	31.24	756.14	30.97	756.06	27.85
30	0	0			0	0	756.84	29.77	757.26	29.35	757.26	29.35	757.06	28.05	756.90	30.21	756.14	31.47	755.87	31.24	756.14	30.97	756.06	27.85
31	0	0			754.98	32.13			757.26	29.35			757.06	28.05	756.90	30.21			755.87	31.24			756.06	27.85

Table 5 Sheet 10 of 10
Year 2015
Tail Water Elevation (TWE) & Gross Head (Ft)

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Date	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head	TWE	Gross Head
1	756.06	27.85	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.26	28.15	757.38	27.63	757.36	28.15	757.14	29.77	756.14	29.97	755.87	30.74
2	756.06	27.85	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.26	28.15	757.38	27.73	757.36	28.75	757.26	29.35	756.14	29.77	755.87	31.14
3	756.06	27.85	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.26	28.15	757.38	27.73	757.47	28.24	757.38	29.63	756.30	29.31	755.87	31.14
4	756.06	27.95	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.38	27.83	757.38	27.93	757.47	27.44	757.38	29.63	756.30	29.31	755.87	31.04
5	756.06	27.95	0	0	0	0	0	0	756.78	29.83	757.31	29.30	757.47	27.64	757.38	27.73	757.47	28.74	757.38	29.63	756.01	30.60	755.52	31.49
6	756.06	27.95	0	0	0	0	0	0	756.78	29.73	757.31	29.20	757.47	27.64	757.38	27.33	757.23	28.38	757.38	29.93	756.01	30.60	755.87	31.04
7	756.06	27.95	0	0	0	0	0	0	757.14	29.37	757.31	29.20	757.47	27.64	757.38	27.63	757.23	28.78	757.31	29.30	756.01	30.60	755.87	31.44
8	756.06	27.85	0	0	0	0	0	0	757.14	29.47	757.31	29.30	757.47	27.64	757.38	27.53	757.38	28.63	757.31	29.60	756.01	30.40	755.87	31.04
9	756.06	27.85	0	0	0	0	0	0	757.14	29.47	757.31	29.30	757.47	27.74	757.21	27.50	757.38	28.53	757.31	29.30	756.01	30.40	755.87	31.14
10	756.06	27.85	753.93	33.18	0	0	0	0	757.14	29.47	757.31	29.20	757.47	27.64	757.21	27.90	757.38	28.63	757.31	29.30	756.01	30.40	755.87	31.14
11	756.06	27.85	753.93	33.18	0	0	0	0	757.14	29.47	757.31	28.80	757.10	29.51	757.21	27.90	757.38	29.23	757.31	28.60	756.01	30.40	755.87	31.04
12	753.73	28.18	753.93	33.18	0	0	0	0	757.14	29.47	757.38	29.03	757.10	29.51	756.98	29.13	757.38	29.43	757.31	28.30	756.01	30.60	755.87	31.04
13	0	0	754.48	32.63	0	0	754.98	31.93	757.14	29.47	757.38	29.03	757.10	29.51	756.98	29.83	757.38	29.43	757.31	28.00	756.01	30.50	755.87	31.14
14	0	0	754.48	32.63	0	0	754.98	31.93	757.14	29.47	757.38	29.03	757.38	29.03	756.98	29.63	757.38	29.43	757.31	28.00	756.01	30.60	755.87	31.04
15	0	0	754.48	32.63	0	0	754.98	31.93	757.14	29.47	757.38	29.03	757.38	29.03	756.98	29.63	757.38	29.43	757.31	27.60	756.01	30.60	755.58	31.53
16	0	0	754.48	32.63	0	0	754.98	31.83	757.14	29.47	757.14	29.37	757.38	28.93	756.98	29.63	757.38	29.43	755.75	29.36	756.01	30.60	755.58	31.53
17	0	0	754.48	32.63	0	0	756.40	30.41	757.14	29.47	757.14	29.37	757.38	29.03	756.98	29.63	757.38	28.93	755.75	30.76	756.01	30.60	756.01	30.90
18	0	0	755.44	31.67	0	0	756.40	30.21	757.14	29.47	757.14	29.37	756.91	29.00	757.14	29.67	757.38	28.73	755.75	30.76	756.01	30.60	756.01	30.90
19	0	0	755.44	31.67	0	0	756.40	30.21	757.14	29.47	757.38	29.03	756.91	29.50	757.14	29.77	757.38	28.73	755.75	30.86	756.01	30.60	756.01	30.90
20	0	0	755.44	31.47	0	0	756.19	30.42	757.14	29.47	757.26	29.15	756.91	29.20	757.14	29.97	757.38	28.63	755.75	30.86	756.01	30.60	756.01	30.90
21	0	0	0	0	0	0	756.19	30.42	757.14	29.47	757.26	29.15	756.91	28.70	757.38	29.73	757.38	28.43	755.75	30.76	756.01	30.60	756.01	30.90
22	0	0	0	0	0	0	756.19	30.42	757.14	29.47	757.26	29.15	756.91	29.20	757.38	29.73	757.26	29.25	755.75	30.16	756.01	30.60	756.01	30.90
23	0	0	0	0	0	0	756.19	30.42	757.14	29.47	757.26	29.15	757.38	28.73	757.38	29.73	0	0	755.75	30.16	756.01	30.80	756.01	30.90
24	0	0	0	0	0	0	756.19	30.42	757.31	29.30	757.26	29.15	757.38	27.83	757.38	29.73	0	0	755.75	30.16	756.01	30.60	756.01	30.90
25	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.26	29.15	757.38	27.83	757.47	29.64	0	0	755.75	30.16	756.01	30.60	756.01	30.90
26	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.26	28.65	757.38	27.83	757.47	29.54	0	0	755.75	30.06	756.01	30.60	756.01	27.10
27	0	0	0	0	0	0	756.19	30.42	757.31	29.20	757.38	28.23	757.38	27.73	757.47	29.64	0	0	755.75	30.06	756.01	30.60	756.01	27.30
28	0	0	0	0	0	0	756.19	30.42	757.31	29.20	756.66	29.55	757.38	27.73	757.47	29.64	0	0	755.75	30.36	756.01	30.60	756.17	27.44
29	0	0			0	0	756.19	30.42	757.31	29.20	756.66	29.25	757.38	27.53	757.47	29.64	755.59	31.52	755.75	30.36	755.87	30.74	756.17	27.44
30	0	0			0	0	756.19	30.42	757.31	29.30	757.26	27.95	757.38	27.63	757.47	29.64	755.59	31.52	755.75	30.86	755.87	30.74	756.22	27.39
31	0	0			0	0			757.31	29.10			757.38	27.63	757.47	28.94			755.75	30.56			756.30	27.31

Table 8

Mean Monthly Flow (Cumecs) Passing through Turbine

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	10.96	28.14	30.03	33.38	38.63	37.91	32.82	37.04	28.22	26.17	29.57	7.13
2007	0.00	10.51	0.00	32.66	40.38	39.91	38.81	39.80	38.94	24.32	30.74	26.73
2008	10.34	11.94	30.89	15.14	33.84	39.50	40.56	40.56	40.00	30.55	30.88	24.58
2009	9.08	16.40	13.92	17.83	38.43	39.39	39.52	40.20	37.62	26.92	25.71	24.83
2010	7.12	13.76	23.46	14.86	32.44	36.76	39.55	35.52	38.76	34.94	29.75	28.91
2011	13.89	15.87	24.85	30.52	39.58	39.04	36.67	39.96	35.41	29.45	29.67	28.03
2012	10.32	17.92	21.62	28.45	22.04	38.19	38.69	38.29	14.07	30.08	29.11	24.19
2013	8.57	0.96	21.56	28.45	34.00	36.68	36.94	36.12	39.77	32.00	25.76	26.24
2014	10.74	17.10	10.15	20.40	36.46	38.10	35.72	36.52	10.29	32.06	24.77	26.98
2015	9.05	5.36	0.00	14.56	35.53	38.49	38.63	38.36	29.38	29.78	24.15	23.21
Monthly Mean	9.01	13.80	17.65	23.63	35.13	38.40	37.79	38.24	31.25	29.63	28.01	24.08

CHAPTER 4

Geology and Geotechnical Studies

CHAPTER – 4

GEOLOGY AND GEOTECHNICAL STUDIES

4.1 GENERAL

This section deals with general geological setting of the project area, investigations and testing carried out, the foundation conditions and construction materials.

The regional geologic and tectonic setup has mainly been inferred from the available literature and maps.

4.2 GEOLOGICAL SETTING

Physiographically the area exhibits various types of landform, characterized by low hills of salt range, plateau to the west and vast alluvial plains towards East and South. The relief ranges from 187 meters near Kot Momin to 444 meters near Jhelum. The drainage pattern of the area is generally dendritic to parallel type. Jhelum and Chenab rivers alongwith their tributaries, canals and links contribute to the main source of ground water, recharge and surface water supplies for irrigation purposes. Jhelum river flows to the west of the project area within a short distance (5-6 km).

Rocks of Siwalik group of Pliocene age are exposed, on left bank of upper Jhelum canal, in a limited area. However Khokhra Power Project is located on right bank of the canal in an alluvial plane.

4.3 GEOLOGY

The project area lies in the Chaj Doad between Sarai Alamgir and Mandi Bahauddin, close to the head Rasul.

There are no rock exposures in the project site. The area is almost totally comprised of the alluvium deposited by the Chaj Doad rivers and their layers. The top layer is the sandy silt which is underlain by silty sand, sand with thin layers of silt, silty clay etc. Some gravels were also encountered in the sandy strata at 93' (GTC1), 90' (GTC2), 50' (GTC3), 53' (GTC4) and at 46' (GTC5).

4.3.1 Stratigraphy

Sedimentary rocks ranging in age from Pliocene to Recent are exposed in close proximity towards North & North West of the project. These rocks were deposited in continental environment. These are represented by the Nagri, Dhok Pathan and Soan formations.

Rock formation of upper Tertiary, Siwalik group, are succeeded by Quaternary sediments comprising predominantly of sand, silt and clay or a mixture of these sediments. The sediments have been deposited by Jhelum river and its tributaries (present and the old).

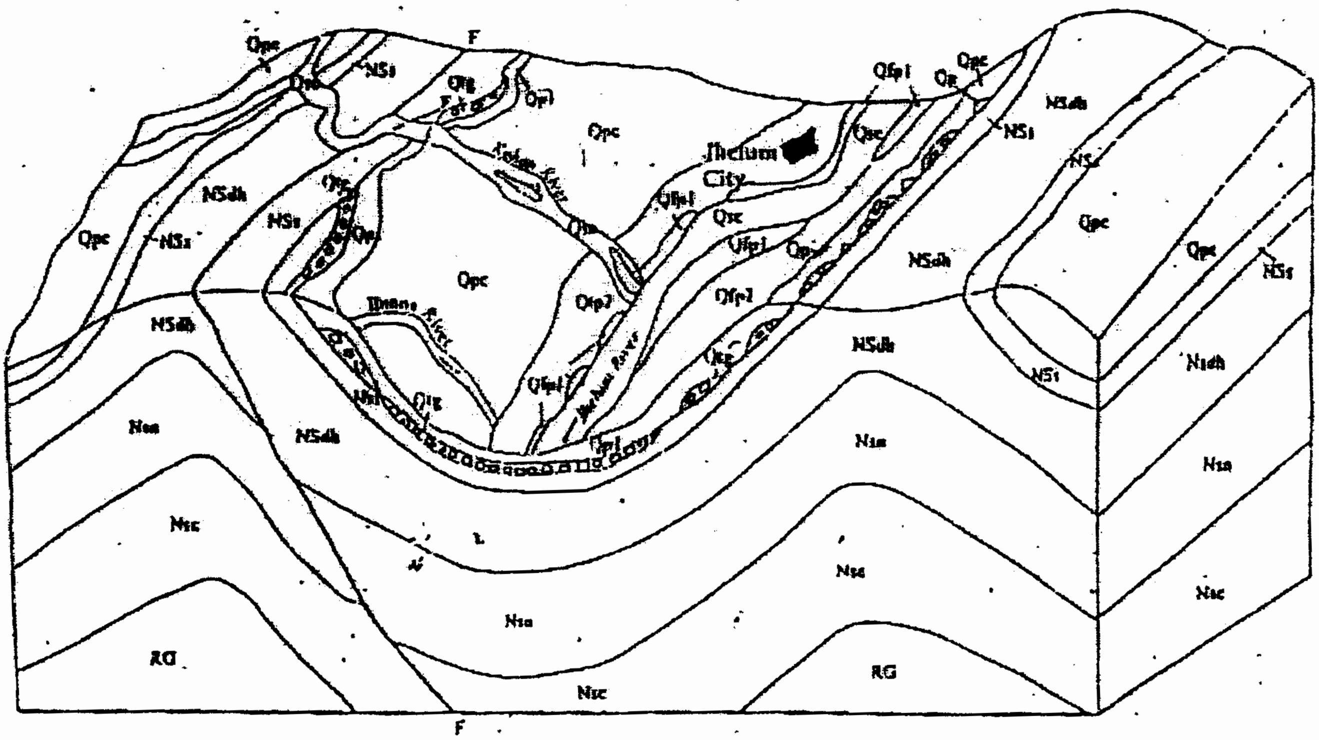
A generalized stratigraphic sequence of the Project area is an explained in the Table-1 below.

Table – 1 : The Generalized Stratigraphic Sequence of the Area

<table>
<tr><th colspan="2">Time Unit</th><th colspan="2">Rock Unit</th><th rowspan="2">Formation</th><th rowspan="2">Description</th><th rowspan="2">Thickness</th></tr>
<tr><th>ERA</th><th>Period</th><th>EPOCH</th><th>Group</th></tr>
<tr><td rowspan="11">CENOZOIC</td><td rowspan="8">QUATERNARY</td><td rowspan="2">RECENT</td><td rowspan="8"></td><td>Stream channel deposits</td><td>Unconsolidated sand, silt sand and detrial material</td><td>3 m</td></tr>
<tr><td>Younger flood plain deposits</td><td>Silty clay and fine sand</td><td>2 – 4 m</td></tr>
<tr><td rowspan="4">SUBRECENT</td><td>Older flood plain deposits</td><td>Loamy clay, sand and gravel</td><td>5 m</td></tr>
<tr><td>Potwar loessic clay deposits</td><td>Clay, silty clay with gravel</td><td>27 m</td></tr>
<tr><td>Sub-piedmont deposits</td><td>Clay and silty clay, silt and marl bands</td><td>21 m</td></tr>
<tr><td>Piedmont deposits</td><td>Loamy clay and clay with conglomerates</td><td>17 m</td></tr>
<tr><td rowspan="2">PLEISTOCENE</td><td>Terrace gravel deposits</td><td>Gravel, pebbles and cobbles in sandy matrix</td><td>20 m</td></tr>
<tr><td colspan="3">Unconformity</td></tr>
<tr><td rowspan="3">TERTIARY</td><td rowspan="3">PLIOCENE</td><td rowspan="3">SIWALIK</td><td>Soan Formation</td><td>Sandstone, conglomeratic sandstone and claystone – Disconformity -</td><td>234 m</td></tr>
<tr><td>Dhok Pathan Formation</td><td>Alternatic bands of sandstone and claystone</td><td>787 m</td></tr>
<tr><td>Nagri Formation</td><td>Sandstone with minor claystone – Based is not exposed-</td><td>+ 343 m</td></tr>
</table>

* Adopted from GSP Information Release No. 699.

The following block diagram shows the common surface material that overlie the bed rock in the Jhelum Valley.



LEGEND

Qsc	Stream channel deposits
Qfp1	Younger flood plain deposits
Qfp2	Older flood plain deposits
Qpc	Potwar loessic clay deposits
Qp	Sub-Piedmont deposits
Qp1	Piedmont deposits
Qtg	Terrace gravel deposits

~~~ UNCONFORMITY ~~~

NSs	Soan Formation
NSdh	Dhok Pathan Formation
Nsn	Nagri Formation
Nsc	Chinji Formation
RG	Rawalpindi Group

Block Diagram Showing Common Surface Materials that Overlie the Bed Rock in Jhelum Valley
~~~

4.4 GEOTECHNICAL INVESTIGATION

The location plan of the subsurface geotechnical investigation is shown in Figure 4.1. Five number of bore holes (GTC-1, GTC-2, GTC-3, GTC-4 and GTC-5) were drilled in the structure areas of the headrace, Power house and the tail race to investigation and assess the foundation conditions and material to be encountered under the foundations.

As expected, rock was not encountered in any one of the above mentioned holes. Holes GTC-1 and GTC-2 were drilled down to 100 ft for the Power house foundations. GTC-3 was drilled upto a depth of 70 ft in head race while GTC-4 (65') and GTC-5 (50') were drilled in the tailrace area of the project.

The foundation layers of the project area generally comprise of sandy soils. Generally laboratory test results of similar soils are unreliable due to the difficulties in obtaining undisturbed samples. Anyhow, Standard penetration tests (SPT) and permeability tests were carried in all above mentioned holes to estimate bearing capacity of the foundation material and to assess the watering requirement. SPTs are the best reliable tests in field conditions since they reflect the actual insitu conditions of the foundation soils, and thereby are considered as a reasonable basis of estimation for the bearing capacity values with a sufficient margin of safety.

The bearing capacity estimated from the SPT blow counts at a depth of 30 ft. works out to 1.76 Tons/ft^2 (170 KPa). However, at 30 ft. an overburden relief of approximately 1.8 Tons/ft^2 is also available, which can be used to advantage in the safety margin assumption of bearing capacity approximations.

Groundwater was encountered at depth of 20' – 23'. At a depth of 40' sand boiling started in GTC 1 and GTC 2 due to rush of ground water making permeability tests impossible.

All holes which were drilled show the alluvium deposited by Jhelum River and its tributaries. The top few feet were sandy silt above a 10' – 20' sand layer, under lain by 10' – 15' of clayey zone, below which the sand was encountered once again.

Geological cross section has been developed through the drilled bore holes which exhibit very well the foundation condition to be encountered during construction (Fig. 4.2).

4.5 CONSTRUCTION MATERIALS

Extensive quantities of the raw construction materials are available in close vicinity of the project which include the following:

4.5.1 Gravel

The gravel being used as aggregate for construction purposes after crushing.

The gravel is obtained from the alluvial deposits, the stream channels and the gravel terrace deposits. A number of stone crushers are working in the area providing sufficient quantities for all present construction works.

4.5.2 Sand

Plenty of medium to coarse grained sand mixed with gravel and gritty material is available and is being extracted from Jhelum, Bunha and Kohan rivers. In general the sand of the Jhelum river is coarse grained admixed with gritty material, whereas the sand of Kohan and Bunha river is medium to fine grained.

4.5.3 Clay

Silty clay is available from top layers of loessic clay deposits of potwar and older flood plain deposits of Jhelum river. The clay available in Kohan and Bunha river is plastic and calcareous.

A number of brick kilns are working in the area getting their supplies of raw material from the above mentioned areas. All production of bricks is based on the old primitive ways. No mechanical system is yet available in the area for making bricks.

SEISMIC RISK

The project site is located in the zone where the distinct earthquakes may cause minor damage to the structures with fundamental periods greater than 1.0 second, corresponding to the intensity V and VI of the M.M. Scale (Seismic Zoning Map of Punjab).

It is further added that inspite of the fact, that two well known faults (Jhelum fault & Salt range fault) are located very close to the project, no damage has been caused to the head works of UJC at RD 255 + 000 or to the head works of Gujrat branch. These structures were constructed in 1915 and are still in good condition.

BOREHOLE LOGS

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-1
SHEET #: 1 of 2
DATE STARTED: 18-10-04
DATE FINISHED: 21-10-04

PROJECT: Khokhra Hydel Project

LOCATION: UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary

CO-ORDINATES: N E:

GROUND ELEV : 779.71 **GROUNDWATER LEVEL:** 757.7 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot Preliminary

DEPTH (Feet)	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	SL cm	K cm/Sec Permeability Test	REMARKS
779.71 0		Sandy Silt/ Silty Sand: Light-Brown,very Loose, Trace to little clay, Non plastic,dry to Moist	Water	SPT									
5		Silty Sand, firm, Light Brown,Medium Dense, Trace Clay,Moist	Water	1 SPT	4	3	4	4	5	16	27	5.73×10^{-4}	Permeability Test- # 1 at 10'
10		Sand: Light-Brownish Grey,Fine to Medium grained, Medium Dense, Micacious,Moist	Water	2 SPT	5	3	4	4	2	13	28		
15		Sandy Silt, Brown, Medium dense, little clay, Non plastic, Moist	Water	3 SPT	2	3	2	3	2	10	30	7.54×10^{-4}	Permeabilily Test- # 2 at 20'
20		Clayey Silt: Brown,firm,Trace Sand, Trace Concretion Slightly Plastic,Medium dry Strength	Water	4 SPT	1	1	2	1	2	6	26		
25		Clayey Silt: Brown,firm,Trace Sand, Trace Concretion Slightly Plastic,Medium dry Strength	Water	5 SPT	2	1	1	2	2	6	22	7.67×10^{-4}	Permeability Test- # 3 at 30'
30		Sandy Silt/Silty Sand, Brown,Loose,Trace Clay	Water	6 SPT	3	2	1	2	2	7	30		
35		Sandy Silt/Silty Sand, Brown,Loose,Trace Clay,trace gravel	Water	7	8	4	7	6	8	25			Gravel in SPT shoe Size (1-1/2 x 1-1/2" x 1")
40		Sandy Silt/Silty Sand, Brown,Loose,Trace Clay,trace gravel	Water	SPT									N=25 may be Erroneous
45		Sand,Light Brownish Grey,Dense,fine to medium grained,miceceuse	Bentonite Mud	8 SPT	10	6	8	9	8	31	30		Sand Boiling at 40'
50				9	11	7	7	8	9	31	31		

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-1
SHEET #: 2 of 2
DATE STARTED: 30-10-2004
DATE FINISHED: 31-10-2004

PROJECT: Khokhra Hydel Project

LOCATION: UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary

CO-ORDINATES: N 949924.622 **E** 3268878.53

GROUND ELEV.: 779.71 **GROUNDWATER LEVEL:**757.7 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot

DEPTH	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	Sl. cm	K cm/Sec Permeability Test	REMARKS
50–55		Sand: light-brownish Grey, Dense, fine to Meo grained, Micaceouse.	Bentonite-Mud	SPT 10	10	7	7	10	11	35	30		
55–60		Sand : light, Brownish Grey, Dense, fine grained, Micaceouse, little Silt		SPT 11	15	10	8	9	8	35	35		
60–65		-do-		SPT 12	19	10	9	11	11	41	36		
65–70		-do-		SPT 13	22	13	14	10	12	49	32		
70–75		-do-		SPT 14	22	13	14	18	14	57	33		
75–80		Sand : Grey, very Dense, fine grained, Trace Silt, Micaceouse		SPT 15	13	10	9	9	7	35	30		
80–90		Sand : Gray, Dense, fine to Medium grained, Trace Silt, Micaceouse		SPT 16	14	11	10	13	12	46	32		
				SPT 17	18	12	12	12	13	49	30		
90–95		Sand: Grey,dense, fine grained, Trace Silt Micaceouse 3" Clay Path at 94		SPT 18	16	9	8	9	11	37	31		gravels at 93'
95–100		-do-		SPT 19	21	10	9	11	9	39	30		

679.71 100

End of Borehole

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-2
SHEET #: 1 of 2
DATE STARTED: 22-10-04
DATE FINISHED: 23-10-04

PROJECT: Khokhra Hydel Project
LOCATION: UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary
CO-ORDINATES: N E

GROUND ELEV.: 779.71 **GROUNDWATER LEVEL:** 757.71 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot Preliminary

DEPTH (Feet)	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	SL cm	K cm/Sec Permeability Test	REMARKS
779.71 0		SILTY Sand/SANDY SILT/Light Brown very Loose Fine grained, Trace to little Clay, Non Plastic dry to Moist	Water	SPT									
5		SILTY SAND: Light Brown,loose,Fine grained	Water	1 SPT	1	1	1	2	1	5	28	6.8×10^{-4}	Permeability Test No 1
10		SILTY SAND: Light Brown,loose,Fine grained	Water	2 SPT	3	2	2	1	2	7	30		
15		SILTY SAND: Light Brown,loose,Fine grained	Water	3 SPT	2	1	2	2	2	7	31	8.6×10^{-4}	Permeability Test No 2
20		CLAY: Brown,firm Trace Silt, Trace Sand.Medium Plastic,Medium dry strength,Wet	Water	4 SPT	2	2	1	2	3	8	30		
25		CLAYEY SILT: Brown, firm,Trace Sand, slightly Plastic, Wet.	Water	5 SPT	2	1	2	1	2	6	32	7.26×10^{-4}	Permeability Test No 3
30		SILTY Sand: Light Brown Medium dence, Fine grained, Non Plastic	Water	6 SPT	3	4	4	4	5	11	34		
35		Sand: Light Brownish Grey, Medium dence Fine grained, Trace Silt	Water	7 SPT	7	4	5	5	6	21	32		Gravel Encountered during drilling Sand Boiling after 40'
40		Sand: Light Brownish Grey, Medium dence Fine grained, Trace Silt	Mud	8 SPT	9	5	5	6	8	24	31		
45		Sand : Light Brownish grey, Medium dence fine to medium grained	Mud	9 SPT	11	6	6	7	8	27	32		
50				10	13	7	8	8	9	32	30		

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-2
SHEET #: 2 of 2
DATE STARTED: 22-10-2004
DATE FINISHED: 23-10-2004

PROJECT: Khokhra Hydel Project **LOCATION:** UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary **CO-ORDINATES:** N E

GROUND ELEV.: 779.71 **GROUNDWATER LEVEL:** 757.71 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot Preliminary

DEPTH	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	SL cm	K cm/Sec Permeability Test	REMARKS
50		-do-	Bentonite-Mud	SPT									
55		-do-		11	13	7	8	10	11	36	32		
				SPT									
60		-do-		12	14	8	7	10	12	37	31		
				SPT									
65		-do-		13	16	9	9	10	11	39	30		
				SPT									
70		Sand: Light Grey, Medium dense,fine to medium grained,Fine concretions.		14	15	9	9	11	11	40	32		
				SPT									
75		-do-		15	19	11	11	12	13	47	28		
				SPT									
80		-do-		16	15	11	10	9	10	40	30		
				SPT									
85		-do-		17	14	11	11	10	11	43	29		
				SPT									
90		-do-		18	17	8	8	9	10	35	30		GRAVELS ENCOUNTERED AT 93'
				SPT									
95		-do-		19	16	7	8	7	11	33	29		
				SPT									
100 (679.71)		End of Borehole		20	16	8	10	10	12	40	30		

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-3
SHEET #: 1 of 2
DATE STARTED: 24-10-2004
DATE FINISHED: 27-10-2004

PROJECT: Khokhra Hydel Project

LOCATION: UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary/Wash Boring

CO-ORDINATES: N E

GROUND ELEV : 781.27 **GROUNDWATER LEVEL:** 762.66 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot

Preliminary

DEPTH (Feet)	Legend	DESCRIPTION OF MATERIALS		Sample Type & No.	STANDARD PENETRATION TEST							K cm/Sec Permeability Test	REMARKS
					6"	3"	3"	3"	3"	N	SL cm		
781.27 0		Sandy Silt/Silty Sand: Light brown,V.loose, fine grained, Trace to little Clay, non-plastic,Moist	Water	SPT									
5		Sand:- Light Brownish Grey, Medium dense, Trace Silt, Moist		1 SPT	3	2	3	3	4	12	30	5.38×10^{-4}	
10		Silty Sand/Sandy Silt, Light Brown, Loose, little clay Moist		2 SPT	4	2	2	2	2	8	31		
15		Do		3 SPT	3	3	3	3	4	13	29	9.8×10^{-4}	
20		SILTY CLAY/CLAYEY Silt: Brown, very Stiff little Sand, Medium Plastic.Medium dry strength, Slightly Moist		4 SPT	5	3	4	5	5	17	31		
25		CLAY: Brown,firm,lightly Plastic, low dry Strength, Moist		5 SPT	2	1	2	2	3	8	35	1.38×10^{-4}	
30		SILTY CLAY/CLAYEY Silt, Brown,Loose, little clay, NON-Plastic		6 SPT	2	2	1	2	1	6	28		
35		Sandy Silt: Brown Loose, little clay, NON-Plastic		7 SPT	3	2	2	2	2	8	29		
40		Sand: Light Brownish Grey, Medium dense, Five to medium grained, Trace Silt		8 SPT	11	7	7	8	8	30			During Drilling Gravel encountered
45		Sand: Light-Brownish Grey, dense,fine grained, Trace Silt	Bentonite Mud	9 SPT	8	9	11	14	13	47	30		
50		-do-		10	14	9	10	11	13	43			

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-3
SHEET #: 2 of 2
DATE STARTED: 24-10-04
DATE FINISHED: 27-10-04

PROJECT: Khokhra Hydel Project

LOCATION: UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary

CO-ORDINATES: N 949924.622 **E** 3268878.53

GROUND ELEV.: 781.27 **GROUNDWATER LEVEL:** **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot

DEPTH	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	SL cm	K cm/Sec Permeability Test	REMARKS
50		Sand (Same as above)	Bentonite-Mud	SPT									During drilling Gravel encountered
55		-do-		11	12	8	8	8	9	33	29		
				SPT									
60		-do-		12	15	10	11	9	10	40	28		
				SPT									
65		-do-		13	12	7	7	8	10	32	30		
				SPT									
70		CLAY(69.6'-74') Brown,Stiff, highly Plastic, light dry strength, Moist		14	14	7	5	5	6	23	28		Clay Layer from 69.5' to 74'
				SPT									
706.27 75				15	14	9	8	10	11	38			

End of Borehole

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-4
SHEET #: 1 of 2
DATE STARTED: 28-10-04
DATE FINISHED: 29-10-04

PROJECT: Khokhra Hydel Project

LOCATION: UJC-GUJRAT BRANCH(Power House Area)

TYPE OF BORING: Straight Rotary/Wash Boring

CO-ORDINATES: N E

GROUND ELEV : 774.1 **GROUNDWATER LEVEL:** 751 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot

Preliminary

Elev.	DEPTH (Feet)	Legend	DESCRIPTION OF MATERIALS	Water	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	SL cm	K cm/Sec Permeability Test	REMARKS
774.1	0		Sandy Silt/Silty Sand:- light Brown, very Loose Trace Clay, Non Plastic, Moist.	Water	SPT									
	5		Sand: light-Grey, loose, five grained, Trace Silt- Moist		1 SPT	1	1	1	2	2	6	26	2.8×10^{-4}	
	10		Sandy Silt/Silty Sand, Light Brown, fine grained, loose, Trace Clay, Non Plastic, Moist\		2 SPT	7	2	2	3	2	9	29		
	15		Silty Clay: Brown, firm, Medium Plastic, Medium dry Strength, Moist.		3 SPT	2	1	2	2	2	7	30	1.29×10^{-4}	
	20		Silty Clay, Brown, Soft, Medium Plastic, Medium dry strength, Wet		4 SPT	1	1	0	1	1	3	32		
	25		Do		5 SPT	1	1	0	1	1	3	30	5.99×10^{-4}	
	30		Sandy Silt/Silty Sand, Brown, Loose, fine grained, Non Plastic Wet		6 SPT	1	1	2	2	2	7	29		
	35		Silty Sand Brownish Grey, Dence, Trace gravel Trace clay, Non Plastic, Wet		7 SPT	7	4	6	6	7	23	30	3.64×10^{-4}	
	40		Sand: Light Brownish Grey, Dense, fine grained Trace Silt		8 SPT	6	5	7	8	8	28	28		
	45				9 SPT	7	7	10	9	10	36	29		
	50				10	11	5	4	3	7	19	30		

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-4
SHEET #: 2 of 2
DATE STARTED: 28-10-04
DATE FINISHED: 29-10-04

PROJECT: Khokhra Hydel Project

LOCATION: UJC-GUJRAT BRANCH (POWER HOUSE)

TYPE OF BORING: Straight Rotary

CO-ORDINATES: N 950073.757 E 3268878.53

GROUND ELEV.: 774.1 GROUNDWATER LEVEL: LOGGED BY: A.Hashmi WHEATHER: Dry + Hot

DEPTH	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST							K cm/Sec Permeability Test	REMARKS
					6"	3"	3"	3"	3"	N	SL cm		
50		Sand (Same as above)	B.Mud	SPT									Gravel encountered at 53'
55		-do-		11	12	6	9	7	6	30			Gravel encountered at 57'
				SPT									
60 (714.1)				12	10	6	8	8	8	30			

End of Borehole

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. BH-1
SHEET #: 1 of 3
DATE STARTED: 10-05-2005
DATE FINISHED: 16-05-2004

PROJECT: 200 MW C.C.P.P MUREDKE

LOCATION: Centre of Project Total Depth 60m

TYPE OF BORING: Straight Rotary

CO-ORDINATES: N 848664.92 E 3314016.43

GROUND ELEV.: 207.01m GROUNDWATER LEVEL: 197.78m LOGGED BY: A.Hashmi WHEATHER: Hot / Clear

Elev.	DEPTH (Feet)	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST 6"	3"	3"	3"	3"	N	SL cm	K cm/Sec Permeability Test	REMARKS
767.28	0		CLAYEY SILT : Light brwon, very soft trace to little sand, trace concretions.	Water	Spt									
	2		Sandy Silt: Light Brown, Loose,little concretion Non Plastic,Moist,	Water	1 Spt	3	2	2	2	3	9	30	2.15x10⁴	Permeability Test at 10'
	4		CLAY = Brown,firm to Stiff, Medium plastic Moderately dry strength,Moist	Bentonite Mud	2 Spt	3	2	2	3	4	11	31		
	6		Clay, Brown, Soft,Medium Plastic, Trace Concretion Medium dry strength, Moist to Wet	Bentonite Mud	3 Spt	2	1	1	1	1	4	30		
	8		Silty Clay:- Brown, Soft, Trace Sand, Low dry Strength, Wet.	Bentonite Mud	4 Spt	2	1	1	1	1	4	28		
	10		Silty Sand:Light.Brownish Grey, fine grained, Trace Concretion	Bentonite Mud	5 Spt	5	3	4	3	5	15	30		
	12		Sandy Silt = Brown,Loose,Little Clay, Non Plastic	Bentonite Mud	6 Spt	4	2	2	2	3	9	31		
	14		Sand: Light Brownish Grey, Medium Dense, five grained, Trace Silt	Bentonite Mud	7 Spt	8	7	5	6	6	24	32		
	16		Sand:-Brownish Grey,device,fine grained Trace Concretions, Trace Silt	Bentonite Mud	8 Spt	11	7	8	8	8	31	30		
	18		Saud: Brownish Grey, dense,fine grained, Trace Silt	Bentonite Mud	9 Spt	12	8	8	7	11	34	34		Gravel encountered at 46'
717.28	20		-do-		10	11	7	8	8	8	31			

End of Borehole

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.

BOREHOLE/TESTPIT LOG

BOREHOLE NO. GTC-5
SHEET #: 2 of 2
DATE STARTED: 30-10-2004
DATE FINISHED: 31-10-2004

PROJECT: Gujrat Branch Hydro Power

LOCATION: POWER HOUSE

TYPE OF BORING: Straight Rotary

CO-ORDINATES: N 949924.622 **E** 3268878.53

GROUND ELEV.: 73.143 **GROUNDWATER LEVEL:** 1.8 **LOGGED BY:** A.Hashmi **WHEATHER:** Dry + Hot

DEPTH	Legend	DESCRIPTION OF MATERIALS	Drilling Fluid	Sample Type & No.	STANDARD PENETRATION TEST							K cm/Sec Permeability Test	REMARKS
					6"	3"	3"	3"	3"	N	SL cm		
50		Sand (as above)		Spt-10	11	7	8	8	8	31			Gravel at 46'
		Bottom of Hole											

CHAPTER 5

Power Potential & Energy Consideration

CHAPTER – 5

POWER POTENTIAL & ENERGY CONSIDERATION

5.1 GENERAL

This chapter deals with availability of power potential at Khokhra Power Station, calculation of annual energy to be generated and utilization of energy.

5.2 DESIGN HEAD

In order to achieve best possible efficiency, the principle to design any hydroelectric turbine is to design it at a head which is available most period of the time. At the same time the turbine should be able to cater for the maximum and minimum of net head in an effective manner, because the efficiency of turbine decreases when it works above or below the designed head. From the data, it was observed that Net head varies between 9.14m and 7.0 m and the value which remains available most period of the time is 8.15 meters. Keeping above in view Design Head (Hd) has been kept at 8.15 m. This value is also ideal for the design head of the turbine because it suitably caters for maximum head of 9.14m and minimum head of 7.0 m with minimum loss in efficiency.

5.3 DESIGN DISCHARGE

Over the analysed 10 year period (from January 2006 to Dec 2015), the maximum discharge in Gujrat Branch has been 1537 cusecs and the maximum discharge of Chillianwala Distributary has been 104 cusecs. Hence the maximum discharge available for power generation has been recorded as 1433 cusecs (1537 minus 104). It is observed from the Flow Duration curve that 1433 cusecs remains available for approximately 15% of the total time. Therefore the net design discharge of power generation is kept as Qd = 1433 Cusecs (40.60 m^3/sec).The Flow Duration Curve versus percentage of time is attached as **Figure 2** and the daily flows of Gujrat Branch and Chillianwala Distributary for last 10 years are given in **Table 2.**

5.4 EFFICIENCIES

For calculating the capacity of the power plant, the following efficiencies have been incorporated:

Turbine Efficiency	=	92%
Transformer efficiency	=	98%
Generator efficiency	=	96%
Combined efficiency (CE)	=	86.54%

5.5 POWER POTENTIAL

CE	=	0.8654
Qd	=	40.6 m^3 / sec

Hd	=	8.15 m
Power	=	9.81 x CE x H x Q
	=	9.81 x 0.8654 x 8.15 x 40.60
	=	2809 KW
	=	2.809 MW.
Say		**2.8 MW.**

5.6 ANNUAL ENERGY

With the above parameters in view, daily energy for the analysed ten years period has been worked out and attached as **Table 6.** The annual energy and monthly energy derived from the actual recorded flows in Gujrat Branch by 2.8 MW power plant for the period from January 2006 to December 2015 are tabulated in **Table 7**. Mean annual energy comes out to be 17.279517 GWh. Summary is as follows:

Water Year	Annual Energy (With 87.77 % Average Turbine Efficiency)	Annual Energy (With 92% Average Turbine Efficiency)
2006	16,882,650	17,695,126 kwh
2007	16,068,781	16,842,089 kwh
2008	17,365,885	18,201,616 kwh
2009	16,525,573	17,320,864 kwh
2010	17,221,930	18,050,733 kwh
2011	18,081,384	18,951,548 kwh
2012	15,783,826	16,543,421 kwh
2013	16,655,451	17,456,993 kwh
2014	15,620,374	16,372,103 kwh
2015	14,674,569	15,380,781 kwh
MEAN ANNUAL ENERGY	16,488,042	17,279,517 kwh

5.7 PLANT FACTOR:

With 87.77 % Average Turbine Efficiency, the mean annual energy over the last 10 year period is 16,488,042 kwh which in terms of plant factor comes out to be 67.0%.

5.8 UTILIZATION OF POWER

The power generated by proposed Khokhra Hydel Station shall be utilised as per Punjab Power Generation Policy 2006 (Revised 2009).

TABLES

Daily & Total Energy In the Month of Jan

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,091	28.81	55,249	0	0	0	1,091	29.11	55,824	930	27.91	45,645	780	28.01	38,420	1,030	28.65	51,893	990	28.65	49,878	820	29.43	42,438	950	27.48	45,908	878	26.90	41,533
2	1,091	28.81	55,249	0	0	0	1,091	29.01	55,632	930	27.81	45,481	780	28.01	38,420	1,030	28.65	51,893	990	28.65	49,878	820	29.23	42,150	950	27.48	45,908	878	26.90	41,533
3	1,091	28.81	55,249	0	0	0	1,091	29.01	55,632	930	27.91	45,645	780	28.11	38,557	1,030	28.55	51,712	990	28.65	49,878	820	29.23	42,150	950	27.48	45,908	878	26.90	41,533
4	1,091	28.81	55,249	0	0	0	1,091	29.01	55,632	850	28.01	41,868	780	28.01	38,420	1,030	28.55	51,712	990	28.65	49,878	820	29.23	42,150	950	27.48	45,908	878	27.00	41,687
5	1,091	28.81	55,249	0	0	0	1,091	29.01	55,632	850	27.91	41,718	780	28.01	38,420	1,030	28.65	51,893	990	28.65	49,878	820	29.13	42,005	950	27.48	45,908	878	27.00	41,687
6	1,091	28.81	55,249	0	0	0	1,091	29.01	55,632	850	27.91	41,718	780	28.01	38,420	1,030	28.55	51,712	990	28.65	49,878	820	29.13	42,005	950	27.48	45,908	878	27.00	41,687
7	1,091	28.71	55,057	0	0	0	1,091	29.01	55,632	850	27.91	41,718	780	28.01	38,420	1,030	28.45	51,531	960	28.63	48,333	820	29.13	42,005	950	27.48	45,908	878	27.00	41,687
8	1,091	28.81	55,249	0	0	0	1,091	29.01	55,632	850	27.91	41,718	780	28.01	38,420	1,030	28.45	51,531	940	28.58	47,243	820	29.13	42,005	950	27.48	45,908	878	26.90	41,533
9	1,091	28.81	55,249	0	0	0	867	29.23	44,566	850	27.91	41,718	780	28.01	38,420	1,030	28.45	51,531	940	28.48	47,078	820	29.13	42,005	950	27.48	45,908	878	26.90	41,533
10	1,091	28.81	55,249	0	0	0	867	29.23	44,566	850	27.91	41,718	780	28.01	38,420	1,030	28.45	51,531	940	28.38	46,913	820	29.23	42,150	950	27.48	45,908	878	26.90	41,533
11	1,091	28.81	55,249	0	0	0	867	28.73	43,803	850	28.81	43,064	0	0	0	1,030	28.45	51,531	940	28.18	46,582	820	29.23	42,150	950	27.48	45,908	878	26.90	41,533
12	0	0	0	0	0	0	0	0	0	352	26.93	16,670	0	0	0	0	0	0	634	27.73	30,916	357	28.03	17,597	950	26.78	44,738	252	27.23	12,067
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	357	27.03	16,969	0	0.00	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	969	28	48,241	0	0	0	0	0	0	0	0	0	0	0.00	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	969	29	48,752	0	0	0	0	0	0	0	0	0	0	0.00	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	969	28	48,411	0	0	0	0	0	0	0	0	0	0	0.00	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	969	28	47,218	0	0	0	0	0	0	0	0	0	0	0.00	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
Month Total			507,545			0			578,185			488,681			384,335			761,092			566,333			480,810			566,693			469,545

Month Average(KWHr) 490,322

Daily & Total Energy in the Month of Feb

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	0	0	0	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1,091	27.01	51,796	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0		0	23.53	0	0	0	0
3	0	0	0	1,091	27.01	51,796	0	0	0	0	0	0	300	29.03	15,315	0	0	0	0	0.00	0	0	0	0	300	28.24	14,898	0	0	0
4	0	0	0	1,091	27.11	51,988	0	0	0	0	0	0	200	29.68	10,439	0	0	0	500	31.53	27,724	0	0		600	26.92	28,403	0	0	0
5	390	29.83	20,458	1,091	27.11	51,988	0	0	0	0	0	0	300	29.33	15,473	0	0	0	500	31.23	27,460	0	0	0	600	29.22	30,831	0	0	0
6	830	28.29	41,291	1,091	27.11	51,988	0	0	0	0	0	0	300	29.33	15,473	0	0	0	500	31.53	27,724	0	0		950	28.07	46,894	0	0	0
7	1,091	27.31	52,372	1,091	27.21	52,180	0	0	0	0	0	0	300	29.43	15,526	0	0	0	500	31.13	27,372	0	0	0	0	0	0	0	0	0
8	1,091	28.01	53,714	1,091	27.51	52,755	0	0	0	0	0	0	323	29.33	16,660	331	28.83	16,781	500	31.03	27,284	0	0		0	0	0	0	0	0
9	1,091	28.11	53,906	1,105	27.91	54,234	0	0	0	0	0	0	307	29.73	16,050	600	30.67	32,361	500	31.03	27,284	0	0	0	0	0	0	0	0	0
10	1,091	28.21	54,098	1,105	28.21	54,817	0	0	0	0	0	0	307	30.83	16,644	600	29.77	31,411	500	31.03	27,284	0	0		0	0	0	301	32.23	17,060
11	1,091	28.41	54,482	545	29.48	28,254	0	0	0	500	29.80	26,202	352	32.05	19,839	996	28.40	49,717	746	29.97	39,290	0	0	0	0	0	0	301	32.23	17,060
12	1,191	26.87	56,253	0	0	0	500	29.80	26,202	995	28.32	49,552	860	29.61	44,780	996	28.60	50,068	746	29.97	39,290	0	0		0	0	0	301	32.23	17,060
13	1,291	26.62	60,411	0	0	0	500	29.50	25,938	960	28.22	47,641	860	29.41	44,478	996	29.00	50,768	756	28.04	37,253	0	0	0	500	31.53	27,724	449	31.68	25,014
14	1,380	27.31	66,251	0	0	0	500	29.90	26,290	935	27.92	45,907	860	29.91	45,234	996	28.80	50,418	756	29.94	39,778	350	30		420	31.53	23,288	449	31.68	25,014
15	1,380	27.41	66,494	0	0	0	500	29.90	26,290	935	27.92	45,907	860	29.91	45,234	820	29.53	42,582	756	29.94	39,778	350	30	18,557	920	30.17	48,811	449	31.68	25,014
16	1,380	27.31	66,251	0	0	0	500	30.00	26,378	905	27.82	44,274	860	29.91	45,234	820	29.53	42,582	860	29.74	44,977	250	31		920	30.07	48,649	449	31.68	25,014
17	1,380	27.61	66,979	0	0	0	500	30.00	26,378	995	27.82	48,677	860	29.91	45,234	820	29.53	42,582	860	29.74	44,977	0	0	0	920	30.07	48,649	449	31.68	25,014
18	1,380	27.81	67,429	0	0	0	500	30.00	26,378	995	27.72	48,502	860	29.91	45,234	820	29.83	43,015	860	29.74	44,977	0	0		1,045	29.76	54,689	750	30.72	40,517
19	1,380	27.81	67,429	0	0	0	500	30.00	26,378	995	27.82	48,677	860	29.91	45,234	820	29.83	43,015	860	29.44	44,523	0	0	0	1,045	29.76	54,689	700	30.72	37,816
20	1,380	27.81	67,429	0	0	0	860	28.71	43,419	995	27.82	48,677	860	29.91	45,234	820	29.83	43,015	860	29.54	44,675	0	0		1,045	29.76	54,689	700	30.52	37,570
21	1,380	27.81	67,429	0	0	0	756	28.51	37,878	891	27.82	43,565	756	29.91	39,738	820	29.83	43,015	756	29.44	39,113	0	0	0	956	29.90	50,241	0	0	0
22	1,091	28.61	54,865	0	0	0	756	28.51	37,878	891	27.82	43,565	756	29.91	39,738	820	30.13	43,448	756	29.44	39,113	0	0		956	29.90	50,241	0	0	0
23	1,091	28.61	54,865	0	0	0	756	28.81	38,277	891	27.82	43,565	556	30.47	29,765	670	30.75	36,231	756	29.44	39,113	0	0	0	956	29.90	50,241	0	0	0
24	1,091	28.71	55,057	0	0	0	756	28.81	38,277	891	28.32	44,348	556	30.47	29,765	650	31.25	35,721	756	29.44	39,113	0	0		956	29.90	50,241	0	0	0
25	1,091	28.71	55,057	0	0	0	756	28.81	38,277	891	28.42	44,505	556	29.97	29,277	650	30.75	35,149	756	29.44	39,113	0	0	0	956	29.90	50,241	0	0	0
26	1,091	28.71	55,057	0	0	0	756	28.81	38,277	850	28.69	42,884	0	0	0	650	30.55	34,920	756	29.44	39,113	0	0		956	29.90	50,241	0	0	0
27	1,091	28.71	55,057	0	0	0	756	28.81	38,277	850	28.89	43,183	0	0	0	500	30.33	26,668	756	29.34	38,980	0	0	0	956	29.90	50,241	0	0	0
28	1,091	28.71	55,057	0	0	0	1,091	28.31	54,290	850	29.19	43,632	0	0	0	500	30.43	26,756	756	29.24	38,847	0	0		956	29.90	50,241	0	0	0
29							991	28.67	49,939										756	28.94	38,449									
Month Total			1,367,692			501,797			625,020			803,265			715,602			820,223			962,605			18,557			884,138			292,155

Month Average(KWHr) 699,105

Table 6 Sheet 3 of 12

Daily & Total Energy in the Month of Mar

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,091	28.71	55,057	0	0	0	1,095	28.67	55,207	850	29.19	43,632	0	0	0	500	30.53	26,844	856	28.68	43,147	0	0	0	956	29.90	50,241	0	0	0
2	1,091	28.71	55,057	0	0	0	1,095	28.67	55,207	850	29.49	44,080	860	30.11	45,537	400	30.88	21,722	856	28.78	43,297	0	0	0	956	29.70	49,904	0	0	0
3	1,091	28.71	55,057	0	0	0	1,091	28.31	54,290	850	29.49	44,080	860	28.01	42,360	400	30.88	21,722	856	28.78	43,297	0	0	0	956	29.70	49,904	0	0	0
4	1,091	28.71	55,057	0	0	0	1,091	28.31	54,290	850	29.49	44,080	860	29.91	45,234	400	31.08	21,862	856	28.78	43,297	500	29.63	26,053	956	29.90	50,241	0	0	0
5	1,091	28.71	55,057	0	0	0	1,091	28.31	54,290	850	29.49	44,080	856	29.63	44,576	400	31.38	22,073	856	28.78	43,297	900	28.33	44,837	956	29.90	50,241	0	0	0
6	1,091	28.81	55,249	0	0	0	1,091	28.31	54,290	845	29.40	43,687	856	29.63	44,576	400	31.38	22,073	856	28.68	43,147	820	28.53	41,140	956	29.90	50,241	0	0	0
7	1,091	28.81	55,249	0	0	0	1,091	28.31	54,290	845	29.50	43,836	856	29.63	44,576	400	31.38	22,073	856	28.68	43,147	820	28.33	40,852	956	29.90	50,241	0	0	0
8	1,091	28.81	55,249	0	0	0	1,091	28.31	54,290	845	29.50	43,836	856	29.63	44,576	400	31.38	22,073	856	28.68	43,147	820	28.33	40,852	956	29.80	50,073	0	0	0
9	1,021	28.99	52,025	0	0	0	1,091	28.31	54,290	845	29.50	43,836	856	29.63	44,576	750	30.25	39,897	856	28.78	43,297	920	27.87	45,089	956	29.80	50,073	0	0	0
10	1,021	28.99	52,025	0	0	0	1,091	28.31	54,290	845	29.50	43,836	856	29.63	44,576	750	30.25	39,897	856	28.78	43,297	920	27.87	45,089	956	29.90	50,241	0	0	0
11	1,091	28.71	55,057	0	0	0	1,091	28.31	54,290	845	29.50	43,836	856	29.63	44,576	1,020	29.30	52,556	696	28.11	34,380	920	27.87	45,089	956	29.90	50,241	0	0	0
12	1,091	28.71	55,057	0	0	0	1,091	28.31	54,290	845	29.50	43,836	856	29.63	44,576	1,020	29.30	52,556	696	27.51	33,646	920	27.87	45,089	0	0	0	0	0	0
13	1,091	28.81	55,249	0	0	0	1,091	28.41	54,482	845	29.50	43,836	856	29.63	44,576	1,020	29.30	52,556	696	28.21	34,502	920	27.87	45,089	0	0	0	0	0	0
14	1,091	28.81	55,249	0	0	0	1,091	28.41	54,482	845	29.50	43,836	856	29.13	43,824	1,020	29.30	52,556	696	28.61	34,992	920	28.57	46,222	0	0	0	0	0	0
15	1,091	28.61	54,865	0	0	0	1,091	28.21	54,098	845	29.50	43,836	856	29.13	43,824	1,020	29.30	52,556	696	28.61	34,992	920	29.27	47,355	0	0	0	0	0	0
16	302	30.43	16,135	0	0	0	1,091	28.41	54,482	845	29.50	43,836	856	29.13	43,824	1,020	29.30	52,556	696	28.61	34,992	920	29.27	47,355	0	0	0	0	0	0
17	1,091	29.01	55,632	0	0	0	1,091	28.41	54,482	845	29.50	43,836	856	29.53	44,426	1,020	29.30	52,556	696	28.61	34,992	920	29.37	47,516	0	0	0	0	0	0
18	1,091	29.01	55,632	0	0	0	1,091	28.31	54,290	845	29.70	44,133	856	29.53	44,426	1,091	29.06	55,728	696	29.11	35,603	920	29.37	47,516	0	0	0	0	0	0
19	1,091	29.01	55,632	0	0	0	1,091	28.41	54,482	0	0	0	856	29.53	44,426	1,091	29.06	55,728	696	29.11	35,603	920	28.67	46,384	0	0	0	0	0	0
20	1,091	29.01	55,632	0	0	0	1,091	28.31	54,290	0	0	0	856	30.13	45,329	1,091	29.56	56,687	696	29.11	35,603	910	28.57	45,719	0	0	0	0	0	0
21	1,091	29.01	55,632	0	0	0	1,091	28.81	55,249	0	0	0	856	30.23	45,479	1,091	29.56	56,687	696	29.11	35,603	910	28.57	45,719	0	0	0	0	0	0
22	1,091	27.81	53,331	0	0	0	1,091	28.31	54,290	0	0	0	856	30.23	45,479	1,091	29.56	56,687	660	29.52	34,262	780	28.94	39,696	0	0	0	0	0	0
23	1,091	27.51	52,755	0	0	0	1,091	28.31	54,290	0	0	0	856	30.23	45,479	1,091	29.56	56,687	756	28.94	38,449	780	29.44	40,382	0	0	0	0	0	0
24	1,091	27.41	52,564	0	0	0	1,091	28.31	54,290	0	0	0	856	30.23	45,479	1,091	29.56	56,687	756	28.94	38,449	780	29.44	40,382	0	0	0	0	0	0
25	1,091	27.41	52,564	0	0	0	1,091	28.21	54,098	0	0	0	856	30.23	45,479	1,091	29.06	55,728	756	29.44	39,113	780	29.44	40,382	0	0	0	0	0	0
26	1,091	27.41	52,564	0	0	0	1,091	27.61	52,947	0	0	0	856	30.23	45,479	1,091	29.06	55,728	756	29.44	39,113	780	29.44	40,382	0	0	0	0	0	0
27	1,091	27.41	52,564	0	0	0	1,091	28.21	54,098	0	0	0	856	30.23	45,479	1,091	29.76	57,070	756	29.44	39,113	780	29.44	40,382	0	0	0	0	0	0
28	1,091	27.41	52,564	0	0	0	1,091	28.31	54,290	0	0	0	856	30.43	45,780	1,091	29.06	55,728	756	29.44	39,113	780	29.44	40,382	0	0	0	0	0	0
29	1,091	27.41	52,564	0	0	0	1,091	28.31	54,290	0	0	0	856	30.53	45,930	1,091	29.06	55,728	756	29.44	39,113	780	29.44	40,382	0	0	0	0	0	0
30	1,091	29.01	55,632	0	0	0	1,091	28.31	54,290	0	0	0	856	30.33	45,630	1,091	29.06	55,728	756	29.24	38,847	780	29.44	40,382	0	0	0	0	0	0
31	1,091	29.01	55,632	0	0	0	1,091	28.31	54,290	0	0	0	856	29.93	45,028	1,091	29.06	55,728	756	29.24	38,847	780	29.44	40,382	600	31.18	32,899	0	0	0
Month Total			1,647,588			0			1,684,817			789,969			1,345,117			1,414,453			1,201,700			1,196,095			584,537			0

Month Average(KWHr) 986,427

Daily & Total Energy in the Month of Apr

	2006			2007			2008			2009			2010		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,091	29.01	55,632	400	31.35	22,052	656	29.48	33,983	0	0	0	856	28.93	43,523
2	1,091	29.01	55,632	746	30.08	39,461	656	30.08	34,674	870	27.81	42,547	960	29.93	50,528
3	1,091	29.01	55,632	1,091	29.01	55,632	656	30.18	34,790	826	27.61	40,080	960	30.63	51,710
4	1,091	29.01	55,632	1,091	29.01	55,632	656	30.18	34,790	826	28.11	40,806	960	30.63	51,710
5	1,091	29.01	55,632	991	29.27	50,984	656	30.18	34,790	826	28.11	40,806	960	30.63	51,710
6	1,091	29.01	55,632	991	29.27	50,984	0	0	0	826	28.11	40,806	960	30.63	51,710
7	1,091	29.01	55,632	1,010	29.27	51,987	0	0	0	830	28.11	41,029	960	30.63	51,710
8	1,091	29.01	55,632	1,010	29.27	51,987	0	0	0	830	28.01	40,883	960	30.93	52,216
9	1,091	29.01	55,632	1,010	29.27	51,987	0	0	0	830	28.01	40,883	960	30.83	52,047
10	1,091	29.01	55,632	1,010	29.27	51,987	0	0	0	830	28.11	41,029	960	30.83	52,047
11	1,041	29.14	53,320	1,010	29.27	51,987	0	0	0	0	0	0	960	30.73	51,879
12	1,041	29.14	53,320	1,010	29.27	51,987	0	0	0	0	0	0	856	30.73	46,231
13	1,041	29.14	53,320	1,010	29.27	51,987	0	0	0	0	0	0	856	30.63	46,081
14	1,041	28.64	52,405	1,010	29.27	51,987	0	0	0	0	0	0	856	30.83	46,382
15	1,041	28.64	52,405	1,088	29.02	55,498	0	0	0	0	0	0	856	30.63	46,081
16	1,221	28.49	61,148	1,205	28.73	60,855	0	0	0	0	0	0	0	0	0
17	1,221	28.49	61,148	1,433	28.19	67,429	0	0	0	0	0	0	0	0	0
18	1,221	28.39	60,933	1,433	28.19	67,429	0	0	0	0	0	0	0	0	0
19	1,221	28.59	61,363	1,433	28.19	67,429	0	0	0	0	0	0	0	0	0
20	1,271	28.27	63,161	1,330	28.63	66,936	1,196	28.25	59,391	0	0	0	0	0	0
21	1,271	28.07	62,715	1,330	28.63	66,936	1,196	28.25	59,391	940	29.01	47,954	0	0	0
22	1,271	28.07	62,715	1,330	28.43	66,469	1,196	27.85	58,550	896	29.01	45,684	0	0	0
23	1,321	27.95	64,904	1,330	28.43	66,469	1,196	27.75	58,340	1,096	28.50	54,904	0	0	0
24	1,321	27.95	64,904	1,330	28.43	66,469	1,196	28.75	60,442	1,096	28.50	54,904	0	0	0
25	1,321	27.95	64,904	1,330	28.43	66,469	1,196	27.65	58,129	1,196	28.25	59,390	0	0	0
26	1,321	27.95	64,904	1,330	28.43	66,469	1,159	27.85	56,738	1,196	28.25	59,390	0	0	0
27	1,321	27.75	64,439	1,330	28.63	66,936	1,159	28.05	57,145	1,196	28.25	59,390	0	0	0
28	1,321	27.65	64,207	1,330	28.63	66,936	1,159	27.65	56,330	1,196	28.25	59,390	0	0	0
29	1,321	27.65	64,207	1,330	28.63	66,936	1,059	27.90	51,933	1,296	28.00	63,789	960	28.03	47,320
30	1,321	26.35	61,188	1,330	28.63	66,936	1,059	27.90	51,933	1,296	28.00	63,789	908	27.68	44,173
Month Total			1,767,932			1,743,246			801,349			937,454			837,058

	2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,091	29.06	55,728	756	29.24	38,847	780	29.44	40,382	720	30.58	38,719	0	0	0
2	1,091	29.06	55,728	756	29.24	38,847	780	27.94	38,324	720	30.58	38,719	0	0	0
3	1,021	29.24	52,474	756	29.24	38,847	780	27.74	38,049	720	30.58	38,719	0	0	0
4	1,021	29.24	52,474	756	29.24	38,847	780	27.74	38,049	920	30.02	48,568	0	0	0
5	1,021	29.24	52,474	756	29.24	38,847	780	27.94	38,324	920	30.02	48,568	0	0	0
6	1,021	29.24	52,474	756	29.24	38,847	780	27.94	38,324	920	30.02	48,568	0	0	0
7	681	30.15	36,080	756	28.44	37,784	780	27.94	38,324	646	30.72	34,872	0	0	0
8	681	30.15	36,080	756	28.94	38,449	780	27.94	38,324	0	0	0	0	0	0
9	681	30.15	36,080	756	28.84	38,316	780	27.94	38,324	0	0	0	0	0	0
10	681	30.15	36,080	756	28.84	38,316	780	27.94	38,324	0	0	0	0	0	0
11	705	30.15	37,379	756	28.84	38,316	780	28.04	38,461	0	0	0	0	0	0
12	690	30.19	36,632	756	28.84	38,316	780	28.04	38,461	0	0	0	0	0	0
13	690	30.19	36,632	756	28.94	38,449	780	28.04	38,461	0	0	0	600	31	32,688
14	690	30.19	36,632	756	28.94	38,449	780	28.04	38,461	0	0	0	600	30.98	32,688
15	1,290	28.63	64,947	756	28.84	38,316	780	28.04	38,461	301	32.23	17,060	600	30.98	32,688
16	1,266	28.63	63,714	1,156	27.40	55,676	1,280	26.86	60,459	620	30.87	33,658	545	30.88	29,596
17	1,266	28.63	63,714	1,046	27.90	51,295	1,256	26.86	59,302	920	30.02	48,568	1,020	29.46	52,843
18	1,266	28.63	63,714	1,046	28.10	51,663	1,256	26.86	59,302	920	30.02	48,568	996	29.26	51,224
19	1,266	28.63	63,714	1,046	28.10	51,663	1,256	26.86	59,302	820	30.29	43,678	996	29.26	51,224
20	1,266	28.63	63,714	1,260	27.70	61,376	1,256	26.86	59,302	820	30.29	43,678	916	29.47	47,445
21	1,266	28.63	63,714	1,296	27.36	62,330	1,256	26.86	59,302	820	30.29	43,678	916	29.47	47,445
22	1,266	28.63	63,714	1,296	27.56	62,786	1,256	26.86	59,302	1,120	29.50	58,102	916	29.47	47,445
23	1,266	28.63	63,714	1,296	27.56	62,786	1,256	26.66	58,861	1,120	29.00	57,117	916	29.47	47,445
24	1,266	28.63	63,714	1,296	27.36	62,330	1,256	26.66	58,861	1,270	28.63	63,940	916	29.47	47,445
25	1,266	28.63	63,714	1,346	27.35	64,712	1,256	26.66	58,861	1,270	28.63	63,940	916	29.47	47,445
26	1,316	28.51	65,953	1,346	27.25	64,476	1,256	26.66	58,861	1,270	28.63	63,940	916	29.47	47,445
27	1,316	28.51	65,953	1,346	27.45	64,949	1,121	27.10	53,399	1,195	28.82	60,564	916	29.47	47,445
28	1,316	28.51	65,953	1,346	26.95	63,766	1,121	27.10	53,399	1,195	28.82	60,564	916	29.47	47,445
29	1,316	28.51	65,953	1,346	26.95	63,766	1,121	27.10	53,399	1,195	28.82	60,564	916	29.47	47,445
30	1,366	28.40	67,429	1,346	26.65	63,056	1,241	26.69	58,223	1,195	28.82	60,564	916	29.47	47,445
Month Total			1,646,274			1,484,425			1,447,185			1,124,917			804,850

Month Average(KWHr) 1,259,469

Table 6 Sheet 5 of 12

Daily & Total Energy in the Month of May

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,321	26.35	61,188	1,330	28.63	66,936	1,159	27.55	56,126	1,296	28.00	63,789	908	28.08	44,812	1,366	28.40	67,429	1,346	26.65	63,056	1,241	26.69	58,223	1,195	28.82	60,564	916	29.47	47,445
2	1,321	26.35	61,188	1,433	28.39	67,429	1,159	27.55	56,126	1,296	28.00	63,789	908	28.08	44,812	1,366	28.40	67,429	1,346	26.45	62,582	1,241	26.69	58,223	1,195	28.82	60,564	916	29.47	47,445
3	1,321	26.35	61,188	1,433	28.39	67,429	1,159	27.55	56,126	1,296	28.00	63,789	908	27.98	44,652	1,366	28.40	67,429	1,346	26.45	62,582	1,191	26.82	56,148	1,246	28.63	62,707	916	29.47	47,445
4	1,371	26.23	63,215	1,433	28.39	67,429	959	28.15	47,449	1,296	28.00	63,789	908	27.98	44,652	1,366	28.40	67,429	1,346	26.45	62,582	1,191	26.82	56,148	1,246	28.63	62,707	916	29.47	47,445
5	1,371	26.23	63,215	1,330	28.63	66,936	959	28.15	47,449	1,296	28.00	63,789	908	27.98	44,652	1,366	28.40	67,429	1,346	26.45	62,582	1,191	26.82	56,148	1,246	28.63	62,707	1,146	28.88	58,176
6	1,371	26.23	63,215	1,433	28.39	67,429	844	28.56	42,364	1,296	28.00	63,789	1,242	27.04	59,033	1,366	28.40	67,429	1,346	26.45	62,582	1,191	26.92	56,358	1,246	28.63	62,707	1,146	28.78	57,975
7	1,371	26.23	63,215	1,433	28.39	67,429	1,244	27.33	59,763	1,296	28.00	63,789	1,242	26.64	58,160	1,366	28.40	67,429	1,346	26.45	62,582	1,191	26.92	56,358	1,246	28.63	62,707	1,296	28.42	64,746
8	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,296	28.20	64,244	1,242	26.44	57,723	1,366	28.40	67,429	992	27.31	47,617	1,176	27.05	55,916	1,246	28.63	62,707	1,296	28.52	64,974
9	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.20	58,235	1,296	28.20	64,244	1,242	26.64	58,160	1,366	28.40	67,429	992	27.71	48,314	1,176	27.05	55,916	1,246	28.63	62,707	1,296	28.52	64,974
10	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,296	28.20	64,244	1,242	26.74	58,378	1,386	28.35	67,429	992	28.21	49,186	1,176	26.95	55,710	1,246	28.63	62,707	1,296	28.52	64,974
11	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,296	28.20	64,244	1,242	26.84	58,597	1,386	28.65	67,429	887	28.49	44,414	1,176	26.95	55,710	1,246	28.63	62,707	1,296	28.52	64,974
12	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,296	28.30	64,472	1,242	27.04	59,033	1,386	28.35	67,429	832	28.63	41,863	1,176	26.95	55,710	1,246	28.63	62,707	1,296	28.52	64,974
13	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,346	28.09	66,464	1,242	28.14	61,435	1,386	28.35	67,429	846	28.63	42,593	1,176	26.85	55,503	1,296	28.52	64,973	1,296	28.52	64,974
14	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,346	28.09	66,464	1,242	28.14	61,435	1,386	28.65	67,429	846	28.63	42,593	1,176	26.95	55,710	1,296	28.52	64,973	1,296	28.52	64,974
15	1,371	26.23	63,215	1,433	28.39	67,429	1,218	27.30	58,450	1,346	28.09	66,464	1,242	28.14	61,435	1,386	28.35	67,429	846	28.63	42,593	1,176	26.95	55,710	1,296	28.52	64,973	1,296	28.52	64,974
16	1,371	26.23	63,215	1,433	28.39	67,429	1,026	27.88	50,278	1,346	27.89	65,990	1,096	28.50	54,904	1,386	28.35	67,429	936	28.63	47,124	1,068	27.32	51,286	1,296	28.52	64,973	1,296	28.52	64,974
17	1,371	26.33	63,456	1,433	28.39	67,429	1,028	27.98	50,557	1,346	27.89	65,990	1,096	28.50	54,904	1,386	28.35	67,429	914	28.69	46,113	1,068	27.32	51,286	1,296	28.52	64,973	1,296	28.52	64,974
18	1,371	29.33	67,429	1,433	28.39	67,429	1,028	27.98	50,557	1,346	27.89	65,990	1,096	28.50	54,904	1,386	28.35	67,429	914	28.79	46,274	1,068	27.32	51,286	1,296	28.52	64,973	1,296	28.52	64,974
19	1,371	28.83	67,429	1,433	27.69	67,429	1,028	27.98	50,557	1,346	27.89	65,990	1,096	28.50	54,904	1,386	28.35	67,429	914	28.79	46,274	1,068	27.32	51,286	1,296	28.52	64,973	1,296	28.52	64,974
20	1,371	28.33	67,429	1,433	28.19	67,429	1,028	27.98	50,557	1,346	27.89	65,990	1,096	28.50	54,904	1,433	28.25	67,429	914	28.79	46,274	1,068	27.32	51,286	1,296	28.52	64,973	1,296	28.52	64,974
21	1,330	27.23	63,663	1,433	27.99	67,429	1,028	28.08	50,738	1,433	27.69	67,429	1,096	28.50	54,904	1,433	28.25	67,429	914	28.79	46,274	1,296	27.16	61,875	1,296	28.52	64,973	1,296	28.52	64,974
22	1,370	26.43	63,674	1,433	27.59	67,429	1,433	26.79	67,429	1,433	27.69	67,429	1,096	28.50	54,904	1,433	28.25	67,429	914	28.79	46,274	1,296	27.16	61,875	1,296	28.52	64,973	1,296	28.52	64,974
23	1,370	26.23	63,192	1,433	27.29	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,096	28.50	54,904	1,433	28.25	67,429	914	28.79	46,274	1,296	27.16	61,875	1,346	28.40	67,197	1,296	28.52	64,974
24	1,370	26.43	63,674	1,433	27.69	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,096	28.50	54,904	1,433	28.25	67,429	145	31.43	8,014	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.35	67,429
25	1,370	26.43	63,674	1,433	27.29	67,429	1,104	27.53	53,447	1,433	27.69	67,429	1,096	28.50	54,904	1,433	28.25	67,429	0	0	0	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
26	1,370	26.43	63,674	1,433	27.29	67,429	1,104	28.43	55,194	1,433	27.69	67,429	1,180	28.29	58,679	1,433	28.25	67,429	0	0	0	1,296	27.56	62,787	1,346	28.70	67,429	1,366	28.25	67,429
27	1,370	27.63	66,565	1,433	27.29	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,180	28.29	58,679	1,433	28.25	67,429	0	0	0	1,296	27.76	63,242	1,346	28.40	67,197	1,366	28.25	67,429
28	1,370	27.73	66,806	1,433	27.29	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,180	28.29	58,679	1,433	28.25	67,429	0	0	0	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
29	1,370	27.73	66,806	1,433	27.09	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,356	27.87	66,433	1,433	28.25	67,429	0	0	0	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
30	1,370	27.63	66,565	1,433	26.99	67,429	1,433	26.69	67,234	1,433	27.59	67,429	1,356	27.87	66,433	1,433	28.25	67,429	0	0	0	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.35	67,429
31	1,370	27.63	66,565	1,433	26.69	67,234	1,433	26.69	67,234	1,433	27.69	67,429	1,356	27.87	66,433	1,433	28.05	67,429	0	0	0	1,096	28.25	54,423	1,346	28.40	67,197	1,366	28.15	67,429
Month Total			1,985,967			2,089,129			1,782,740			2,039,034			1,741,349			2,090,310			1,176,621			1,779,928			2,002,936			1,949,697

Month Average(KWHr) 1,863,771

Table 6 Sheet 6 of 12

Daily & Total Energy in the Month of Jun

	2006			2007			2008			2009			2010		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,370	27.63	66,565	1,433	26.69	67,234	1,433	26.89	67,429	1,433	27.69	67,429	1,356	27.87	66,433
2	1,370	27.63	66,565	1,433	26.69	67,234	1,433	26.69	67,234	1,433	27.69	67,429	1,356	27.87	66,433
3	1,370	27.63	66,565	1,433	26.69	67,234	1,433	26.69	67,234	1,433	27.69	67,429	1,356	27.87	66,433
4	1,370	28.03	67,429	1,433	26.69	67,234	1,433	26.69	67,234	1,433	27.69	67,429	1,356	27.87	66,433
5	1,370	28.43	67,429	1,433	26.69	67,234	1,433	26.59	66,982	1,433	27.69	67,429	1,356	27.87	66,433
6	1,370	28.43	67,429	1,433	26.69	67,234	1,433	26.59	66,982	1,433	27.69	67,429	1,356	27.87	66,433
7	1,370	27.83	67,047	1,433	26.69	67,234	1,433	26.59	66,982	1,433	27.69	67,429	1,356	27.87	66,433
8	1,370	27.63	66,565	1,433	26.79	67,429	1,433	26.59	66,982	1,433	27.69	67,429	1,356	27.87	66,433
9	1,371	27.53	66,349	1,433	26.79	67,429	1,133	27.71	55,186	1,433	27.69	67,429	1,356	27.87	66,433
10	1,371	26.63	64,180	1,433	26.79	67,429	1,145	30.91	62,239	1,433	27.69	67,429	1,356	28.37	67,429
11	1,431	26.19	65,882	1,433	26.99	67,429	1,342	27.83	65,677	1,375	27.82	67,243	1,356	28.37	67,429
12	1,431	26.09	65,631	1,433	27.19	67,429	1,433	27.69	67,429	1,375	27.82	67,243	1,061	28.99	54,064
13	1,431	26.09	65,631	1,433	27.19	67,429	1,433	26.69	67,234	1,375	27.82	67,243	1,061	28.99	54,064
14	1,431	25.99	65,379	1,433	26.89	67,429	1,433	26.69	67,234	1,375	27.82	67,243	1,061	28.99	54,064
15	1,262	26.59	58,986	1,433	27.99	67,429	1,433	26.69	67,234	1,375	27.82	67,243	1,212	28.71	61,165
16	1,262	26.59	58,986	1,433	27.29	67,429	1,433	26.69	67,234	1,375	27.82	67,243	1,212	28.71	61,165
17	1,262	27.39	60,762	1,433	27.19	67,429	1,433	26.59	66,982	1,375	27.82	67,243	1,212	28.21	60,100
18	1,262	27.59	61,205	1,433	27.09	67,429	1,433	26.59	66,982	1,375	27.82	67,243	1,152	28.36	57,427
19	1,262	27.59	61,205	1,433	27.29	67,429	1,433	26.59	66,982	1,375	27.82	67,243	1,152	28.36	57,427
20	1,262	27.59	61,205	1,433	26.89	67,429	1,133	27.71	55,186	1,375	27.82	67,243	1,152	28.36	57,427
21	1,262	27.49	60,983	1,433	26.89	67,429	1,286	27.13	61,330	1,375	27.82	67,243	1,152	28.36	57,427
22	1,262	27.39	60,762	1,433	26.79	67,429	1,433	26.69	67,234	1,375	27.82	67,243	1,152	28.36	57,427
23	1,262	27.39	60,762	1,433	26.69	67,234	1,433	26.59	66,982	1,375	27.82	67,243	1,433	27.69	67,429
24	1,262	27.49	60,983	1,433	26.69	67,234	1,433	26.59	66,982	1,375	27.62	66,760	1,433	27.69	67,429
25	1,262	27.49	60,983	1,433	25.49	64,211	1,433	26.49	66,730	1,361	27.35	65,434	1,433	27.69	67,429
26	1,262	27.39	60,762	1,433	27.19	67,429	1,433	26.59	66,982	1,361	27.35	65,434	1,433	27.69	67,429
27	1,402	26.96	66,445	1,433	27.39	67,429	1,433	26.69	67,234	1,361	27.35	65,434	1,433	27.69	67,429
28	1,402	28.76	67,429	1,433	27.09	67,429	1,433	26.59	66,982	1,361	27.35	65,434	1,433	29.09	67,429
29	1,402	29.06	67,429	1,195	27.58	57,957	1,433	26.99	67,429	1,361	27.65	66,152	1,433	27.69	67,429
30	1,402	28.76	67,429	975	28.23	48,402	1,433	27.69	67,429	1,361	28.15	67,348	1,433	27.39	67,429
Month Total			1,924,966			1,989,406			1,977,976			2,010,451			1,903,951

	2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,433	28.25	67,429	1,190	28.27	59,159	1,096	28.25	54,423	1,346	28.40	67,197	1,366	28.25	67,429
2	1,433	28.25	67,429	1,396	27.53	67,429	1,096	28.25	54,423	1,346	28.40	67,197	1,366	28.25	67,429
3	1,433	28.25	67,429	1,396	27.53	67,429	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
4	1,433	28.25	67,429	1,396	27.53	67,429	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
5	1,433	28.25	67,429	1,367	27.70	66,564	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.35	67,429
6	1,433	28.25	67,429	1,367	27.60	66,323	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
7	1,433	28.05	67,429	1,217	28.25	60,434	1,296	27.56	62,787	1,346	28.40	67,197	1,366	28.25	67,429
8	1,433	27.25	67,429	1,367	27.40	65,842	1,346	27.45	64,949	1,346	28.40	67,197	1,366	28.35	67,429
9	1,433	27.45	67,429	1,267	27.63	61,536	1,346	27.45	64,949	1,346	28.40	67,197	1,366	28.35	67,429
10	1,433	27.55	67,429	1,267	27.53	61,314	1,346	27.45	64,949	1,346	28.40	67,197	1,366	28.25	67,429
11	0	0	0	1,267	27.63	61,536	1,346	27.45	64,949	1,346	28.40	67,197	1,366	27.85	66,876
12	1,433	27.25	67,429	1,367	27.60	66,323	1,346	27.45	64,949	1,346	28.40	67,197	1,396	28.08	67,429
13	1,433	27.25	67,429	1,367	27.40	65,842	1,221	27.74	59,538	1,346	28.40	67,197	1,396	28.08	67,429
14	1,388	27.35	66,732	1,367	27.60	66,323	1,221	27.74	59,538	1,346	28.40	67,197	1,396	28.08	67,429
15	1,388	27.35	66,732	1,367	28.00	67,285	1,271	27.62	61,709	1,346	28.40	67,197	1,396	28.08	67,429
16	1,388	27.75	67,429	1,367	28.10	67,429	1,271	27.12	60,592	1,346	28.40	67,197	1,296	28.42	64,746
17	1,388	27.85	67,429	1,367	28.10	67,429	1,271	27.12	60,592	1,346	28.40	67,197	1,296	28.42	64,746
18	1,433	27.45	67,429	1,367	28.10	67,429	1,271	26.82	59,921	1,346	28.40	67,197	1,296	28.42	64,746
19	1,433	27.45	67,429	1,367	28.10	67,429	1,271	26.82	59,921	1,346	28.40	67,197	1,396	28.08	67,429
20	1,433	27.45	67,429	1,367	27.40	65,842	1,271	27.62	61,709	1,346	28.40	67,197	1,395	28.20	67,429
21	1,433	27.25	67,429	1,367	27.40	65,842	1,271	27.62	61,709	1,346	28.40	67,197	1,395	28.20	67,429
22	1,433	27.25	67,429	1,367	27.70	66,564	1,271	27.62	61,709	1,346	28.40	67,197	1,395	28.20	67,429
23	1,433	27.25	67,429	1,367	25.90	62,237	1,271	27.62	61,709	1,346	28.40	67,197	1,395	28.20	67,429
24	1,433	27.25	67,429	1,367	25.90	62,237	1,271	27.62	61,709	1,346	28.40	67,197	1,395	28.20	67,429
25	1,433	27.25	67,429	1,367	25.80	61,997	1,346	27.45	64,949	1,346	28.40	67,197	1,395	28.20	67,429
26	1,433	27.55	67,429	1,367	25.80	61,997	1,396	27.33	67,068	1,346	28.40	67,197	1,395	27.70	67,429
27	1,433	27.65	67,429	1,367	25.90	62,237	1,396	27.33	67,068	1,346	28.40	67,197	1,445	27.28	67,429
28	1,433	28.35	67,429	1,367	25.80	61,997	1,396	26.83	65,841	1,346	28.40	67,197	1,145	28.60	57,587
29	1,433	27.65	67,429	1,367	25.80	61,997	1,396	26.23	64,369	1,346	28.40	67,197	1,145	28.30	56,982
30	1,433	27.25	67,429	1,367	26.80	64,400	1,396	27.23	66,823	1,346	28.40	67,197	1,395	27.00	66,234
Month Total			1,954,057			1,937,836			1,874,001			2,015,914			1,992,792

Month Average(KWHr) 1,958,135

Table 6 Sheet 7 of 12

Daily & Total Energy in the Month of Jul

	2006			2007			2008			2009			2010		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,428	28.10	67,429	975	27.83	47,716	1,433	28.39	67,429	1,361	27.35	65,434	1,433	27.69	67,429
2	1,383	28.70	67,429	975	27.83	47,716	1,433	27.19	67,429	1,361	27.35	65,434	1,433	27.39	67,429
3	1,383	28.30	67,429	975	28.53	48,917	1,433	26.59	66,982	1,412	27.28	67,429	1,433	27.39	67,429
4	1,383	28.80	67,429	1,143	28.31	56,903	1,433	26.59	66,982	1,315	27.69	64,032	1,433	27.39	67,429
5	1,433	27.89	67,429	1,433	27.29	67,429	1,433	26.89	67,429	1,433	27.19	67,429	1,433	27.49	67,429
6	1,433	28.69	67,429	1,433	26.19	65,974	1,433	26.59	66,982	1,433	27.09	67,429	1,433	27.59	67,429
7	1,433	27.19	67,429	1,433	29.19	67,429	1,433	26.89	67,429	1,260	26.29	58,228	1,433	28.19	67,429
8	1,433	27.19	67,429	1,345	27.93	66,060	1,433	26.59	66,982	1,260	27.69	61,329	1,433	28.79	67,429
9	1,433	26.89	67,429	1,345	27.43	64,878	1,433	26.49	66,730	1,260	26.59	58,893	1,433	27.49	67,429
10	1,433	26.69	67,234	1,345	26.43	62,512	1,433	26.49	66,730	1,260	26.49	58,671	1,433	27.69	67,429
11	1,433	27.69	67,429	1,433	27.39	67,429	1,433	26.49	66,730	1,260	26.49	58,671	1,433	29.29	67,429
12	1,433	27.99	67,429	1,433	25.89	65,219	1,433	26.49	66,730	1,433	26.09	65,722	1,433	27.19	67,429
13	1,433	29.59	67,429	1,433	25.89	65,219	1,433	26.69	67,234	1,433	26.09	65,722	1,433	28.29	67,429
14	0	0	0	1,433	25.89	65,219	1,433	26.49	66,730	1,433	26.69	67,234	1,433	26.59	66,982
15	0	0	0	1,433	26.09	65,722	1,433	26.49	66,730	1,433	26.49	66,730	1,433	26.59	66,982
16	0	0	0	1,433	26.09	65,722	1,433	26.49	66,730	1,433	26.69	67,234	1,433	26.69	67,234
17	1,090	27.13	52,002	1,433	26.09	65,722	1,433	26.69	67,234	1,433	26.49	66,730	1,433	27.19	67,429
18	1,090	28.13	53,919	1,433	25.89	65,219	1,433	26.59	66,982	1,433	26.49	66,730	1,133	28.31	56,380
19	1,090	27.83	53,344	1,433	25.89	65,219	1,433	26.59	66,982	1,433	28.99	67,429	1,433	29.69	67,429
20	1,090	27.73	53,152	1,433	26.09	65,722	1,433	26.69	67,234	1,433	27.19	67,429	1,433	27.49	67,429
21	1,090	28.43	54,494	1,433	25.89	65,219	1,433	26.49	66,730	1,433	27.09	67,429	1,433	27.99	67,429
22	1,433	27.59	67,429	1,433	28.89	67,429	1,433	26.39	66,478	1,433	28.89	67,429	1,433	27.49	67,429
23	1,433	27.19	67,429	1,433	29.29	67,429	1,433	26.39	66,478	1,433	28.49	67,429	1,133	28.01	55,783
24	1,433	27.19	67,429	1,433	29.29	67,429	1,433	26.39	66,478	1,433	27.19	67,429	1,286	29.03	65,625
25	1,386	27.30	66,515	1,433	28.19	67,429	1,433	26.39	66,478	1,433	27.59	67,429	1,356	28.37	67,429
26	1,055	29.21	54,192	1,433	27.69	67,429	1,433	26.39	66,478	1,433	26.99	67,429	1,356	27.67	65,956
27	1,055	29.61	54,934	1,433	27.29	67,429	1,433	26.59	66,982	1,433	27.69	67,429	1,356	27.97	66,671
28	1,055	29.01	53,821	1,433	26.89	67,429	1,433	26.59	66,982	1,433	26.29	66,226	1,356	28.07	66,910
29	1,055	28.81	53,450	1,433	26.89	67,429	1,433	26.59	66,982	1,433	29.19	67,429	1,416	28.03	67,429
30	1,055	28.51	52,893	1,433	26.39	66,478	1,433	26.59	66,982	1,433	27.29	67,429	1,416	26.63	66,286
31	1,055	29.01	53,821	1,433	26.39	66,478	1,433	26.49	66,730	1,433	28.09	67,429	1,416	27.23	67,429
Month Total			1,735,212			1,989,556			2,074,206			2,034,458			2,060,825

	2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,393	28.34	67,429	1,367	26.90	64,641	1,096	27.75	53,460	1,262	28.60	63,446	1,395	27.20	66,725
2	1,393	29.34	67,429	1,367	26.50	63,679	1,296	26.96	61,419	1,262	28.60	63,446	1,395	27.20	66,725
3	1,393	28.84	67,429	1,367	26.40	63,439	1,296	28.46	64,837	1,262	28.60	63,446	1,395	27.20	66,725
4	1,393	28.14	67,429	1,367	26.50	63,679	1,296	28.26	64,382	1,262	28.60	63,446	1,396	26.88	65,964
5	1,393	27.54	67,429	1,367	26.70	64,160	1,296	28.26	64,382	1,262	28.80	63,890	1,433	26.69	67,234
6	1,393	27.34	66,948	1,367	26.70	64,160	1,296	27.56	62,787	1,262	28.90	64,111	1,433	26.69	67,234
7	1,393	27.34	66,948	1,367	26.70	64,160	1,296	27.16	61,875	1,262	28.90	64,111	1,433	26.69	67,234
8	1,328	28.98	67,429	1,367	27.90	67,044	1,296	27.66	63,014	1,262	28.90	64,111	1,433	26.69	67,234
9	1,328	28.48	66,485	1,367	25.90	62,237	1,296	27.66	63,014	1,262	28.90	64,111	1,433	26.79	67,429
10	1,328	29.08	67,429	1,367	25.60	61,516	1,296	28.66	65,293	1,262	28.90	64,111	1,433	26.69	67,234
11	1,328	27.98	65,318	1,367	27.40	65,842	1,120	29.05	57,216	1,262	28.90	64,111	1,300	28.56	65,291
12	1,328	27.48	64,150	1,367	29.20	67,429	1,120	28.85	56,822	1,262	28.90	64,111	1,300	28.56	65,291
13	1,433	27.25	67,429	1,367	27.70	66,564	1,120	28.85	56,822	1,262	28.90	64,111	1,300	28.56	65,291
14	1,433	27.25	67,429	1,367	27.40	65,842	1,120	28.55	56,231	1,262	28.90	64,111	1,396	28.08	67,429
15	1,233	29.71	64,393	1,367	27.80	66,804	1,120	28.75	56,625	1,262	28.90	64,111	1,396	28.08	67,429
16	1,333	27.87	65,306	1,367	28.10	67,429	1,433	28.05	67,429	1,262	28.90	64,111	1,396	27.98	67,429
17	1,333	27.47	64,368	1,367	27.80	66,804	1,433	28.25	67,429	1,262	29.10	64,555	1,396	28.08	67,429
18	1,333	27.47	64,368	1,367	27.80	66,804	1,433	28.25	67,429	1,262	28.90	64,111	1,196	28.05	58,970
19	1,333	27.47	64,368	1,367	27.80	66,804	1,360	28.95	67,429	1,262	28.90	64,111	1,220	28.55	61,251
20	1,416	27.09	67,429	1,367	27.60	66,323	1,360	29.15	67,429	1,262	28.90	64,111	1,220	28.25	60,608
21	1,416	26.99	67,183	1,367	27.00	64,881	1,360	29.25	67,429	1,262	28.90	64,111	1,220	27.75	59,535
22	1,416	27.09	67,429	1,367	26.70	64,160	1,360	28.95	67,429	1,262	28.90	64,111	1,220	28.25	60,608
23	1,416	28.89	67,429	1,367	26.40	63,439	1,360	29.45	67,429	1,262	28.90	64,111	1,396	27.78	67,429
24	1,433	28.55	67,429	1,367	26.40	63,439	1,360	29.45	67,429	1,262	28.90	64,111	1,396	26.88	65,964
25	1,433	29.55	67,429	1,367	26.40	63,439	1,260	29.68	65,764	1,262	27.90	61,893	1,396	26.88	65,964
26	0	0	0	1,367	28.10	67,429	1,396	28.63	67,429	1,262	28.10	62,336	1,396	26.88	65,964
27	900	24.23	38,347	1,367	26.90	64,641	1,396	29.03	67,429	1,262	28.10	62,336	1,396	26.78	65,719
28	644	24.53	27,779	1,367	26.90	64,641	1,396	29.03	67,429	1,262	28.10	62,336	1,396	26.78	65,719
29	1,433	23.85	60,078	1,367	26.90	64,641	1,396	29.03	67,429	1,262	28.10	62,336	1,396	26.58	65,228
30	1,433	24.25	61,086	1,367	26.90	64,641	1,396	29.13	67,429	1,262	27.10	60,118	1,396	26.68	65,473
31	1,396	24.13	59,214	1,367	26.90	64,641	1,396	29.03	67,429	1,262	27.10	60,118	1,396	26.68	65,473
Month Total			1,910,351			2,015,354			1,985,381			1,967,706			2,029,232

Month Average(KWHr) **1,980,228**

Table 6 Sheet 8 of 12

Daily & Total Energy in the Month of Aug

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,055	29.21	54,192	1,433	26.39	66,478	1,433	26.69	67,234	1,433	26.89	67,429	1,416	28.53	67,429	1,396	24.83	60,932	1,367	26.90	64,641	1,396	29.03	67,429	1,262	26.60	59,008	1,396	26.68	65,473
2	1,433	28.19	67,429	1,433	28.89	67,429	1,433	27.69	67,429	1,433	26.99	67,429	1,416	28.53	67,429	1,396	25.33	62,159	1,367	27.40	65,842	1,396	29.03	67,429	1,262	26.60	59,008	1,396	26.78	65,719
3	1,433	28.19	67,429	1,433	27.69	67,429	1,433	28.69	67,429	1,433	27.49	67,429	1,416	29.03	67,429	1,433	25.35	63,858	1,367	27.60	66,323	1,260	28.98	64,212	1,262	27.10	60,118	1,396	26.78	65,719
4	1,433	27.59	67,429	1,433	26.89	67,429	1,433	28.19	67,429	1,433	27.09	67,429	1,416	28.33	67,429	1,433	25.35	63,858	1,367	27.40	65,842	1,360	29.45	67,429	1,262	27.60	61,227	1,396	26.98	66,209
5	1,249	28.73	63,103	1,433	28.69	67,429	1,433	27.89	67,429	1,433	27.29	67,429	1,416	28.13	67,429	1,433	25.35	63,858	1,367	28.90	67,429	1,360	29.45	67,429	1,262	27.60	61,227	1,396	26.78	65,719
6	1,249	28.93	63,542	1,433	28.89	67,429	1,433	26.79	67,429	1,433	27.29	67,429	1,416	27.83	67,429	1,433	25.35	63,858	1,367	26.80	64,400	1,396	29.03	67,429	1,262	27.60	61,227	1,396	26.38	64,737
7	1,249	27.73	60,906	1,183	29.08	60,471	1,433	26.49	66,730	1,433	27.09	67,429	940	29.51	48,781	1,433	25.35	63,858	1,367	27.00	64,881	1,396	28.83	67,429	1,262	27.60	61,227	1,396	26.68	65,473
8	1,090	28.33	54,303	1,433	27.89	67,429	1,433	25.69	64,715	1,433	27.89	67,429	940	29.31	48,450	1,433	24.75	62,346	1,367	25.90	62,237	1,396	29.33	67,429	1,262	27.60	61,227	1,396	26.58	65,228
9	1,090	27.63	52,961	1,433	28.19	67,429	1,433	25.49	64,211	1,433	27.39	67,429	940	29.21	48,285	1,433	25.75	64,865	1,367	26.30	63,199	1,396	28.93	67,429	1,262	27.60	61,227	1,326	26.55	61,886
10	1,246	26.23	57,450	1,433	28.19	67,429	1,433	25.59	64,463	1,433	27.29	67,429	1,096	28.10	54,134	1,433	25.85	65,117	1,367	26.20	62,958	1,396	29.03	67,429	1,262	27.60	61,227	1,326	26.95	62,818
11	1,246	25.93	56,793	1,433	28.19	67,429	1,433	26.69	67,234	1,433	27.59	67,429	1,256	29.10	64,248	1,433	25.25	63,606	1,367	25.90	62,237	1,396	28.83	67,429	1,262	27.60	61,227	1,326	26.95	62,818
12	1,246	25.73	56,354	1,433	28.19	67,429	1,433	26.69	67,234	1,333	28.22	66,126	1,256	28.40	62,702	1,433	25.25	63,606	1,367	25.90	62,237	1,396	28.83	67,429	1,262	27.10	60,118	1,226	28.18	60,730
13	1,246	25.73	56,354	1,433	28.19	67,429	1,433	26.99	67,429	1,433	27.69	67,429	1,256	28.10	62,040	1,433	27.75	67,429	1,367	25.90	62,237	1,396	28.83	67,429	1,262	27.10	60,118	1,226	28.88	62,239
14	1,246	25.73	56,354	1,433	28.39	67,429	1,433	27.19	67,429	1,433	27.69	67,429	1,256	28.10	62,040	1,433	25.75	64,865	1,367	25.90	62,237	1,260	29.18	64,656	1,371	27.46	66,204	1,226	28.68	61,808
15	1,246	25.73	56,354	1,138	28.83	57,695	1,433	27.39	67,429	1,433	27.69	67,429	1,256	27.60	60,936	1,433	28.05	67,429	1,367	26.30	63,199	1,110	29.95	58,462	1,371	27.46	66,204	1,226	28.68	61,808
16	1,396	25.27	62,012	1,138	28.33	56,694	1,433	27.39	67,429	1,433	27.69	67,429	1,256	28.10	62,040	1,433	25.35	63,858	1,367	26.40	63,439	1,110	29.55	57,681	1,371	27.46	66,204	1,226	28.68	61,808
17	1,396	26.17	64,221	1,433	27.69	67,429	1,433	27.29	67,429	1,433	28.59	67,429	1,256	27.60	60,936	1,433	25.35	63,858	1,367	26.40	63,439	1,110	29.65	57,876	1,426	26.96	67,429	1,226	28.68	61,808
18	1,396	26.27	64,467	1,433	27.49	67,429	1,433	27.59	67,429	1,433	27.89	67,429	1,256	29.60	65,352	1,433	25.35	63,858	1,367	25.70	61,757	1,110	29.65	57,876	1,426	27.46	67,429	1,296	28.72	65,430
19	1,396	26.27	64,467	1,433	27.59	67,429	1,433	27.49	67,429	1,133	28.81	57,376	1,316	29.26	67,429	1,433	27.05	67,429	1,367	25.70	61,757	1,110	30.05	58,657	1,426	27.46	67,429	1,296	28.82	65,658
20	1,396	26.47	64,958	1,433	27.59	67,429	1,433	27.49	67,429	1,433	27.29	67,429	1,316	28.46	65,838	1,433	26.25	66,125	1,367	25.70	61,757	1,110	29.75	58,071	1,346	27.64	65,423	1,296	29.02	66,113
21	1,396	26.47	64,958	1,433	27.59	67,429	1,433	27.69	67,429	1,433	26.59	66,982	1,316	27.96	64,681	1,433	26.15	65,873	1,144	26.03	52,342	1,110	30.05	58,657	1,426	27.46	67,429	1,396	28.78	67,429
22	1,396	26.37	64,712	1,433	27.49	67,429	1,433	27.69	67,429	1,433	26.59	66,982	1,316	28.46	65,838	1,433	25.75	64,865	1,144	26.13	52,543	1,110	30.05	58,657	1,426	27.46	67,429	1,396	28.78	67,429
23	1,396	26.37	64,712	1,433	27.49	67,429	1,433	27.89	67,429	1,433	27.19	67,429	1,316	28.26	65,375	1,433	25.85	65,117	1,367	25.60	61,516	1,110	30.05	58,657	1,426	27.46	67,429	1,396	28.78	67,429
24	1,396	26.27	64,467	1,433	27.49	67,429	1,433	27.99	67,429	1,433	27.09	67,429	1,316	29.46	67,429	1,433	25.75	64,865	1,367	26.20	62,958	1,110	30.05	58,657	1,196	29.36	61,724	1,396	28.78	67,429
25	1,396	26.27	64,467	1,433	27.49	67,429	1,433	27.99	67,429	1,433	27.09	67,429	1,196	27.75	58,339	1,433	25.75	64,865	1,367	25.90	62,237	1,110	30.05	58,657	1,196	29.36	61,724	1,433	28.69	67,429
26	1,396	26.27	64,467	1,433	27.49	67,429	1,433	28.19	67,429	1,433	27.29	67,429	1,196	28.05	58,970	1,133	28.16	56,081	1,367	25.80	61,997	1,110	30.05	58,657	1,196	29.36	61,724	1,433	28.59	67,429
27	1,396	26.27	64,467	1,433	27.49	67,429	1,433	27.19	67,429	1,433	27.49	67,429	1,196	28.15	59,180	1,396	26.13	64,123	1,367	26.10	62,718	1,296	29.56	67,344	1,196	29.36	61,724	1,433	28.69	67,429
28	1,065	27.39	51,296	1,433	27.49	67,429	1,433	27.19	67,429	1,433	27.29	67,429	1,196	28.45	59,811	1,396	26.03	63,877	1,367	25.80	61,997	1,433	28.25	67,429	1,196	29.36	61,724	1,433	28.69	67,429
29	1,396	27.97	67,429	1,433	27.49	67,429	1,433	27.19	67,429	1,433	27.29	67,429	1,196	28.55	60,021	1,396	25.53	62,650	1,367	25.70	61,757	1,433	28.85	67,429	1,196	29.36	61,724	1,433	28.69	67,429
30	1,396	28.77	67,429	1,433	27.49	67,429	1,433	27.19	67,429	1,433	27.49	67,429	1,196	28.45	59,811	1,396	25.53	62,650	1,367	25.70	61,757	1,433	28.85	67,429	1,196	29.26	61,514	1,433	28.69	67,429
31	1,196	29.75	62,545	1,433	27.49	67,429	1,433	26.89	67,429	1,433	27.69	67,429	1,371	27.83	67,072	1,296	25.86	58,912	1,367	25.80	61,997	1,433	26.75	67,385	1,196	29.26	61,514	1,433	27.99	67,429
Month Total			1,912,027			2,061,931			2,080,125			2,078,058			1,924,313			1,980,649			1,935,869			1,975,604			1,950,171			2,020,923

Month Average(KWHr) 1,991,967

Table 6 Sheet 9 of 12

Daily & Total Energy in the Month of Sep

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,196	29.75	62,545	1,433	27.19	67,429	1,433	27.19	67,429	1,433	27.69	67,429	1,371	27.83	67,072	1,296	25.86	58,912	1,367	25.80	61,997	1,433	28.55	67,429	1,196	29.26	61,514	1,386	27.20	66,271
2	1,090	30.13	57,754	1,433	27.19	67,429	1,433	26.99	67,429	1,433	27.69	67,429	1,371	27.83	67,072	1,096	26.75	51,532	1,367	25.80	61,997	1,433	28.55	67,429	1,196	29.26	61,514	1,386	27.80	67,429
3	0	0	0	1,433	27.19	67,429	1,183	28.09	58,412	1,433	27.69	67,429	1,321	27.95	64,903	1,096	26.85	51,725	1,367	25.90	62,237	1,433	28.75	67,429	1,196	29.36	61,724	1,433	27.29	67,429
4	0	0	0	1,433	27.19	67,429	1,433	27.29	67,429	1,433	27.89	67,429	1,371	27.83	67,072	1,096	26.85	51,725	1,367	26.20	62,958	1,433	28.25	67,429	1,196	29.26	61,514	1,433	26.49	66,730
5	0	0	0	1,433	27.19	67,429	1,433	27.19	67,429	1,433	29.69	67,429	1,371	27.83	67,072	1,096	26.75	51,532	820	27.63	39,842	1,433	28.55	67,429	0	0	0	1,433	27.79	67,429
6	0	0	0	1,433	27.29	67,429	1,433	27.59	67,429	1,433	27.89	67,429	1,371	28.83	67,429	1,196	26.80	56,342	820	27.43	39,554	1,433	28.75	67,429	0	0	0	1,333	27.43	64,275
7	0	0	0	1,245	28.06	61,433	1,433	27.69	67,429	1,433	27.19	67,429	1,371	28.03	67,429	1,296	26.36	60,052	720	27.91	35,338	1,433	28.75	67,429	0	0	0	1,333	27.83	65,213
8	0	0	0	1,245	27.66	60,558	1,433	27.49	67,429	1,433	28.39	67,429	1,371	28.03	67,429	1,296	27.06	61,647	720	27.71	35,085	1,433	28.75	67,429	0	0	0	1,396	27.68	67,429
9	0	0	0	1,245	27.66	60,558	1,433	27.49	67,429	1,133	29.01	57,775	1,371	27.83	67,072	1,296	27.26	62,102	720	27.71	35,085	1,433	28.75	67,429	0	0	0	1,396	27.58	67,429
10	0	`0	0	1,245	27.66	60,558	1,433	27.49	67,429	1,433	28.39	67,429	1,371	27.83	67,072	1,296	28.56	65,065	720	27.71	35,085	1,433	28.75	67,429	0	0	0	1,396	27.68	67,429
11	1,433	27.79	67,429	1,245	27.66	60,558	1,433	27.59	67,429	1,433	28.69	67,429	1,371	27.43	66,108	1,296	27.26	62,102	720	27.71	35,085	1,433	28.75	67,429	0	0	0	1,396	28.28	67,429
12	1,433	27.49	67,429	1,245	27.66	60,558	1,433	27.69	67,429	1,433	28.49	67,429	1,371	27.83	67,072	1,296	26.36	60,052	720	27.71	35,085	1,433	28.75	67,429	0	0	0	1,396	28.48	67,429
13	1,433	27.69	67,429	1,433	27.19	67,429	1,433	27.69	67,429	1,433	27.69	67,429	1,371	27.83	67,072	1,296	26.16	59,596	720	28.11	35,591	1,433	28.75	67,429	0	0	0	1,396	28.48	67,429
14	1,433	27.29	67,429	1,433	27.19	67,429	1,433	27.39	67,429	1,433	27.69	67,429	1,371	27.83	67,072	1,296	26.16	59,596	720	28.11	35,591	1,433	28.75	67,429	0	0	0	1,396	28.48	67,429
15	1,433	27.29	67,429	1,433	27.19	67,429	1,433	27.29	67,429	1,257	28.50	62,973	1,371	28.33	67,429	1,296	26.06	59,368	720	28.11	35,591	1,433	28.75	67,429	0	0	0	1,396	28.48	67,429
16	1,433	27.29	67,429	1,433	27.19	67,429	1,433	27.69	67,429	1,257	28.50	62,973	1,371	28.13	67,429	1,296	26.16	59,596	720	28.11	35,591	1,433	28.75	67,429	0	0	0	1,396	28.48	67,429
17	1,433	27.29	67,429	1,433	27.19	67,429	1,433	27.39	67,429	1,257	28.10	62,089	1,371	28.13	67,429	1,296	28.16	64,153	0	0	0	1,433	28.75	67,429	0	0	0	1,396	27.98	67,429
18	1,433	27.29	67,429	1,433	27.19	67,429	1,433	26.59	66,982	1,257	28.10	62,089	1,371	29.73	67,429	1,296	26.96	61,419	0	0	0	1,396	29.03	67,429	0	0	0	1,396	27.78	67,429
19	1,433	27.29	67,429	1,433	27.19	67,429	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.53	67,429	1,296	26.56	60,507	0	0	0	1,396	29.03	67,429	0	0	0	1,396	27.78	67,429
20	1,433	27.19	67,429	1,433	27.19	67,429	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.03	67,429	1,296	26.06	59,368	0	0	0	1,396	29.33	67,429	0	0	0	1,396	27.68	67,429
21	1,433	27.09	67,429	1,433	27.19	67,429	1,433	26.69	67,234	1,257	28.10	62,089	1,371	27.93	67,313	1,296	26.06	59,368	0	0	0	1,396	29.03	67,429	0	0	0	1,396	27.48	67,429
22	1,233	28.06	60,817	1,433	27.19	67,429	1,433	26.59	66,982	1,257	28 10	62,089	1,371	28.33	67,429	1,246	26.28	57,559	0	0	0	1,396	28.93	67,429	0	0	0	1,346	28.30	66,961
23	1,233	28.06	60,817	1,433	27.19	67,429	1,433	26.59	66,982	1,257	28.10	62,089	1,371	29.33	67,429	1,246	26.48	57,997	0	0	0	1,396	28.83	67,429	0	0	0	0	0	0
24	1,433	27.69	67,429	1,433	27.19	67,429	1,085	27.93	53,266	1,257	28.10	62,089	1,371	28.63	67,429	1,246	26.38	57,778	0	0	0	1,396	28.73	67,429	600	27.68	29,205	0	0	0
25	792	25.93	36,113	1,333	27.43	64,275	1,433	26.79	67,429	1,257	28.10	62,089	1,371	28.33	67,429	1,246	26.38	57,778	0	0	0	1,296	29.06	66,204	920	28.52	46,141	0	0	0
26	1,433	27.69	67,429	1,333	27.43	64,275	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.73	67,429	1,246	26.48	57,997	0	0	0	1,296	29.06	66,204	920	30.02	48,568	0	0	0
27	1,433	27.69	67,429	1,333	27.43	64,275	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.73	67,429	1,246	26.38	57,778	0	0	0	1,296	28.76	65,521	920	30.22	48,892	0	0	0
28	1,433	27.69	67,429	1,333	27.43	64,275	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.53	67,429	1,246	26.38	57,778	0	0	0	1,376	28.38	67,429	920	30.52	49,377	0	0	0
29	1,433	27.69	67,429	1,333	27.43	64,275	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.33	67,429	1,246	26.38	57,778	0	0	0	1,376	28.38	67,429	920	30.52	49,377	800	30.57	43,007
30	1,433	27.69	67,429	1,333	27.43	64,275	1,433	26.69	67,234	1,257	28.90	63,857	1,371	28.33	67,429	1,246	26.58	58,216	600	29.40	31,021	1,376	28.38	67,429	920	30.52	49,377	745	30.57	40,050
Month Total			1,424,345			1,963,600			1,996,798			1,931,321			2,015,698			1,756,419			712,731			2,018,522			567,205			1,558,806

Month Average(KWHr) **1,594,544**

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Daily & Total Energy in the Month of Oct

	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,433	27.69	67,429	1,333	28.43	66,619	1,433	26.69	67,234	1,257	28.30	62,531	1,371	28.33	67,429	1,246	26.58	58,216	600	29.40	31,021	1,376	28.38	67,429	1,296	29.02	66,113	1,296	28.82	65,658
2	1,433	27.69	67,429	1,383	28.30	67,429	1,433	26.69	67,234	1,257	28.10	62,089	1,371	28.33	67,429	1,246	26.58	58,216	800	28.81	40,531	1,376	28.18	67,429	1,296	29.02	66,113	1,346	28.40	67,198
3	1,433	27.69	67,429	1,433	28.19	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,371	28.23	67,429	1,246	26.68	58,435	1,246	27.98	61,283	1,376	28.28	67,429	1,296	29.02	66,113	1,396	28.68	67,429
4	1,433	27.69	67,429	1,433	28.09	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,371	28.33	67,429	1,246	26.58	58,216	1,346	27.55	65,186	1,376	28.38	67,429	1,296	29.02	66,113	1,396	28.68	67,429
5	1,433	28.39	67,429	1,433	28.19	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,321	28.45	66,065	1,246	26.48	57,997	1,346	27.45	64,949	1,376	28.38	67,429	1,296	29.02	66,113	1,396	28.68	67,429
6	1,433	27.69	67,429	1,433	28.09	67,429	1,433	26.59	66,982	1,433	27.69	67,429	1,321	28.45	66,065	1,246	26.48	57,997	1,146	28.12	56,645	1,376	28.38	67,429	1,296	29.02	66,113	1,396	28.98	67,429
7	1,433	27.69	67,429	1,433	28.09	67,429	1,433	26.69	67,234	1,433	27.69	67,429	1,321	28.45	66,065	1,246	26.38	57,778	1,146	28.22	56,846	1,376	28.38	67,429	1,296	29.02	66,113	1,366	28.35	67,429
8	1,433	27.69	67,429	1,433	28.09	67,429	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.45	66,065	1,346	26.15	61,872	1,146	28.22	56,846	1,376	28.38	67,429	1,296	29.02	66,113	1,366	28.65	67,429
9	1,433	27.69	67,429	1,433	28.19	67,429	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.55	66,297	1,346	26.15	61,872	1,146	28.22	56,846	1,376	28.38	67,429	1,296	29.02	66,113	1,366	28.35	67,429
10	1,433	27.69	67,429	1,433	28.19	67,429	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.45	66,065	1,346	26.15	61,872	1,146	28.22	56,846	1,376	28.38	67,429	1,336	28.92	67,429	1,366	28.35	67,429
11	1,433	27.69	67,429	1,433	28.19	67,429	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.45	66,065	1,346	26.15	61,872	1,060	28.67	53,442	1,376	28.38	67,429	1,336	28.92	67,429	1,366	27.65	66,395
12	1,433	27.69	67,429	1,433	28.19	67,429	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.45	66,065	1,346	26.05	61,636	1,060	28.67	53,442	1,376	28.38	67,429	1,336	28.92	67,429	1,366	27.35	65,675
13	1,433	27.69	67,429	1,433	28.19	67,429	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.45	66,065	1,346	26.05	61,636	1,060	28.67	53,442	1,376	28.38	67,429	1,336	28.92	67,429	1,366	27.05	64,954
14	1,433	27.69	67,429	1,221	28.64	61,495	1,433	26.59	66,982	1,433	27.19	67,429	1,321	28.45	66,065	1,346	26.05	61,636	1,060	28.67	53,442	1,376	28.38	67,429	1,336	28.92	67,429	1,366	27.05	64,954
15	1,433	27.69	67,429	1,221	28.64	61,495	1,433	26.59	66,982	1,433	26.59	66,982	1,321	28.45	66,065	1,346	26.15	61,872	1,060	28.67	53,442	1,316	28.51	65,954	1,336	28.92	67,429	1,366	26.65	63,993
16	1,433	27.69	67,429	1,221	28.54	61,280	1,433	26.69	67,234	560	29.31	28,864	1,371	28.33	67,429	756	27.54	36,589	1,060	28.67	53,442	1,091	29.06	55,728	1,336	28.92	67,429	756	28.41	37,745
17	1,433	27.69	67,429	1,221	28.54	61,280	1,433	26.59	66,982	560	30.01	29,553	1,371	28.33	67,429	756	27.44	36,456	1,146	28.42	57,249	1,091	29.06	55,728	1,336	28.92	67,429	756	29.81	39,605
18	1,433	27.69	67,429	1,091	29.31	56,208	1,433	26.59	66,982	560	30.71	30,243	1,371	28.33	67,429	756	27.64	36,721	1,146	28.42	57,249	1,091	29.06	55,728	1,336	28.92	67,429	756	29.81	39,605
19	1,433	27.19	67,429	1,091	28.91	55,441	1,433	26.59	66,982	560	30.81	30,341	1,371	28.43	67,429	756	27.54	36,589	1,146	28.42	57,249	1,091	29.06	55,728	1,336	28.92	67,429	756	29.91	39,738
20	1,433	25.69	64,715	1,091	28.41	54,482	1,433	25.19	63,455	560	30.81	30,341	1,371	28.53	67,429	756	27.44	36,456	1,146	28.42	57,249	1,091	29.06	55,728	1,336	28.92	67,429	756	29.91	39,738
21	0	0	0	0	0	0	0	0	0	560	30.81	30,341	1,371	28.33	67,429	756	27.64	36,721	994	28.81	50,334	1,091	29.06	55,728	796	30.49	42,653	756	29.81	39,605
22	0	0	0	0	0	0	0	0	0	560	30.81	30,341	1,371	28.33	67,429	756	27.94	37,120	994	28.61	49,984	816	29.78	42,708	796	30.29	42,373	756	29.21	38,808
23	0	0	0	0	0	0	0	0	0	560	30.81	30,341	1,371	28.63	67,429	756	28.44	37,784	994	28.61	49,984	790	30.25	41,999	796	30.29	42,373	756	29.21	38,808
24	0	0	0	0	0	0	0	0	0	560	30.81	30,341	1,371	28.83	67,429	756	28.54	37,917	994	28.61	49,984	790	30.25	41,999	796	30.29	42,373	756	29.21	38,808
25	0	0	0	0	0	0	0	0	0	560	30.81	30,341	1,371	28.43	67,429	756	28.54	37,917	994	28.61	49,984	790	30.25	41,999	796	30.29	42,373	756	29.21	38,808
26	0	0	0	0	0	0	406	29.03	20,726	456	30.81	24,679	756	30.31	40,269	756	28.54	37,917	994	28.61	49,984	790	29.85	41,443	796	30.29	42,373	756	29.11	38,675
27	0	0	0	0	0	0	824	27.81	40,273	456	30.81	24,679	756	29.91	39,738	756	28.24	37,519	994	27.81	48,587	790	29.85	41,443	796	30.29	42,373	756	29.11	38,675
28	0	0	0	0	0	0	824	28.51	41,287	456	30.81	24,679	756	30.21	40,136	756	28.74	38,183	994	27.81	48,587	790	29.85	41,443	796	30.29	42,373	756	29.41	39,074
29	0	0	0	0	0	0	824	29.71	43,025	456	30.81	24,679	756	30.31	40,269	756	28.74	38,183	994	27.81	48,587	790	29.85	41,443	796	30.29	42,373	756	29.41	39,074
30	0	0	0	0	0	0	824	29.71	43,025	456	31.81	25,481	756	30.31	40,269	1,091	27.56	52,851	994	28.51	49,810	790	29.85	41,443	796	30.29	42,373	756	29.91	39,738
31	0	0	0	0	0	0	1,091	29.01	55,632	456	31.71	25,400	756	30.31	40,269	1,091	27.06	51,892	994	28.91	50,509	790	29.85	41,443	796	30.29	42,373	756	29.61	39,340
Month Total			1,345,872			1,287,450			1,581,851			1,451,403			1,911,906			1,527,939			1,642,980			1,761,699			1,803,125			1,624,108

Month Average(KWHr) 1,593,833

Table 6 Sheet 11 of 12

Daily & Total Energy in the Month of Nov

	2006			2007			2008			2009			2010		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,091	27.41	52,564	1,091	26.41	50,646	1,091	29.01	55,632	856	29.23	43,974	756	30.31	40,269
2	1,091	27.01	51,796	1,091	29.31	56,208	1,091	28.51	54,673	856	29.53	44,426	1,091	29.01	55,632
3	1,091	27.01	51,796	1,091	29.51	56,591	1,091	28.21	54,098	856	29.33	44,125	1,091	29.31	56,207
4	1,091	26.71	51,221	1,091	29.51	56,591	1,091	28.21	54,098	856	29.13	43,824	1,091	29.01	55,632
5	1,091	26.91	51,605	1,091	29.51	56,591	1,091	28.21	54,098	996	28.75	50,330	1,091	29.01	55,632
6	1,091	27.11	51,988	1,091	29.51	56,591	1,091	28.21	54,098	996	28.75	50,330	1,091	29.01	55,632
7	1,091	28.31	54,290	1,091	29.21	56,016	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
8	1,091	28.91	55,441	1,091	29.51	56,591	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
9	1,091	28.71	55,057	1,091	29.41	56,400	1,091	28.51	54,673	996	28.75	50,330	1,091	29.31	56,207
10	1,091	28.71	55,057	1,091	29.51	56,591	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
11	1,091	28.61	54,865	1,091	29.51	56,591	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
12	1,091	28.71	55,057	1,091	29.51	56,591	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
13	1,091	28.91	55,441	1,091	29.51	56,591	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
14	1,091	29.01	55,632	1,091	29.51	56,591	1,091	28.51	54,673	996	28.75	50,330	1,091	29.01	55,632
15	1,091	29.01	55,632	1,091	29.51	56,591	1,091	28.51	54,673	856	29.03	43,673	1,091	29.01	55,632
16	1,091	29.11	55,824	1,091	29.51	56,591	1,091	28.51	54,673	856	29.03	43,673	1,091	28.91	55,440
17	1,091	29.11	55,824	1,091	29.51	56,591	1,091	28.51	54,673	856	29.03	43,673	1,091	28.91	55,440
18	1,091	29.01	55,632	1,091	29.51	56,591	1,091	28.31	54,290	856	29.03	43,673	1,091	28.91	55,440
19	1,091	29.01	55,632	1,091	29.51	56,591	1,091	28.41	54,482	856	28.93	43,523	1,091	28.91	55,440
20	1,091	28.51	54,673	1,091	29.51	56,591	1,091	28.41	54,482	856	28.93	43,523	1,091	29.01	55,632
21	1,091	28.51	54,673	1,091	29.51	56,591	1,091	28.41	54,482	856	28.93	43,523	1,091	29.01	55,632
22	1,091	28.51	54,673	1,091	29.51	56,591	1,091	28.41	54,482	856	28.93	43,523	1,091	29.01	55,632
23	991	28.77	50,113	1,091	29.51	56,591	1,091	28.41	54,482	856	28.93	43,523	1,051	29.12	53,795
24	991	28.77	50,113	1,091	29.51	56,591	1,091	28.41	54,482	880	28.93	44,769	1,051	29.12	53,795
25	991	28.77	50,113	1,091	29.51	56,591	1,091	28.41	54,482	880	28.93	44,769	960	29.89	50,460
26	991	28.77	50,113	1,091	29.51	56,591	1,091	28.31	54,290	880	28.93	44,769	960	29.89	50,460
27	841	29.17	43,115	1,091	29.51	56,591	1,091	28.31	54,290	880	28.93	44,769	960	29.89	50,460
28	841	29.17	43,115	1,091	29.51	56,591	1,091	28.31	54,290	880	28.33	43,841	960	29.39	49,616
29	841	29.17	43,115	1,091	29.51	56,591	1,091	28.31	54,290	880	28.33	43,841	960	29.39	49,616
30	855	29.17	43,858	941	29.80	49,287	1,091	28.31	54,290	880	28.33	43,841	960	29.39	49,616
Month Total			1,568,030			1,683,341			1,635,215			1,382,560			1,616,740

	2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,091	27.06	51,892	994	28.81	50,334	1,091	29.06	55,728	1,091	29.52	56,610	896	29.02	45,700
2	1,091	27.06	51,892	994	28.81	50,334	1,091	29.06	55,728	1,091	29.52	56,610	896	28.82	45,385
3	1,091	27.06	51,892	994	28.81	50,334	1,091	29.06	55,728	1,091	29.52	56,610	956	28.36	47,653
4	1,091	27.06	51,892	994	28.91	50,509	1,091	29.06	55,728	1,091	29.52	56,610	956	28.36	47,653
5	1,091	27.06	51,892	1,091	28.55	54,750	1,091	29.06	55,728	1,091	29.52	56,610	846	29.65	44,085
6	1,091	27.06	51,892	1,091	28.55	54,750	1,091	29.06	55,728	1,091	29.52	56,610	846	29.65	44,085
7	1,091	27.06	51,892	1,091	28.45	54,558	1,091	29.06	55,728	1,091	29.52	56,610	846	29.65	44,085
8	1,091	27.06	51,892	1,091	28.45	54,558	920	29.57	47,840	891	30.04	47,042	846	29.45	43,788
9	1,091	26.56	50,933	1,091	28.45	54,558	820	29.83	43,015	903	30.04	47,702	846	29.45	43,788
10	1,091	27.06	51,892	1,091	28.45	54,558	820	29.83	43,015	903	30.04	47,702	846	29.45	43,788
11	1,091	27.06	51,892	1,091	28.55	54,750	720	30.11	38,124	758	30.43	40,563	846	29.45	43,788
12	1,091	27.06	51,892	1,091	28.55	54,750	720	30.11	38,124	758	30.43	40,563	846	29.65	44,085
13	1,091	27.56	52,851	1,091	28.55	54,750	870	29.70	45,439	758	30.43	40,563	846	29.55	43,937
14	1,091	28.06	53,810	1,091	28.45	54,558	870	29.70	45,439	758	30.43	40,563	846	29.65	44,085
15	1,091	28.16	54,002	1,091	28.45	54,558	870	29.70	45,439	758	30.43	40,563	846	29.65	44,085
16	1,091	28.26	54,193	1,091	28.45	54,558	870	29.70	45,439	758	30.43	40,563	846	29.65	44,085
17	1,091	28.46	54,577	1,091	28.45	54,558	870	29.70	45,439	758	30.43	40,563	846	29.65	44,085
18	1,091	28.56	54,769	991	28.82	50,199	870	29.70	45,439	758	30.43	40,563	846	29.65	44,085
19	1,091	28.56	54,769	991	28.92	50,374	870	29.70	45,439	758	30.43	40,563	846	29.65	44,085
20	1,091	28.46	54,577	991	28.92	50,374	870	30.00	45,898	758	30.43	40,563	846	29.65	44,085
21	1,091	28.46	54,577	991	28.92	50,374	870	30.20	46,204	758	30.43	40,563	846	29.65	44,085
22	1,091	28.46	54,577	991	28.92	50,374	870	30.20	46,204	758	30.43	40,563	846	29.65	44,085
23	955	28.74	48,266	991	28.92	50,374	870	30.20	46,204	758	30.43	40,563	846	29.85	44,383
24	955	28.74	48,266	991	28.92	50,374	870	30.20	46,204	758	30.53	40,696	846	29.65	44,085
25	955	28.74	48,266	991	28.92	50,374	870	30.20	46,204	758	30.43	40,563	846	29.65	44,085
26	910	28.86	46,184	991	28.92	50,374	870	30.20	46,204	908	30.02	47,935	846	29.65	44,085
27	910	28.86	46,184	991	28.92	50,374	870	30.20	46,204	908	30.02	47,935	846	29.65	44,085
28	910	28.86	46,184	935	29.07	47,798	870	30.20	46,204	908	30.02	47,935	846	29.65	44,085
29	910	28.86	46,184	935	29.17	47,962	870	30.20	46,204	908	30.02	47,935	796	29.79	41,674
30	940	28.78	47,574	910	29.27	46,840	870	30.20	46,204	908	30.02	47,935	796	29.79	41,674
Month Total			1,541,549			1,557,882			1,426,226			1,386,962			1,326,750

Month Average(KWHr) 1,512,525

Table 6 Sheet 12 of 12

Daily & Total Energy In the Month of Dec

	2006			2007			2008			2009			2010		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	1,046	28.63	52,638	941	29.80	49,287	850	29.31	43,811	880	28.33	43,841	960	29.39	49,616
2	1,046	28.63	52,638	941	29.80	49,287	850	29.71	44,409	880	27.63	42,757	960	29.39	49,616
3	1,046	28.63	52,638	941	29.80	49,287	850	29.71	44,409	880	28.93	44,769	960	29.39	49,616
4	890	29.06	45,482	941	29.80	49,287	850	30.01	44,858	880	29.13	45,079	960	29.39	49,616
5	820	29.35	42,323	941	29.80	49,287	850	29.81	44,559	880	29.23	45,234	1,030	28.71	52,002
6	496	31.84	27,772	941	29.80	49,287	850	29.81	44,559	880	29.13	45,079	1,030	28.21	51,096
7	496	29.84	26,028	941	29.80	49,287	850	29.81	44,559	880	29.13	45,079	1,030	28.11	50,915
8	496	30.24	26,376	941	29.80	49,287	850	29.61	44,260	880	29.13	45,079	1,030	28.11	50,915
9	496	30.84	26,900	941	29.80	49,287	850	29.41	43,961	880	29.13	45,079	1,030	28.11	50,915
10	490	30.84	26,575	941	29.80	49,287	850	29.31	43,811	880	29.13	45,079	1,030	28.51	51,640
11	490	30.84	26,575	891	30.02	47,011	850	29.31	43,811	880	29.13	45,079	1,030	27.91	50,553
12	0	0	0	891	30.02	47,011	850	29.61	44,260	880	29.23	45,234	1,030	28.71	52,002
13	0	0	0	891	30.02	47,011	850	29.61	44,260	880	29.13	45,079	1,030	28.31	51,277
14	0	0	0	891	30.02	47,011	850	29.61	44,260	880	29.13	45,079	1,030	28.51	51,640
15	0	0	0	891	30.02	47,011	850	29.61	44,260	1,020	28.75	51,569	1,030	28.61	51,821
16	0	0	0	891	29.92	46,855	850	29.61	44,260	1,020	28.65	51,389	1,030	28.61	51,821
17	0	0	0	891	29.92	46,855	850	29.61	44,260	920	28.91	46,772	1,030	28.61	51,821
18	0	0	0	991	29.67	51,681	850	29.71	44,409	920	28.91	46,772	1,030	28.61	51,821
19	0	0	0	991	29.67	51,681	850	29.71	44,409	920	28.91	46,772	1,030	28.61	51,821
20	0	0	0	941	29.80	49,287	850	29.71	44,409	920	28.91	46,772	1,030	28.71	52,002
21	0	0	0	941	29.80	49,287	850	29.71	44,409	920	28.91	46,772	1,030	28.71	52,002
22	0	0	0	941	29.80	49,287	850	29.51	44,110	920	28.91	46,772	1,030	28.71	52,002
23	0	0	0	941	29.80	49,287	850	29.11	43,512	920	29.01	46,934	1,030	28.71	52,002
24	0	0	0	941	29.80	49,287	850	29.21	43,662	920	27.51	44,507	1,030	28.71	52,002
25	0	0	0	941	29.30	48,460	930	27.61	45,154	780	27.91	38,283	1,030	27.21	49,285
26	0	0	0	941	29.40	48,625	930	27.91	45,645	780	27.91	38,283	1,030	28.71	52,002
27	0	0	0	959	29.33	49,463	930	28.21	46,135	780	27.91	38,283	1,030	28.71	52,002
28	0	0	0	959	29.83	50,307	930	28.01	45,808	780	28.21	38,694	1,030	28.71	52,002
29	0	0	0	959	29.83	50,307	930	28.01	45,808	780	28.21	38,694	1,030	28.71	52,002
30	0	0	0	1,091	29.21	56,016	930	27.91	45,645	780	28.21	38,694	1,030	28.71	52,002
31	0	0	0	1,091	29.21	56,016	930	27.91	45,645	780	28.21	38,694	1,030	28.71	52,002
Month Total			405,943			1,530,625			1,381,327			1,372,201			1,591,830

	2011			2012			2013			2014			2015		
Day	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr	Flow	Head	KWHr
1	990	28.65	49,878	910	29.27	46,840	870	30.20	46,204	908	30.02	47,935	796	29.79	41,674
2	990	28.65	49,878	910	29.27	46,840	870	30.20	46,204	908	30.02	47,935	796	30.19	42,234
3	990	28.65	49,878	910	29.27	46,840	870	30.20	46,204	908	30.02	47,935	796	30.19	42,234
4	990	28.65	49,878	910	29.27	46,840	870	30.20	46,204	908	30.02	47,935	796	30.09	42,094
5	990	28.65	49,878	910	29.27	46,840	870	30.20	46,204	908	30.02	47,935	676	30.54	36,279
6	990	28.65	49,878	910	29.27	46,840	870	30.20	46,204	968	29.86	50,830	796	30.09	42,094
7	990	28.65	49,878	910	28.87	46,200	870	30.20	46,204	968	29.86	50,830	796	30.49	42,654
8	990	28.65	49,878	910	29.17	46,680	870	30.20	46,204	968	29.86	50,830	796	30.09	42,094
9	990	28.65	49,878	910	29.17	46,680	870	30.20	46,204	968	29.86	50,830	796	30.19	42,234
10	990	28.65	49,878	910	29.17	46,680	950	29.98	50,085	968	29.86	50,830	796	30.19	42,234
11	990	28.65	49,878	810	29.43	41,921	950	29.98	50,085	968	29.86	50,830	796	30.09	42,094
12	990	28.65	49,878	810	29.43	41,921	950	29.88	49,918	968	29.86	50,830	796	30.09	42,094
13	990	28.65	49,878	810	29.43	41,921	950	29.88	49,918	868	28.73	43,854	796	30.19	42,234
14	990	28.65	49,878	810	28.93	41,208	950	29.88	49,918	968	29.86	50,830	796	30.09	42,094
15	990	28.65	49,878	810	28.53	40,638	950	29.88	49,918	968	29.86	50,830	696	30.58	37,402
16	990	28.65	49,878	810	28.53	40,638	950	29.88	49,918	968	29.86	50,830	696	30.58	37,402
17	990	28.65	49,878	910	28.07	44,919	950	29.88	49,918	968	29.86	50,830	846	29.95	44,532
18	990	28.65	49,878	910	27.97	44,759	950	29.88	49,918	968	29.86	50,830	846	29.95	44,532
19	990	28.65	49,878	910	27.97	44,759	950	29.78	49,751	968	29.86	50,830	846	29.95	44,532
20	990	28.65	49,878	810	28.23	40,211	950	29.88	49,918	968	29.86	50,830	846	29.95	44,532
21	990	28.65	49,878	810	28.23	40,211	950	29.98	50,085	968	29.86	50,830	846	29.95	44,532
22	990	28.65	49,878	810	28.23	40,211	950	29.98	50,085	968	29.86	50,830	846	29.95	44,532
23	990	28.65	49,878	810	28.23	40,211	950	29.98	50,085	968	29.86	50,830	846	29.95	44,532
24	990	28.65	49,878	810	28.23	40,211	950	29.98	50,085	1,028	29.71	53,709	846	29.95	44,532
25	990	28.65	49,878	820	28.23	40,707	950	29.98	50,085	1,028	28.21	50,997	846	29.95	44,532
26	990	28.65	49,878	820	29.53	42,582	950	27.48	45,908	1,028	26.31	47,562	846	26.15	38,881
27	990	28.65	49,878	820	29.53	42,582	950	27.48	45,908	978	26.54	45,644	846	26.35	39,178
28	990	28.65	49,878	820	29.43	42,438	950	27.48	45,908	978	26.54	45,644	908	26.49	42,274
29	990	28.65	49,878	820	29.43	42,438	950	27.48	45,908	878	26.90	41,533	908	26.49	42,274
30	990	28.65	49,878	820	29.43	42,438	950	27.48	45,908	878	26.90	41,533	927	26.44	43,078
31	990	28.65	49,878	820	29.73	42,871	950	27.48	45,908	878	26.90	41,533	956	26.36	44,292
Month Total			1,546,219			1,347,073			1,490,973			1,515,786			1,309,907

Month Average(KWHr) **1,349,188**

Table 7

Yearly and Mean Monthly Energy (KWH)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Mean
Jan	607,545	0	578,185	488,681	384,335	761,092	566,333	480,810	566,693	469,545	**490,322**
Feb	1,367,692	501,797	625,020	803,265	715,602	820,223	962,605	18,557	884,138	292,155	**699,105**
Mar	1,647,588	0	1,684,817	789,969	1,345,117	1,414,453	1,201,700	1,196,095	584,537	0	**986,427**
Apr	1,767,932	1,743,246	801,349	937,454	837,058	1,646,274	1,484,425	1,447,185	1,124,917	804,850	**1,259,469**
May	1,985,967	2,089,129	1,782,740	2,039,034	1,741,349	2,090,310	1,176,621	1,779,928	2,002,936	1,949,697	**1,863,771**
Jun	1,924,966	1,989,406	1,977,976	2,010,451	1,903,951	1,954,057	1,937,836	1,874,001	2,015,914	1,992,792	**1,958,135**
Jul	1,735,212	1,989,556	2,074,206	2,034,458	2,060,825	1,910,351	2,015,354	1,985,381	1,967,706	2,029,232	**1,980,228**
Aug	1,912,027	2,061,931	2,080,125	2,078,058	1,924,313	1,980,649	1,935,869	1,975,604	1,950,171	2,020,923	**1,991,967**
Sep	1,424,345	1,963,600	1,996,798	1,931,321	2,015,698	1,756,419	712,731	2,018,522	567,205	1,558,806	**1,594,544**
Oct	1,345,872	1,287,450	1,581,851	1,451,403	1,911,906	1,527,939	1,642,980	1,761,699	1,803,125	1,624,108	**1,593,833**
Nov	1,568,030	1,683,341	1,635,215	1,382,560	1,616,740	1,541,549	1,557,882	1,426,226	1,386,962	1,326,750	**1,512,525**
Dec	405,943	1,530,625	1,381,327	1,372,201	1,591,830	1,546,219	1,347,073	1,490,973	1,515,786	1,309,907	**1,349,188**
Total	17,695,126	16,842,089	18,201,616	17,320,864	18,050,733	18,951,548	16,543,421	17,456,993	16,372,103	15,380,781	**17,279,517**

CHAPTER 6

Project Layout & Description of Project Components

CHAPTER– 6

PROJECT LAYOUT AND DESCRIPTION OF PROJECT COMPONENTS

6.1 GENERAL

Gujrat Branch off takes from right side of UJC at R.D 155.080.The discharges of Gujrat Canal are controlled by Khokhra head regulator. The designed discharge of Gujrat Branch is 1537 Cusecs. Chillianwala distributary off-takes from right side at RD 1.000 of Gujrat branch. The designed discharge of distributary is 104 Cusecs.

6.2 PROJECT LAYOUT

The Project layout has been planned as described below. An intake structure has been planned on the right bank of UJC about 500 ft upstream of Khokhra Head Regulator. The intake structure will convey water to Head Race (Power Channel). From right side of Head race at a distance of 50 ft from intake structure a diversion channel of capacity 104 Cusecs has been planned to divert water to existing Chillianwala distributary.

From head race (power channel) the water is carried to power house.After running the turbines, the water will be diverted back to Gujrat branch at its R.D 2+150.The length of tail race is about 1800 ft. The Project layout is shown in Drawing 6.1

6.3 DESCRIPTION OF COMPONENTS (CIVIL WORKS)

6.3.1 Intake Structure

Intake structure has been planned at R.D 254+500 of UJC. The structure is proposed nearly 50 ft away (towards south) from right bank of UJC. The 50 ft portion shall act as barrier between Intake structure and UJC Canal during construction stage. After completion of the project, this portion of right side bank of UJC shall be removed strictly in accordance with the design. Stone pitching shall be laid in the bed and right and left sides of this cut portion U/S of Intake structure.

Intake structure has been planned to divert the discharge with minimum head loss. It has been designed as a broad crested weir with a total width of 47 ft between side abutments. A central pier has also been provided so that bridge and trash tracks are conveniently and economically supported. Bridge with 18 ft width has been proposed on top of intake structure to allow traffic to proceed along the UJC. As it is more convenient to collect the trash at intake as compared to that at just U/S of penstocks, trash rack has been proposed here. Smooth transition both at U/S and D/S sides have been proposed to connect the UJC flow to rectangular section of intake and from rectangular section of intake to trapezoidal section of headrace channel. Cut off walls up to maximum expected scour depth are provided while whole of the foundation has been placed on medium dense silty clay well above the existing water table. Details have been shown on drawing no 6.2 and 6.3.

6.3.2 Head Race (Power Channel)

Head race channel is designed for a discharge of 1537 Cusecs. Length of this channel is 304 ft and it has a mild bed slope of 1: 10,000 bed width 37 ft. and side slopes 1.5 H : 1 V. Brick lining has been proposed in this section. Before entry in to power house, the bed width of head race reduces to 34 ft. Preliminary design of channel has been based on Manning formula with value of n as 0.015. Longitudinal section and longitudinal cross section has been shown in drawing no 6.3 and 6.4.

6.3.3 Power House

The Intake structure of power house consists of two 10 ft dia steel penstocks , embedded in RCC block 31 ft wide, 14 ft deep and 50 ft long. The Centre line of penstocks drops down to 762.2 ft from 777.82 ft. At the entry of penstocks two gates have been provided. Which can be closed during annual maintenance of power house. At the end of each penstock two Kaplan S type turbines are proposed.

The main power house is 50 ft long, 51.25 ft wide and 37.5 ft high. A crane shall also be installed in the Power house building, a double storey office building 64 ft long and 23.5 ft wide has been provided on right side of Power house. The office building consists of store room, O & M staff room, RE-room battery room, control room and canteen. The water after generating power shall emerge from an 18' x 32' structure with a pier in between. Access road to Power house will pass through a bridge constructed on this outlet structure. Floor level of power house is at EL. 758.55. Below this level mass concrete with embedded parts of turbine shall be provided. Structure will be RCC framed structure. Details have been shown in drawing no 6.5, 6.6 and 6.7.

6.3.4 Tail Race

The water after generating power will be conveyed back to Gujrat Branch at R.D 2+150 , through tail race. Tail race has been designed as a brick lined trapezoidal channel for a maximum discharge of 1433 Cusecs.The bed slope has been kept as 1:5000, bed width as 60 ft.Side slopes have been provided as 1.5 H : 1 V. At the junction of tail race with Gujrat branch, stone pitching is proposed on bed and side slopes of Gujrat Branch for a length of 100 ft U/S and D/S. Design has been based on Mannings formula with value of n = 0.015. Total length of tail race will be about 1800 ft. Longitudinal section and cross section has been shown in drawing no 6.3 and 6.4.

6.3.5 Chillian Wala Distributary

The head regulator of Chillianwala distributary exists at RD 1+000 on right bank of Gujrat Canal. In the proposed scheme the designed discharge of Gujrat branch shall be diverted for Power generation about 500 ft upstream of Khokhra head works, therefore there will be no water in Gujrat branch for diversion to Chillianwala distributary.

In the proposed scheme the Chillianwala distributary shall take off from head race of power house at a distance of about 50 ft from end of Intake Structure. The section of distributary has been proposed as a trapezoidal section, with bed width as 9.16 ft and side slope as 1.5 H : 1 V. A gate to control the discharge shall be provided at head. After a straight reach of 30 ft. RCC rectangular channel, a fall has been proposed. This straight reach can be utilized in future for small hydel power station if so planned. Details has been shown in drawing no 6.8 and 6.4.

6.4 HYDRO-MECHANICAL EQUIPMENT

General

This section gives general information and guidelines used for the feasibility design of the hydro-mechanical equipment of Khokhra power station. The equipment which will be required comprises of:

Mechanical equipment, comprising:

- Turbines and Governors
- Powerhouse Bridge Crane
- Cooling and Dewatering Systems
- Auxiliary Equipment
- Draft Tube Gates

Hydraulic Steel Structures, comprising:

- Power Intake Gates complete with hoisting gantry and Trashracks
- Penstocks

6.4.1 Turbines

Types and Rating of Turbines

Net head and the installed capacity of Khokhra power station characterized this scheme as a low head (Less than 65ft) small hydro (Less than 30MW) hydropower development which is practically the operational zone of the Kaplan turbines, may be Kaplan Vertical, Kaplan Bulb turbines and Kaplan Tubular (S or inclined). The merits and demerits are separately discussed for each turbine as hereunder:

6.4.1.1. Kaplan Vertical

Merits:

- Most economical turbines from E&M point of view.
- Easier maintenance as compared to the other types of turbines.
- Extensively used all over the world and consequently a lot of turbine manufacturers provide it competitively.
- Comparatively easy to manufacture and hence more providers.
- Good efficiency.
- Most commonly used Layout and hence simpler civil work design.

Demerits:

- The generator coupled directly with the turbine, needs bigger overhead crane.
- Deeper centerline of Turbine requires more effort for dewatering / excavation.

6.4.1.2. Kaplan Bulb

Kaplan bulb is usually considered feasible for heads upto 20ft, however very specific and few manufacturers world around do have the capability to provide Kaplan bulb turbines over 20ft. The bulb type generating set has successful record of operation and development world-wide. The merits and demerits of Kaplan Bulb are given below:

Merits:

- Most efficient Turbine for Low Head Power Plants.
- Lesser excavation and dewatering required.

Demerits:

- Most expensive Electromechanical equipment.

- Larger size of the power house increases the cost of construction.
- Larger overhead crane required.
- Fewer high tech providers.
- Complex installation and maintenance.
- Requires efficient cooling system due to enclosed generator.

6.4.1.3. Kaplan 'S' Type

Kaplan 'S' type also qualify for Khokhra power station. This tubular type of turbine is often referred to as an 'S' type because of the S-shaped waterway from inlet to outlet, the tubular turbine of the Kaplan or fixed propeller type being located centrally within the waterway.

From the turbine, the shaft extends through the casing to drive the generator either directly or via a speed-increasing gear.

According to the geometry, the shaft arrangement can be horizontal or inclined upwards from turbine to generator. The S-shaped waterway suits relatively high heads as of Khokhra power station. Merits and demerits as discussed below:

Merits :

- Lesser Excavation of power station required.
- Less expenditure on dewatering.
- Generator size can be reduced with speed increaser.
- Good efficiency

Demerits:

- Fewer providers/less practiced.
- More costly Electro Mechanical Equipment as compared to vertical Kaplan Turbines, but less than bulb turbine.

No. of Turbines

A single Turbine has the advantage of reduced E & M costs, however, has the disadvantage that any fault will cause the whole plant to shut down. Keeping the cost to benefit ratio, it is recommended to install two units (one single regulated and one double regulated) of 1.4 MW capacity each.

Recommendation

Latest quotations have been invited from the manufacturers for the above three types of turbines. Previous quotations however indicated Bulb type Turbine to be the least beneficial as per the cost to benefit ratio analysis. However for reference purposes in the Feasibility Study we have selected Kaplan S type Turbines for Khokhra Hydropower Project.

At present, the decision is pending between S type and vertical Kaplan, which will be finalized after detailed quotations have been received.

6.4.2 Turbines and Governors

Basic Data

Kaplan 'S' turbines as selected for Khokhra power station will operate under the following conditions of discharge, head and tailrace level:

Discharge

Rated Discharge/unit 718.5ft.^{3}/s

Minimum. Discharge 597.5ft.^{3}/s

Headrace and Tailrace Levels

UJC/Power Channel(FSL) level El.787.07

Tailrace Level

The tailrace level will fluctuate between EL756.8 and 754.5 for full turbines discharges of 1437ft^3/s in kharif and 1195ft^3/s in Rabi seasons respectively.

Turbine Setting

The turbines of Khokhra power station are set at +5.4ft above the tailrace level of El.756.8.

Head Loss and Rated Head

The maximum gross head with two units operation for this power station would be 27.72ft, whereas, the waterways head loss is assumed as 0.3m. Therefore, the rated net head will be 26.74 ft.

Synchronous Speed

The turbine speed is selected as 214.3rpm and will be stepped up to generator synchronous speed of 1000rpm through a speed increasing gears may be of epicycle design.

Efficiency

The turbine full gate efficiency will be 92%.

The characteristics of the selected Kaplan 'S' turbines for Khokhra power station are summarised hereunder:

Characteristics of the selected Turbines

Rated Net head	26.74 ft
Rated Discharge/unit	718.5ft^3/s
Rated turbine output	1.4 MW
Turbine speed	214.3 rpm
Generator speed	1000 rpm
Specific speed	555.7
Runaway speed	545 rpm
Runner diameter	72.6 inches
Number of runner blades	4
Runner weight	4318lbs
inlet diameter	120 inches
Hydraulic thrust	9526 lbs
Number of units	2

Generator Inertia Wr^2	0.01×10^6 lb $ft.^2$
Installed capacity	2.8 MW
Average Energy Production	17.28 GWh

Materials

The materials standards as are normally used for turbine parts are mentioned hereunder:

Item No.	Part	Material Designation
1	Runner	Cr13Ni4Mo
2	Draft tube liner	A283GrC
3	Discharge ring	A283GrC
4	Spiral Case	A516Gr70
5	Stay Ring	A516Gr70
6	Shaft	A668classD
7	Guide vanes	Cr13 Ni4 Mo
8	Regulating ring	A283GrC
9	Links	A668classD
10	Servomotor cylinder	G485-275
11	Servomotor piston	A283GrC
12	Guide bearing pad	G485-275
13	Guide bearing white metal	B23-83
14	Rotating wearing rings	S41500 ASTM
15	Governor accumulator	A515Gr70

6.4.3 Turbine Governors

Digital governors with PID characteristics and based on programmable logic controller (PLC) are proposed for both the units. The digital governors will be suitable for network (grid) and isolated operation and will have the following function and properties:

- Automatic frequency and speed (signal from PT and shaft gear) control
- Automatic load control
- Headrace level measurement and control

- Tailrace level measurement
- Manual and auto mode
- Turbine start and stop sequence
- Permanent speed droop adjustable between 0-10%
- Black start operation

The Contractor shall supply all instruments, cabling etc. for the measurement of the above quantities/values.

6.4.4 Hydraulic Power Packs

The hydraulic power packs suitable for parallel operation (grid and isolated loads) are proposed for the hydraulic control of the Kaplan 'S' turbines which work under the command of the digital governors. The hydraulic power packs will comprise of all instruments such as pilot valve, actuators, distribution valves, two (2) pumps of gear or screw type with motors, sump tank with oil capacity not less than 30 litres, filter, oil level indicator, pressure switches, alarms and indications and any other instruments as would be necessary for safe operation of the turbines in the parallel mode as briefly described hereinabove.

6.4.5 Powerhouse Bridge Crane

A 10 ton mechanically operated bridge crane with separate wheel drives for longitudinal travel of the bridge and cross travel of trolley, is proposed considering rotor weight of 7 ton. The crane will consist of traveling rails for full length of the power station with all embedded anchors, sole plates, cleats etc. The crane shall be designed in accordance with the CMAA or FEM standards.

6.4.6 Cooling and Dewatering Systems

Cooling Water System

It is intended that the turbine and the generator bearings will be of the self lubricated type having operational life over 100,000 hours, however, if required the shaft seal or the glands will be supplied filtered water from duplex filters with raw water intake from a well source. Similarly, cooling of the generator windings for such small capacity is not foreseen at this stage of the feasibility study, however, provision of a small generator surface cooler if required will be considered during the detail design stage evaluating the manufacturer experience.

Dewatering System

The dewatering of the penstocks and bulbs will be carried out through crack opening of guide vanes upto the tailrace level of El.756.8 and to cater for the remaining water column in the draft tubes, a mobile centrifugal pump having a capacity of 40GPM and capable of discharging against head of 15ft is proposed. This mobile pump can be temporarily positioned on the downstream draft tube deck and suction line dropped in the inspection manhole of the draft tube for dewatering as required.

6.4.7 Auxiliary Equipment

Maintenance Tools

Adequate number of maintenance tools to facilitate repair or renewal of components which do not need specialized skill or experience are proposed which consist of the following:

- All types of keys, spanners, gauges, screw drivers, vernier caliper, micrometer etc.

- Different size of hydraulic jacks, hoses, slings etc.
- Small pedestal and portable drilling machine with tools
- A small welding plant.
- Small electrical tools, air driven tools and a small capacity mobile compressor.

Fire Fighting Equipment

In general, 6 kg hand held and 25 kg mobile fire extinguishers shall be placed at central location in the power station and at the intake.

6.4.8 Draft Tube Gate

For annual operation and maintenance of the turbine and generator, there seems no reason to close the draft tube exist, being the tailrace water level well below the turbine and generator centreline. However, for inspection of the draft concrete part, one draft tube gate of size 16ftx15ft is proposed for the closure of draft exist. The gate will be designed for downstream tailrace level of El756.8 and in accordance with the relevant DIN or ASTM standards considering the dead, hydrostatic, dynamic, friction, wind and seismic loads. Structural steel gates are usually proposed for such utility, however, possibility of using wood stoplogs in place of steel gate, will also be checked to economize the project overall investment cost during the detail design period.

6.4.9 Hydraulic Steel Structures

6.4.9.1 Power Intake Gates

The power intakes of the Khokhra power station comprises of trashrack, stoplogs and vertical fixed wheel gates and rope hoisting system. All these hydraulic structures as shown in Figure ---- will be designed according to data as mentioned in the following table:

Description	Full Supply Level (FSL)	Bed Level (BL)	Designed Head
Power Intake gates	El. 787.07	El. 772.82	14.25" 15 ft
Stoplogs	El. 787.07		
Trashrack	El. 787.07	El. 775.59	11.55 ft

6.4.9.2 Fixed Wheel Gates

The power intake will be supplied with two vertical fixed wheel gates complete with rope hoists fixed on concrete gantry each for one penstock; automatically controlled through the digital governor of each turbine and manually from the Unit Local Control Panel(ULCP) and Local Control Panel(LCP) at the power intake gates control room.

The power intake fixed wheel gates will be of size 14.25ft x 16.66ft and designed in accordance with the relevant DIN or ASTM standards considering upstream water level, the dead, hydrostatic, dynamic, friction, wind and seismic loads.

6.4.9.3 Trashracks

Two trashracks are proposed at the off take point of UJC to avoid entrance of debris and trash into the power channel. The trashrack main dimension and design will be as stipulated in the following table:

Number of trashracks	2
Free opening between the bars, approx.	135 mm

Two wooden stoplogs each of size ------ is proposed at the off take point of UJC to seal the power channel for inspection.

6.4.10 Penstocks

Two 10ft. diameter, 55ft. long steel penstock encased in concrete are planned to feed the water to two turbines. Each penstock has an internal operating pressure of 13psi which could increase to atmospheric pressure of 14.7psi even under the load rejection condition. Under such circumstances large steel penstock are designed to provide rigidity required during fabrication and handling. It is therefore planned to adopt a thickness of 3/8 inches for each penstock and fabricate them from flat rolled carbon steel plates 5LA as prepared by Pakistan Steel which have minimum yield point strength of 30000psi.

6.4.10.1 Design Standards

The penstocks will be designed as per USBR Engineering Manual No. 3, AISI steel Plate Engineering Data- Volume 3&4 and ASCE Engineering Practice No. 79.

6.4.11 Power Station layout

The total length and width of the power station including the loading bay and control building has been determined as 75ft. long and 50ft. wide. The powerhouse arrangement and main dimensions are shown in the Figures 6.1, 6.2 and 6.3. The turbines and generators are arranged above the tailrace level of El.756.8, whereas, the control room and the electrical panels are disposition on the 1st floor of the control building to safeguard them against flooding. The power station is placed at elevation El.758.55t. The Resident Engineer, operation and maintenance staff offices and store are planned on ground floor of the control building.

6.5 ELECTRICALEQUIPMENT

6.5.1 Generator Data / Scope

Installation and commissioning of the two horizontal type, self excited brush less synchronous generators, for direct coupling to turbines, complete with excitation equipment.

6.5.1.1 Main Data of Generator

No. of generators	2
Rated output	1.4 MW
Rated power factor	0.85
Rated voltage	11 KV
Power frequency	50 Hz
Rated speed	1000 rpm
Efficiency	96%
Ambient temperature	40°C
Cooling	Water / Air heat exchangers
Degree of protection	IP 44
Insulation class Generator	F

6.5.1.2 Excitation System

The excitation system will have brush less excitation system formed by an integrated exciter

Ambient temperature	40°C
Cooling	Water / Air heat exchangers
Degree of protection	IP 44
Insulation class Generator	F

6.5.1.2 Excitation System

The excitation system will have brush less excitation system formed by an integrated exciter having its own stator and rotor and rotating rectifier with all its necessary protections. The supply includes but not limited to the following:

- AC / DC circuit breaker, cubicle mounted
- AC / DC converter with controlled thyristors / diodes
- De – excitation circuit
- Over voltage protection
- Electronic automatic voltage regulator (AVR).

6.5.2 Switchgears

General

This section covers the scope of MV, LV switchgears and associated auxiliaries. It covers all the aspects of supply, installation, erection and commissioning of the equipment to be installed at various locations is listed as per drawing.

AC auxiliaries electrical power supply shall be distributed on 400 V AC auxiliary supply system to the various locations of the power plant as per drawing. Stand by diesel generator set shall automatically supply if AC power tripped out. On restoration of AC power, the diesel generator shall be synchronized before shutting down.

The E&M Contractor shall supply all internal wiring terminated in interconnection cubicles.

The single line diagram and the layout drawings showing the location and arrangements of the switchgear are included in Drawings.

Engineering

All equipment shall be designed according to the relevant IEC standards.

Switchgear connected to the generator terminals shall be rated according to the highest actual generator voltage.

The E&M Contractor shall perform short circuit calculations for the systems as basis for final determination of equipment ratings and selection of protection devices.

The E&M Contractor shall perform transient over voltage analysis as basis for selection of surge arresters. All design calculations shall be subject to approval by the Engineer.

APPLICABLE IEC STANDARDS

The design, manufacturing and testing shall comply with the below listed standards:

IEC	**Safety Handbook containing all IEC basic safety standards**
27	Letter symbols to be used in electrical technology.
38	IEC standard voltages.
50	International Electro technical Vocabulary

56 High-voltage alternating current circuit breakers

59 IEC standard current ratings.

71 Insulation coordination

129 Alternating current disconnectors (isolators) and earthing switches

168 Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V

185 Current transformers

186 Voltage transformers

233 Test on hollow insulators for use in electrical equipment

265 High-voltage switches

273 Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V

282 High-voltage fuses

298 A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.

383 Insulators for overhead lines with a nominal voltage above 1000 V

865 Short-circuit currents - Calculation of effects

909 Short-circuit current calculations in three-phase A.C. systems.

MV Switchgears

For MV equipment shall comprise, metal-enclosed cubicle assemblies including all apparatus and requisite accessories, clamps and connections, earthing devices, internal wiring and terminals, base frames and fixing materials, circuit breakers, disconnectors, busbars, conductors, insulators and bushings.

EQUIPMENT SPECIFICATION

11 kV Switchgear

The switchgear shall be of the metal-enclosed type, and be equipped with a top mounted pressure relief channel.

Rated voltage:	12 kV
Breaking medium:	SF_6 or vacuum

Each cubicle shall be equipped with an instrument compartment including mimic diagram, indicators, control switches, instrumentation, transducers and protection relays.

If protection relays are equipped with display showing electrical measurements as phase currents, line voltages, kW and kVAr, and also measuring transducer function, electrical instruments and transducers shall be omitted.

The compartment includes following equipment:

- Mimic diagram
- Control switches and position indicators for circuit breaker, and earth switch.
- Three-phase earthing switch.

- Terminations for the cables.
- Instrument) flush mounted A-meters.
- 1 (one) flush mounted V-meter
- 1 (one) voltmeter selector switch, 6 positions, for selecting phase-phase and phase-earth voltages.
- Transducer input 0-6 A, output 4-20 mA.
- Transducer input 0-132 V A.C., output 4-20 mA.
- Sync check equipment.

If the protection relay is equipped with display showing electrical measurements, and also is including transducer function, instruments and transducers shall be omitted.

Relays shall be equipped with two independent adjustable current settings for instantaneous and delayed tripping. The time delay setting shall be independent of the current setting.

Cable system for distribution of control voltage and auxiliary voltage, connectors, fuses, terminals etc.

Arc relay connected to arc detectors inside the cubicle.

Busbar, Measurement and Earthing Cubicle

- One cubicle with the following equipment:
- (One) three-phase busbar module
- 3 -(three) single-phase voltage transformers for three-phase connection-.

  Ratio: $\frac{11000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{3} V$

- 1 (one) load resistor connected to the voltage transformer open delta winding.
- 1 (one) three-phase earthing switch.
- Instrument compartment including the following equipment:
  - Mimic diagram
  - Control switch and position indicator for earth switch 3. 3 (three) flush mounted V-meters
  - 1 (one) voltmeter selector switch, 2 positions, for selecting phase-phase and phase earth voltages
  - 3 (three) transducers
- Cable system for distribution of control voltage and auxiliary voltage, connectors, fuses, terminals etc.
- Arc relay connected to arc detectors inside the cubicle.

Earthing Equipment

- 4 (twelve) sets of movable earthing equipment
- 2 (two) voltage indicators with lamp for 11 kV level

6.5.2.1 Technical Requirements

Design Criteria

All busbars and equipment shall be designed to withstand, without any damage whatsoever, all stresses caused by the maximum asymmetrical short circuit (peak) current corresponding to the symmetrical values.

Circuit Breakers

The circuit breakers shall be of the three-phase SF6 (preferred) or vacuum type.

The breakers shall be capable of handling the following operation cycle without external power, according to the IEC standards:

0-t-CO-t'-CO t = 0.3 sec. t' = 3 min.

The total breaking time (opening time plus duration of the arc) of the breakers shall be as short as possible, but in no case longer than 5 cycles.

The operating mechanism shall be of the stored-energy type with electrically driven spring charging and have provision for automatic local and remote control.

Power supply for spring charging motors shall be 400/230 V A.C.

A crank, lever or other similar suitable device, shall be provided to permit charging the operating mechanism by hand in the event of a failure of the auxiliary supplies or in the event of a failure of the energy-storing device.

The opening device shall be provided with two independent release coils, connected to separate terminal blocks in the terminal cubicle, allowing for the connection of two independent opening command circuits.

Control voltage for closing and opening operation shall be 220 V D.C.

A local position indicator shall be mounted in the front panel of the operating mechanism cubicle.

For the SF6 generator circuit breakers the gas density shall be monitored. Alarm contacts shall close at low and critically low gas densities. At critically low density the circuit breaker shall be tripped automatically and blocked against operation.

The circuit breakers shall be mechanically interlocked with the corresponding earthing switch.

A manual/automatic control selection switch shall be provided on the front of the circuit breaker cubicle.

A sufficient number of auxiliary contacts for 220 V D.C. shall be provided for control, interlock, signal and alarm purposes.

Circuit breaker and earthing switch positions shall be indicated on the front of the cubicles, as well as transmitted to the control system for remote indication.

All internal wiring shall lead to terminals. Ten percent of the terminals shall be spare.

Disconnectors

The following requirements apply to automatic operated switches, but shall also apply to manual switches as far as applicable.

The switch-disconnectors shall be of the three-phase SF6 or air break type.

For the generator disconnectors, the operating mechanism shall preferably be of the stored-energy type with electrically driven spring charging and have provision for manual / automatic control.

Power supply for any spring charging motors shall be 400/230 V A.C. A crank, lever or other similar suitable device, shall be provided to permit charging the operating mechanism by hand in the event of a failure of the auxiliary supplies or in the event of a failure of the energy-storing device.

For all disconnectors, the control voltage for closing and opening operation shall be 220 V D.C.

For disconnectors equipped with fuses, the fuses shall be properly dimensioned for the maximum expected load current, and shall have sufficient breaking capacity to clear a short circuit under the most severe conditions. The breaking characteristics shall be selected to ensure selective fault clearing with regard to other protection devices in the current path.

Each fuse shall be equipped with signal contact for blown fuse. Rupture of any fuse shall cause instantaneous opening of the switch-disconnector.

The switch-disconnectors shall be mechanically interlocked with the corresponding earthing switch.

A Local/Remote control selection switch shall be provided on the front of the switch-disconnector cubicle.

A sufficient number of auxiliary contacts for 220 V D.C. shall be provided for control, interlock, signal and alarm purposes.

Switch-disconnector position shall be indicated on the front of the cubicles, as well as transmitted to the control system for remote indication.

All internal wiring shall lead to terminals. 10 (ten) % of the terminals shall be spare.

Earthing Switches

The earthing switches shall be operated manually by a crank on the cubicle front.

The earthing switches shall be spring operated and dimensioned to withstand full short circuit current.

A mechanical interlock system shall be provided so that the operating crank cannot be inserted when the circuit breaker is closed. Any attempt to close the earthing switch when the interlock is out of order, shall cause the circuit breaker to trip.

Current Transformers

The current transformers shall be of dry, synthetic cast resin insulated type.

The current transformers for the generator terminal ends and the generator neutral ends shall be of a type especially suitable for installation in the generator terminals and inside the generator busbars.

All secondary connections shall be connected to terminal blocks, which shall be located in a dust-proof and watertight terminal box and shall be clearly labeled.

A protective earth connection to the housing shall be provided.

The current transformers shall be designed to carry continuously a current of 120% of the rated current.

The rated current of the secondary windings shall be 5 A.

The winding for measuring purposes shall have the following characteristics:

Accuracy class:	0.2
Accuracy limit factor:	< 5

Windings for protection purposes shall have the following characteristics:

Accuracy class:	5 P
Accuracy limit factor:	> 10

The burden for the current transformers for measuring and protection purposes shall be between 25 - 80% of the nominal burden for the measuring transformers including cables and measuring equipment connected to the measuring transformer secondaries. The Bidder shall ensure that no damages on equipment connected to current transformers secondaries or mall-operation of protection relays will occur in case of short circuits on the medium voltage systems.

Voltage Transformers

The indoor voltage transformers shall be of the single-phase dry synthetic resin type.

All primary and secondary connections shall be clearly marked.

A protective earth connection to the housing shall be provided. Earthing of the cores and the neutrals shall be done on the transformers and not on the terminal boxes.

The windings for measuring purposes shall be designed for accuracy according to class 0.2.

The voltage transformers shall have an additional secondary winding for earth fault protection, connected in open delta with a resistive burden. The accuracy class shall be 3P.

The secondaries shall be provided with miniature circuit breakers with alarm contacts.

The burden for voltage transformers secondaries shall be between 25 - 80 % of the nominal burden. The voltage drop in cables between measuring transformers and measuring equipment shall be less than 0,5%.

For the stator earth fault protection the Bidder shall propose a transformer and resistor combination suitable for or matching the stator earth fault relay.

Lightning Arresters

The lightning arresters shall be of the gapless metal oxide (MOA) type. Their characteristics shall be proposed by the Contractor.

The arresters shall have the following ratings:

Nominal discharge current:	10 kA
Voltage class:	in accordance with the actual voltage level.
Earth fault factor (a) approx.:	1.9 for generator buses and 1.4 for 11 kV switchgear and transmission line respectively.

The final characteristics shall comply with the results of the Contractor's transient over voltage analysis.

The outdoor lightning arresters shall be mounted on steel structures and shall be fitted with a pressure relief device. Surge counters shall be supplied. The earth conductor from the arrester to the counter, as well as the terminal of the counter, shall be sufficiently insulated or protected against accidental touching by a screen.

Outdoor Insulators

Each insulator shall be marked with the initials or trademark of the manufacturer and with the guaranteed electrical and mechanical strength. All markings shall be plainly legible and durable.

Each insulator shall be wet-process, homogeneous porcelain, free of laminations, cavities or other flaws, which could affect the mechanical or electrical strength and shall be verified, tough and impervious to moisture.

The insulators shall be carefully glazed in a uniform shade of brown, free of such imperfections as blisters and burns.

The metal parts shall be designed to transfer the mechanical stresses to the porcelain by compression.

In general the contours of the metal and porcelain parts shall be such as to eliminate areas or points of high electrical flux concentration. All surfaces of metal parts shall he smooth with no projecting points or irregularities.

All ferrous material that is not made of stainless steel shall be hot-dip galvanized in accordance with the Specification.

Protection Relays

Protection relays shall be equipped with two independent adjustable current settings for instantaneous and delayed tripping for each protection relay function. The time delay setting shall be independent of the current setting.

Accessories

For all accessories such as clamps, connections, etc., care shall be taken to fulfill all requirements concerning current carrying capacity, mechanical strength, glow discharge characteristics, corrosion resistivity, easy erection, etc.

All nuts and bolts shall be hexagonal, either normal or of the round head socket type and be non-corrosive made of galvanized steel and secured against loosening by appropriate means.

Cubicles

The metal-enclosed cubicle assemblies for the indoor switchgear shall he of approved and attractive appearance, adequately dimensioned, and shall consist of rigid, steel- plated cubicles enclosed on all sides and open at the top having full-length doors for easy access to the equipment inside. All doors shall be equipped with handles and key locks and windows making inspection easy.

Along the top, steel-plated pressure relief ducts shall lead to louvers in the building outer wall.

The open busbars shall be carried on support insulators mounted on the top of the partitions between each cubicle. Supporting insulators shall be of the synthetic resin or other approved type. Porcelain insulators will not be accepted.

In case, system of different materials is used, any Cu-Al connections shall be made using special junction pieces.

An earthing bus (copper) of approved size shall be available in each cubicle, with the separate pieces connected together to form a continuous bus through the complete length of the cubicle assembly. All framework, devices, neutrals of instrument transformers, etc., shall be connected to the earth bus that shall have provisions for connection to the station earthing system.

Lighting inside each cubicle shall be provided, mounted in a separate lighting panel. The cubicles shall be vermin proof.

In order to avoid any moisture, thermostat controlled heaters shall be built in to the cubicles.

6.5.2.2 LV Switchgear

Equipment shall comprise of MCB, MCCB's and air break type switchgear including all apparatus and requisite accessories, busbars, conductors, clamps and connections, earthing devices, internal wiring and terminals, base frames and fixing materials.

APPLICABLE STANDARDS:

Circuit Breakers	IEC 947-2
Load-Break Switches, disconnectors, switch disconnectors, fuse units	IEC 947-3
Electro-mechanical Control Devices	IEC 947-5-1
Automatic Selector Switches	IEC 947-6-1

WAPDA standards for LV switchgear, Protection and Control Devices shall also be applicable.

Generator Terminal Equipment

The busbar isolating system shall cover all LV equipment for Powerhouse, for the generator neutral point, and also the connections from the generator terminals to the generator circuit breaker, including measuring transformers, disconnector, earth switch, excitation transformer and surge arresters, as applicable.

The stator winding shall be terminated by means of six bushings on the stator housing, three for the phase outlets and three for the neutral end outlets.

The neutral end equipment shall have the same insulation level as the phase terminal equipment.

The neutral point shall be connected to earth through grounding transformer / secondary resistor, dimensioned to limit the maximum earth fault current to approximately 10A and shall withstand this current for minimum 5s. The Contractor will submit calculations support capacity of grounding transformer/secondary resistor for approval of the Engineer.

Inside the generator pit, the busbars for phases and neutral point shall have safety provisions against accidental touching.

TECHNICAL REQUIREMENT

General characteristics

Type	fixed in rack mounted in Column/cubicle
Installation	indoor
Duty	uninterrupted continuous
Degree of protection	IP 32
Nominal voltage	400 V
Frequency	50 Hz
Rated short circuit withstand	25 KA rms/1s

Bus bar	three phases, neutral and ground, copper
Nominal current	400 A

Switchboards shall be made up of vertical units from bolted steel section and fabricated sheet. Units shall be of modular design for assembly to form these switchboards, with separate compartments for:

- Switchgear and protective devices.
- Three phase busbars.
- Power and control wiring.
- General accessories.

All control, metering and faults and position indicating equipments shall be on the front panel.

The racks shall be fitted with the following switchgear and protective devices:

- ▶ Electrically and/or manually operated circuit breaker.
- ▶ Fuse switch.

The cubicle shall be specified so that worker protection, equipment protection, flexibility of use and maintenance, reliability purposes can be reached.

The cubicle can be locked with a key or a tool. The side and back panels can be taken off.

The vertical bars shall be mounted on insulated supports at the back of equipments.

The horizontal bus bars shall be located at the upper part of the cubicle.

Breaking capacities and ratings of busbars, circuit-breakers, contactors, and fuses shall suit the equipment to be connected with rated loads and the short circuit currents of the switchboards.

The breakers and protection devices shall be mounted either on rails or on sheet steel plates. The front face shall be equipped of fixed cover plates.

Generator Circuit Breaker Scheme

Generator circuit breaker will be interposed between generator and station bus-bar scheme shown in Drawing. The rating of generator circuit breaker shall be 400 V, 100 A, 3 Phase with insulation levels as per IEC standards.

Generator – Generator Circuit breaker and station bus interconnection shall be through air-insulated 3 Phase busduct.

Generator neutral grounding shall be through grounding transformer/resistor so that grounding current do not exceed 10A.

OPERATION

Normal Duty

The alternative current auxiliaries for the scheme shall take their low voltage supply through a set of switchboards and (if needed) sub-distribution boards, cubicles and boxes.

The emergency generator shall be capable of delivering enough power to ensure the under-listed functions efficiently, in the event of total loss of the electric power.

- ▶ Stop generators in good conditions.

- Start one unit in order to recover the power on LV bus bar.
- Essential auxiliaries of general services of plant.

Neutral connection

Low voltage a.c. circuits shall have their neutral solidly earthed.

Lighting and power circuits shall have their neutrals solidly earthed, and distributed.

Voltage

Standard voltage shall be three phases, 400 V, 50 Hz on load phase-to-phase voltage. Allowable variations at the equipment terminals will be ± 10% voltage and ± 5% frequency.

Automatic systems and controls

The automatic systems, interlocks and main controls for the station service transformers will be required mainly for:

- Priority to the normal source by station service transformer.
- Automatic starting of the diesel generating set, incase of voltage loss on normal source.
- Preventing different sources being connected in parallel.

The devices for detecting loss of power and switching over to an alternative source shall incorporate a time delay (loss of power adjustable between 0 and 10 sec., switchover adjustable between 0 and 2 sec.).

Electrical interlocks based on voltage detection and circuit-breaker position shall be such that it will be impossible for different power sources to be connected in parallel, even if the necessary automatic or manual control signals or operations are performed.

Tests

Factory and routine tests shall be according to IEC are equivalent standards.

6.5.3 Transformers

Scope

This section covers the requirements for the design, manufacture, and delivery and erecting of station supply transformer and other auxiliary transformers complete with their accessories.

The transformers shall be supplied complete with all requisite accessories as specified below.

The station supply and power transformers shall be installed as per drawings. Embedded temperature detectors (Pt-100) for monitoring winding temperatures shall be included.

The E&M works contractor shall provide foundation and pads or pole mounted transformer station as per drawings.

The main transformer pits, foundations and other concrete works including cable trenches, necessary recesses for pipes and cables, etc., grouting and finishing works, all in accordance with the Contractor's drawings and instructions as approved by the Engineer. The delivery and installation of all the material required for complete operational transformer is responsibility of the E&M works contractor.

APPLICABLE STANDARDS

WAPDA	Specification P-46: 82, Power Transformers
IEC 76	Power transformers
IEC 296	Specification for unused mineral insulating oils for transformers and switchgear
IEC 354	Loading guide for oil-immersed power transformers
IEC 551	Determination of transformer and reactor sound level
IEC 599	Interpretation of the analysis of gases in transformers and other oil-filled electrical equipment in service
IEC 606	Application guide for power transformers
IEC 616	Terminal and tapping markings for power transformers
IEC 722	Guide to the lightning impulse and switching impulse testing of power transformers and reactors

TRANSFORMER DATA/SCOPE

The technical detail of transformers to be installed, are given as under.

Technical Data

a) **Oil Filled Transformers**

► No. of Power transformers	1
► Rated power	4 MVA

Rating shall be decided at final design stage.

The transformer shall be equipped with:

- ► Oil conservator with level gauge
- ► Valve for oil samples
- ► Off-load tap changer

b) **Dry type transformer**

► No. of transformers	2 Nos.
► Rated power	200 KVA
► Rated voltage, HV winding	11 kV
► Rated voltage, LV winding	400 V
► Frequency	50 Hz
► Vector group	Dyn 11
► Connection:	
- High voltage side	Delta
- Low voltage side	Star with neutral brought out
► Cooling	ANAN
► Tap changer on HV winding	Off-load
► Tapping range	± 2 x 2.5%
► Impedance voltage at rated current	4%

TECHNICAL REQUIREMENTS

The following requirements shall in particular apply to the 4 MVA oil-filled main transformers.

General

The transformers shall be designed to supply full rated power under the specified climatic conditions. The temperature rise of the transformers shall not exceed the values specified in IEC 76-2 and 289 respectively.

Bushings

The HV bushings shall be suitable for interface between the transformer and nude conductor. On the LV-side, cables shall be connected. Final design details shall be elaborated by the Contractor at a later stage, and be subject to approval by the Engineer. The bushings shall comply with IEC Publication No. 137.

The transformer bushings shall withstand accidental arcing or flashover without damage to seals or other vital parts. Stresses due to expansion and contraction in any part of the bushing shall not lead to development of bulges, hairline cracks or other defects. Suitable connecting clamps shall be able to absorb shocks due to vibration of the connecting jumpers. All the bushings of any transformer shall have a rated current of at least 120% of the rated current of the winding to which they are connected.

It shall be possible to replace the bushings without lifting or dismantling the transformer cover.

Cores

The transformer core shall be built up of laminations of the best quality non-ageing magnetic steel of high permeability and low loss coefficient.

All joints between laminations shall be of the interleaved type and the laminations shall be clamped firmly and securely with non-magnetic straps. Butt joints will not be accepted.

The laminations shall be separated by hot-oil proof insulation, and the fastening to the frame shall be firm to prevent undue vibrations or noises.

The design shall be such as to prevent hot spots due to eddy currents and deficient oil circulation.

The core, framework, clamping arrangements and general structure of the transformers shall be of robust design, capable of withstanding any shock to which they may be subject during transport, installation or service.

Windings

The windings shall consist of high quality copper or aluminum, wound on frames to form circular coils. The current densities in the windings shall be stated in the Appendix E to Tender.

The insulation of the end turns of each winding adjacent to the transformer terminals shall be reinforced between turns to protect the windings satisfactorily against surges and transients. Details of the reinforcements shall be given in the Bid.

All windings and all fibrous and hygroscopic materials used in the construction of the transformer shall be dried under vacuum and impregnated with hot oil.

It is essential that the windings shall be subject to a thorough shrinking and seasoning process, so that no further shrinking of windings occurs at site. Clamping arrangements shall be provided, however, to compensate for any possible shrinking of coils when in service. None of the materials used shall shrink, disintegrate, carbonize or become brittle under the action of hot oil, when the transformer is operated continuously at the maximum specified temperature.

The windings, connections and tapings of all transformers shall be clamped in position and braced so as to withstand shocks or undue stresses during transport, short circuit conditions, and other transient causes.

Adequate provision shall be made for circulation of oil around and between the winding so that a low temperature gradient between the conductors and the oil is assured and any risk of excessive local heating is avoided.

The Bidder shall furnish a fully detailed description of the windings as well as the drying out and vacuum treatment.

Tap Changers

The off-load tap changer shall be manually operated from the ground level. The tap changer shall include an operation crank or hand wheel, tapping position indicator and means for locking the tap changer in any tapping position. The locking device shall be arranged to prevent blocking of the tap changer in an intermediate or off-tapping position.

All contacts and connections shall allow at least 120% current loading, compared to the transformer rated current.

Tanks and Accessories

Transformer tanks shall be of welded construction, and all shall be designed and constructed to withstand without leakage or permanent distortion an internal pressure and also permit the handling of the entire weight of the completely filled transformer. Pulling eyes shall be provided so as to allow for the attachment of a pulling rig and moving the transformer horizontally on wheels or rollers in either direction.

Jacking pads shall be available at convenient locations on the transformer tanks to allow the jacking of the completely filled transformer. The same set of jacks shall be used for all the main transformers.

Each transformer tank shall have at least two earthing terminals of adequate dimensions. These shall be welded near the tank bottom, at opposite sides.

The necessary number of pockets for thermometers and temperature detectors shall be provided on the tank cover.

After installation (positioning) of the transformers on their final foundations, the wheels or rollers shall be anchored in position by approved means furnished for this purpose by the Contractor.

Flanged Wheels

Flanged wheels shall be bi-directional, for moving the fully assembled transformer in perpendicular directions on rails.

All bearings shall be of roller or ball type, with suitable arrangement provided for lubrication.

Suitable means shall be provided to enable the wheels being locked to the rail firmly when the transformer is in service.

Valves

Each transformer shall be equipped with the required number of valves for:

Tank draining, oil sampling at tank bottom filter press connections (upper and lower), isolating each cooling unit, draining each cooling unit, air venting of tank coolers, isolating conservator from transformer and so forth.

Flanges, valves, etc., shall conform to standards agreed with the Engineer. The dimensions will be decided at a later stage to achieve compliance with other main transformers in the transmission system.

Transformer Oil

The transformer oil shall be of the standard mineral, uninhibited type and shall be of the same make and type for all transformers.

The Contractor shall submit for the Engineer's approval in due course information regarding the make, type and properties of the transformer oil which he intends to supply.

Oil Conservator

The conservator shall preferably be of the diaphragm scaled type, complete with necessary fittings.

Each conservator shall have a dehydrating breather assembly, complete with glass observation window fitted with silica gel, and necessary connecting piping to the conservator. The silica gel drum shall be easy to operate with regard to emptying and refilling.

Measuring and Supervision

All Instruments and Plates must be easily accessible and readable from the ground.

Oil Level Gauges

Oil level gauges shall be of the dial type fitted to the conservator chamber. The indicating pointer shall be magnetically coupled to the float inside the chamber so that fracture of the glass cover of the gauge shall not result in loss of oil.

The gauges shall be of such size that they can be easily read directly or by means of a mirror arrangement, from the ground vertically below. The gauges shall have alarm and tripping contacts for high and low oil level.

Resistance Temperature Detectors

Resistance temperature detectors shall be of the three-wire Pt-100 type. They shall be located in specially designated oil filled measuring pockets in the transformer tank cover.

Dial Type Thermometers

Dial type thermometers shall be mounted on the transformer tank at a convenient height from ground level. The thermometers shall be provided with at least 2 sets of adjustable contacts for alarm and trip circuits.

Cooling Systems

The ONAN cooling system shall comprise radiators connected to the transformer tank. Shut-off valves shall be mounted at the oil inlet and outlet so that each radiator can be removed from service or replaced without disturbing major parts of the transformer and without the need of interruption of the transformer operation. Lifting lugs, drain and vent plugs shall be provided for each radiator.

Rating Plates

A corrosion-resistant nameplate and diagram/rating plate shall be provided on each transformer.

In addition to the rating nameplate of the transformers, each major transformer part shall also carry an identification plate giving serial number and other relevant information needed for identifying the said transformer component.

SHIPMENT

Reference is made to the Instruction to Bidders and the Specifications regarding the transport of heavy equipment to the site.

The Contractor shall endeavor to construct the main transformers so that the core/winding assembly can be transported in its own tank, oil filled, taking into account the weight limitations of loading facilities and of the roads and rails.

SPECIFICATIONS OF DRY TYPE TRANSFORMER (2 NOS)

All transformers installed indoor shall be dry type as per following general specifications.

Rated power 2 No. 200 KVA

A. Dry Type Transformers

Each transformer shall be provided with winding temperature indication and protection.

Indication shall be in the form of a dial-type indicator calibrated in degrees centigrade and be fitted with a hand-reset pointer to register the highest temperature attained. The indicator shall be visible from outside of the transformer's enclosure.

Protection shall be a two stage device with adjustable setting giving alarm and trip facilities. Output contacts, two for each setting shall be voltage free contacts. The contact outputs shall be brought out to a junction box mounted on the transformer enclosure.

For oil filled transformers dial type mercury thermometer for measuring the oil temperature with two normally open contacts for temperature alarm and tripping shall be provided. Also, dial type float operated, magnetic type oil level gauge with one low level normally open contact shall be furnished.

B. Windings and Insulation

Dry type transformers may be of the cast resin type or open winding type suitability braced to withstand short-circuit forces. The thermal classification to IEC 85 shall be 200.

The windings shall be of high-conductivity electrolytic copper an transposed winding conductors shall be employed where appropriate.

The windings shall be designed to reduce to a minimum the out-of-balance electromagnetic forces in the transformer at all voltage ratios.

Windings shall be adequately braced to prevent distortion due to any abnormal operating condition.

The stocks of windings shall receive adequate shrinkage treatment before final assembly.

Windings shall be arranged to permit free circulation of air.

Clamping of the core and coil assemblies shall be of approved material and be arranged to prevent deterioration of the core characteristics.

Insulation material shall be of Class F (IEC 76-2).

The insulation of windings and connections shall be free from insulating composition liable to soften, ooze out, shrink or collapse during service. The insulation of windings shall have high degree of dielectric and mechanical strength.

C. **Cooling**

The cooling shall be natural air circulation only designated as follows in accordance with IEC 76-2.

- Dry type in a ventilated enclosure AN
- Dry type in a non-ventilated enclosure ANAN

If the design of the transformer is such that deposits of dust on the windings is liable to curtail the circulation of cooling air then air filters shall be provided on a ventilated enclosure (AN) or the transformer shall be in a non-ventilated enclosure (ANAN).

D. **Enclosures**

For dry type transformers, each enclosure shall consist of a rigidly constructed steel framework which shall be completely clad in sheet steel and if necessary with the provision of screened openings to provide natural cooling.

The degree of enclosure protection shall be IP23 IEC 529.

Internal access shall be by means of hinged doors at the front of the enclosure and the arrangement shall ensure that the transformer can be withdrawn easily.

Termination chambers shall be provided on these enclosures. Each enclosure shall be provided with anti-condensation heaters.

TESTS

Factory routine and field tests shall be as per relevant IEC or equivalent standards.

6.5.4 Protection and Relay Equipment

Scope

This section specifies the technical requirements for the design, manufacture, delivery, erection and testing of the protection systems, relays and the associated equipment for the generators, transformers, metal clad switchgear, switchboards.

Location

The equipment will be installed in the Khokra Powerhouse Building and Control room.

Operating Conditions

The ambient air temperature will normally not exceed 45°C in the control room of the power house building and control room.

Protection Schemes

The outline of protection scheme for the generators, transformers and the switchgear for auxiliary supply.

The general principle for the protection shall be that all parts of the installation are covered by high speed protection schemes which, shall be independent to avoid common-mode failures. The protection equipment shall be complete with all relay panels, instruments, meters, interposing and auxiliary relays, control switches, interposing current and voltage transformers, transducers and all auxiliary equipment. All protections, as far as possible, shall be connected to separate current transformers and shall have separately protected voltage circuit. The DC supply for the auxiliary circuits (Control and Protection) shall be arranged such that auxiliary circuits are assigned to each function and branch so that only one function or one bay is effected by a fault. Faults in the Control Circuit do not than influence the protection circuit and vice versa.

Protection equipment shall be designed and supplied to provide maximum discrimination between faulty and healthy circuits. All equipment is to remain inoperative during transient phenomena which may arise during switching or other disturbances to the system.

The detailed protection details shall be determined at final design stage.

6.5.5 Control and Instrumentation

Scope

This section specifies the requirements for the design, manufacture, works testing, erection, site testing and setting to work of the Control and Instrumentation equipment for the generators, excitation equipment, transformers, metal clad switchgear, switchboards etc. at Powerhouse and Forebay.

CONTROL

General

Control, alarm and tripping of the Plant shall generally be in accordance with ANSI/IEEE Std 1010-1987-IEEE guide for Control of Hydroelectric Power Plants.

The Contractor shall supply, install and commission all instrumentation required for the control, alarm and protection of the equipment.

Overall Control Philosophy of the Scheme

The overall control philosophy of the project scheme is given herein for the information of the Contractor.

The positions from which control is available will depend on the individual plant and will include:

- For the Generating Units

  Manual/Auto at the ULCP

- For the 0.4/11 kV switchgear

  Manual at the LCPs

- For the Intake(forebay)

Manual at the LCPs and remotely from ULCPs in the Control room.

ULCPs for the generating units and LCPs for the 11kV switchgear and 400 Volts switchboards shall be located in the control room. A local control system for the gates at the intake(forebay) shall be located in the intake(forebay) control room.

The operator control at the ULCPs will be provided with controls to start or stop the turbine generator unit. In addition to the unit start, stop controls and sequence single step facility, all other indications and controls required for operation of the units will be provided at the ULCP.

Emergency stop push-buttons for each unit will be provided in the ULCP and be wired directly into the unit protection system.

The turbine, generator and switchgear protection will be provided by dedicated protection systems.

The MV switchgear will be controlled from the Control room via the LCP.

All the 400 V (LV) ACBs shall be controlled locally via the switchboard located in the control room.

A local control system for the gate at the intake(forebay) will be located in the Intake(Forebay) control room. It will be possible to control all the plant locally from the local panels and remotely from ULCPs in the control room.

An interlock shall be provided to enable closing of the circuit breakers provided on LV (400V) for the generating units and MV (11KV) for outgoing feeders through synch check scheme only.

Mimic Diagrams shall be offered on all the Control Panels.

6.5.6 Telecommunication System

General

This section describes and specifies the telecommunication system. The Contract comprises of the following telecommunication equipment.

- Permanent telephone equipment and network.

  One independent telephone exchange will be provided for Khokhra Powerhouse with two trunk lines and eight independently subscriber lines at following points of Powerhouse:-

  - Control Room
  - Loading Bay
  - Kitchen
  - Outside Security Guard Room
  - Intake/Forebay
  - Offices
  - Spare

TECHNICAL REQUIREMENTS

General Requirements

This specification covers the technical and associated requirements for the telecommunication equipment including all various equipment.

All materials and parts, which are not specifically mentioned herein but are necessary for the proper purchase, erection and safe operation of the equipment shall be identified by the bidder and furnished at no increase in cost to the Employer.

No deviations shall be made from this specification and standards unless approved by the Engineer.

All equipment shall be modular in order to keep necessary stocks and spares to a minimum and shall have possibilities for future extensions.

Requirement for the Telephone Network

The telephone equipment shall be digital, programmable and modular with possibilities for future extensions (increased number of lines). The following PBAX features shall be provided as minimum:-

- Programmable code area restriction with 2 levels
- Call transfer
- Call forwarding no answer
- Hotline facility to selected extensions
- Ambient temperature range for guaranteed operation shall be 0 – 50°C.
- Placing an outside call
- Emergency short call

The telephone sets shall be designed for desktop as well as for wall mounted DTMF telephone sets according to ITLI-T Q23 shall be supplied.

6.5.7 Internal and External Electrification

Scope

This section covers general requirements for furnishing, installation and testing of items of electrification works in Powerhouse consisting of:

- Internal electrification
- External electrification

REFERENCE STANDARDS

List of Standards

Standards under which items of electrification works covered in this Section are to be furnished, tailed or tested are specified in the text in abbreviated form (ASTM A36), where such standards are specified it shall be understood that the latest issue or revision in effect one month before the time of submission of tender shall apply. The numbers subjects of specified standards are given below for convenience.

ANSI CI	National Electrical Code
ANSI C7.4	Tinned soft or annealed copper wire for electrical purposes
ASTM B33	Tinned soft or annealed copper wire for electrical purposes
BS 2484	Straight concrete and clayware cable covers
CIBS	Codes of practice
IEE	Regulations for electrical equipment of buildings
IEEE 80	Guide for safety in AC substation grounding
NEMA WC-30	Colour coding of wires and cables
ASTM A36	Specification for structural steel
ASTM A525	Specification for general requirements for steel sheet, zinc-coated (galvanised) by the hot-dip, process
BS 449	Use of cold formed steel sections in building
BS 5467	Armoured cables with thermosetting insulation for electricity supply

BS 6346	PVC- insulated cables for electricity supply
ICEA S-19	Rubber insulated wire and cable for the transmission and distribution of electrical energy
IEC-207	Aluminum stranded conductors
WAPDA Specifications P34:	Lattice steel poles

INTERNAL ELECTRIFICATION OF POWER HOUSE

This section describes the installation of indoor electrification.

Supply

The installations cover supply for normal and emergency lighting, 230 V single-phase, 400 V, 3-phase socket-outlets, bracket fans, exhaust fans, cables of appropriate sizes, etc.

Engineering

The contractor shall undertake the complete installations including,

Main/ Sub Distribution Panels

Main/sub-distribution panels. Panels with MCCB and MCB's for normal lighting and socket outlets in the grid station, to be fed from the 400/230 V mains.

Lighting

Indoor lighting will be installed in the control room building, battery room, office and sanitary facilitates.

The control room will have intensity-controlled illumination, so that it might be adapted to special situations.

Lighting Fittings

i) 230 V AC light fittings for the control room.

ii) 230 V AC light fittings for the exterior i.e. for the control building.

iii) 220 V DC emergency lighting fitting.

All fittings to be delivered with fluorescent tubes.

Socket Outlets

Socket outlets and power points shall be installed in all areas as follows:

Normal duty socket outlets

Single phase 230 V, 10 A. All areas shall be reached with cable length of maximum 20 m.

Power outlets

Single phase outlets 230 V, 20 A. All areas shall be reached with a cable length of maximum 10 m.

TECHNICAL REQUIREMENTS

General

The equipment and the installations shall be in accordance with IEC Standards and relevant Pakistani approved practice. All equipment shall be designed for use in a tropical climate.

Distribution Boards and Panels

Distribution boards and panels shall be self-ventilated. No ventilating fans shall be used.

Panels shall be designed for easy access to the equipment, cable terminals, etc., during maintenance.

Permissible temperature rises shall not be exceeded.

Each panel shall have at least 25 % spare installed capacity and furthermore 25 % spare space.

Bus bars shall be of copper and shall have three phases and a combined neutral bar and earthing bar.

Generally molded case circuit breakers (MCCB) and miniature circuit breakers (MCB's) shall be used. Use of ordinary fuses will not be permitted.

Lighting System

An adequate indoor and outdoor lighting with illumination levels in accordance with recognized standards will be provided. Inside the control building, also, an emergency lighting system powered from the station battery must be installed; the system will operate instantly as the normal power supply fails.

AC lighting and power socket outlets, for 230 V, shall be single-phase, connected between phase and neutral of the 400 V systems.

Fluorescent lighting fittings are preferred everywhere indoor where it is feasible.

For outdoor lighting, waterproof lighting fixtures are recommended.

- Lighting and power socket-outlets shall be for 230 V single-phase, connected between phase and neutral of the 400 V 3phase/4wire power system.
- Loads shall, as far as possible, be evenly distributed between the phases.
- In addition to the current-carrying conductors, an earthing conductor shall be run in each cable and circuit running from the distribution board to the equipment and appliances, which are to be earthed.

Lighting Installations

In the Power house, indoor lighting shall consist of normal lighting and emergency lighting.

For the switchyard, outdoor areas, only normal lighting shall be installed.

During normal conditions both the emergency and normal lighting shall be lit.

These two systems shall be fed by separate circuits.

Normal lighting shall be supplied from distribution boards and panels.

Permanently emergency lighting comprising fixtures and exit luminaries shall be supplied from a distribution panel dedicated for this purpose. About ten-percent of all fixtures shall be emergency fixtures with minimum one such fixture in each room. The exit luminaries shall be installed above doors and corridors etc. The exit illumination shall have a sufficient distribution to ensure safe egress from the areas during a blackout.

All indoor lighting shall be controlled by wall-mounted switches.

Emergency lighting shall only be controlled by switches mounted on the front of the emergency lighting distribution panel.

Illumination Levels

The average illumination levels, as measured at a height of 0.8 m above floor, at any location, after approximately 100 - 150 operation hours, shall be as follows (minimum levels):

It is recommended that the normal lighting system should be designed according to the following design criteria:

Type of area	Illumination level
Outdoor	
Areas with common staff traffic	100 lux
Roads and yard.	100 lux
Indoor	
Offices, control rooms, switch-gear rooms	400 lux

The illumination requirement for the emergency lighting shall be at least 1 lux all over the related areas.

The lighting fittings shall be mounted in such a manner that the light, as far as possible, will be evenly distributed throughout the rooms or areas.

Wiring and Accessories

For all installations insulated multi-core power cables shall be used for the wiring. Wiring shall be laid on or in the walls and ceilings. The wiring shall be installed in a neat and orderly manner. All cables shall be run either horizontally or vertically.

All installations shall be carried out in accordance with internationally accepted methods to a high standard of workmanship.

Cable and wire termination shall be performed without damage to the conductors; lugs shall be soldered or shrunk with approved tools. Lugs shall be used for all cables above 4 mm2.

The following installation levels shall be used, referring to the height above the finished floor or finished ground (outdoor):

Lighting switches	1.30 m
Socket-outlets, offices, etc.	0.30 m

For outdoor lighting, poles of galvanized steel shall be provided. Each pole shall be delivered with steel bracket or a concrete foundation whatever the installation method require. Every pole shall be equipped with a junction box.

Local Earthing

The Contractor shall be responsible for providing the earthing system required for the electrification works and co-ordinate this with the main earthing system.

EXTERNAL ELECTRIFICATION

Lighting for Khokra Powerhouse External Area

Introduction

It describes the outdoor lighting installation for the:

- Power House External Area

The lighting installations cover luminaries, steel masts, and cables, foundations complete. All fittings to be delivered with light sources.

Poles for the Lighting

The Contractor shall furnish and install tubular steel poles 30 ft long for the lighting, generally in accordance with the requirements of Metal Work specifications.

TECHNICAL REQUIREMENTS

General

The equipment and the installations shall be in accordance with IEC Standards and relevant Pakistani National Standards. All equipment shall be designed for use in a tropical climate.

Lighting System

Lighting shall be for 230 V single-phase, connected between phase and neutral of the 400 V, 3 -phases/4wire power system.

Loads shall, as far as possible, be evenly distributed between the phases.

In addition to the current-carrying conductors, an earthing conductor shall be run in each cable and circuit running from the distribution board to the equipment and appliances, which are to be earthed.

Lighting Installations

Outdoor lighting shall be, centralized as much as possible, and all lighting shall be controlled from a lighting control panel.

All light fixtures are waterproof.

Wiring and Accessories

All installations shall be carried out in accordance with internationally accepted methods to a high standard of workmanship.

Cable and wire termination shall be performed without damage to the conductors; lugs shall be soldered or shrunk with approved tools. Lugs shall be used for all cables above 4 mm^2.

Local Earthing

The Contractor shall be responsible for providing the earthing system required for the electrification works and co-ordinate this with the main earthing system.

TESTING

General

Inspection and testing of all items of electrification work shall be in conformity with the applicable recognized standards for making such tests and inspections.

Electrical Equipment and Wiring

All electrical equipment and wiring shall be tested in accordance with the applicable provisions of IEC or other approved Standard.

The test results and plans shall be submitted to the Engineer for approval.

Provision of Instruments and Labour

The E&M works contractor shall provide the supervision, labour, apparatus and instruments required to adjust and thoroughly test the installation, to his own satisfaction, to the satisfaction of Supply Authority and to the satisfaction of the Engineer.

Testing Upon Completion

The following tests shall be carried out.

- Insulation tests between all phases, from each phase to neutral to earth:
- Resistance tests on the earth continuity conductor and on any or all circuits as the Engineer's representative shall choose;
- The resistance to earth of any or all earth electrodes, as the Engineer's representative shall choose; Ref BS-7176 and BS -7430.
- The correct operation of controls, lights and other outlets;
- Measurement of illumination level.

6.5.8 Cables and Cable Trays

CABLES

General

This section covers the requirement of medium voltage power cables and accessories, low voltage power, control and communication cables and accessories.

The 11 kV cable, the control and low voltage cables between the power station shall be laid on cable racks and the cable trenches.

The final cable routing and length will be determined during detailed design by the contractor under his responsibility.

REFERENCES

The design, manufacturing and testing shall, comply with the below listed standards:

IEC	Safety Handbook containing all basic safety standards
IEC 38	Standard Voltages
IEC 59	Standard Current Ratings
IEC 228	Conductors, solid or stranded plain copper
IEC 287	Calculation of the continuous current rating of cables
IEC 332	Tests on electric cables under fire conditions, Part 3: Tests on Bunched Wires or cables, Category C.
IEC 446	Colour codes
IEC 502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV
IEC 811	Common test methods for insulating and sheathing materials of electric cables

EXTENT OF REQUIREMENT

Power Cables and Accessories

Medium Voltage Power Cables

- MV Cable interconnection between MV Panel and 11 kV terminal pole LV.
- AC 400/230 3 Phase cable between generator terminal to auxiliary supply panels.
- Any other MV/LV Cables required for complete functional installation.

The supply shall include connections to all A.C. powered equipment included in E&M Contract.

- All low-voltage A.C. power cables at the system.
- All low-voltage A.C. power cables at the intake.
- All 220 V D.C. power supply and control cables.
- All telecommunication cables.

All cables shall be complete with terminal bushings, connection lugs and fixing equipment.

Control Cables

The supply shall cover all interconnecting cables for control, protection, measuring, indication and telecommunication for the power station and intake installations. The cable insulation shall be of a halogen free type.

Cable Accessories

The supply shall cover:

Termination material, clamps, cable boxes and all necessary material for installation and erection of the cables.

Fire Protection Material

1 (one) lot of fire-proof paint for painting all cables one meter on both side of any fire cell passage (block-outs) and one meter for each 5 meter on the cable lengths.

1 (one) lot of material for fire proof barriers in all blackouts for cables in walls and floors.

TECHNICAL DESCRIPTION

Cables are composed of:

- Conductors, solid or stranded plain copper conform to IEC standards
- Conductor screen for medium voltage cables of extruded sheath or tape.
- Conductor insulation of PVC or XLPE identified by colour code according to applicable IEC standards, identification by colours,
- Black outer sheath of PVC for medium and low voltage cables.
- Gray outer sheath of PVC for control and measure cables.

Main Technical Characteristics

The conductor cross section, is calculated according to:

- Rated current at temperature of 90 °C for MV cables and 90 °C or 70 °C for LV cables.
- Short circuit current at temperature of 250°C for MV cables and 250°C or 160°C for LV cables,
- Maximum voltage drop of 5 %
- Ambient temperature of 40°C.

Medium Voltage Cable

Medium voltage cables of 50 mm^2 conform to IEC 502.

▶	Insulating material	PVC or XLPE
▶	Rated voltage	8.7/15 kV for 11 kV cables
▶	Highest rated temperature	250 ° C
▶	Conductor	Copper
▶	Class	2
▶	Semi-conductor	Extruded compound
▶	Screen of cores	Copper type
▶	Assembly of cores	
	- Inner covering and fillers.	Plastic
	- Intermediate sheath	Polyvinyl Chloride
	- Separation sheath	Paraffin waxed crepe paper
▶	Metallic layers for core cables	
▶	Armour	Steel
▶	Non metallic outer sheath	PVC
▶	Fire behavior	Flame retardant IEC 332

Low Voltage Cable

Low voltage cables are insulation type with a minimum conductor cross section of 95 mm^2 for auxiliary power.

▶	Insulating material	PVC or XLPE
▶	Rated voltage	600/1000 V Conductor Copper Class 1 or 2
▶	Number of cores	4
▶	Metallic armour	none
▶	Non metallic outer sheath	PVC
▶	Fire behaviour	Flame retardant

Interconnection between Generator and Power station switchgear

Cables are insulation type with a conductor cross section of 400 mm^2 or of appropriate size.

▶	Insulating material	PVC or XLPE
▶	Rated voltage	600/1000 V Conductor Copper Class 1 or 2
▶	Number of cores	1
▶	Metallic armour	none
▶	Non metallic outer sheath	PVC
▶	Fire behaviour	Flame retardant

Control Cable

Control cables are insulation type multi-conductors with a minimum conductor cross-section of 4 mm^2 for command and control and conform to IEC standards.

▶ Insulating material	PVC or XLPE
▶ Rated voltage	600/1000 V
▶ Conductor	Copper
▶ Class	1 or 2
▶ Number of cores	Multi cores
▶ Metallic armour	None
▶ Non metallic outer sheath	PVC
▶ Fire behaviour	Flame retardant

Metering and Protective Circuit Cables

Metering and protective circuit cables are 600/1000 V insulation type multi-conductors with a minimum conduce cross section of 6 mm^2 for voltage circuit and 6 mm^2 for current circuit and conform to IEC standards.

▶ Insulating material	PVC or XLPE
▶ Rated voltage	600/1000 V
▶ Conductor	Copper
▶ Class	1 or 2
▶ Number of cores	4
▶ Metallic Armour	none
▶ Non metallic outer sheath	PVC
▶ Fire behavior	Flame retardant

Measuring Cable

Measuring cables of 500 V insulation are multi pair type with a minimum cross section of 0.88mm^2. The pairs are individually twisted and conform to IEC standard - PVC Insulated cables of rated voltage 450/750V.

▶ Insulating material	PVC
▶ Conductor	Copper
▶ Class	2 or 5
▶ Number of cores	4
▶ Shielding	Aluminum tape with spiral plastic
▶ Metallic Armour	none
▶ Non metallic outer sheath	PVC
▶ Fire behaviour	Flame retardant

DC Cables

D.C. cables between chargers and batteries and between batteries and distribution panels shall be single core type without metallic shield or armour.

Cable trays

Scope of supply

This specification defines technical characteristics for the continual structure cable trays.

The cable trays are the mechanical devices over which the cables between equipments, within the power stations are laid. They include trays support; ladders and sectional irons.

TECHNICAL DESCRIPTION

The cable trays consist of trays, ladder type or perforated plate type fitted on brackets. The bracket is themselves fixed to the vertical supports or hanging supports fixed to the main building structure, or they are directly fixed to the concrete walls.

The cable trays are said "simple" when one or more trays are fitted on one side only of their support or on the wall.

The cable trays are said "dual" when trays are fitted on both sides of their support.

The design of the trays is such that appropriate natural ventilation of the cables and their easy outlet through the trays lower part are ensured.

The connection pieces used for the direction or level changes are calculated taking into account the cables radius or curvature.

The general structure of the cable trays has been designed to receive a cover for eventual mechanical protection.

The vertical cable trays consist of one or several cable rises, which are parallel on a vertical plan.

Each tray is made of pieces, fitted on the supports. These supports are directly gripped. The cable trays for measuring cables are made of -plain or perforated sheet metal with folded flanges and fitted with a lid.

Surface Treatments

The cable trays equipment is protected against corrosion by galvanization.

For the supports and brackets they are hot dip galvanized after manufacturing.

The steel is galvanized directly by immersion in a bath of molten zinc (zendzimit process) according to the French norms NFA 36321 and NFA 36322.

The thickness of the coating is about 15 microns per side (275 gr/m2).

After site welding or cutting cold galvanization is carried out by SENDZIMIR process the bolts and nuts allowing fixation of the cable trays are electro-galvanized.

Cable Warning Tape

Cable warning tape, bright yellow in colour and of plastic material 300 mm wide by 0.1 mm thick, shall be supplied. The tape shall be continuously and indelibly marked in English and an Urdu translation with the words:

CAUTION x CAUTION x CAUTION

Check Cable 500 mm Below

The lettering should be block. The tape shall be installed in accordance with these Specifications.

Cable Trenches

The trenches shall be laid true to line and level and shall be completely embedded in concrete, with a minimum 150 mm thickness of concrete of grade 20 MPa surrounding the ducts on all sides. Ducts shall be sealed at each end after installation of the cable with split hard wood plugs and bitumen or by other approved means to exclude water and vermin.

Cable Protective Covers

Cable protective covers shall be of reinforced concrete and, unless otherwise approved, shall be 300 mm wide, 50 mm thick and 1 m long. The covers shall be designed for interlocking one with the other, both vertically and laterally. Special covers shall be provided where required for short radius bends. All cable protective covers shall meet the requirements of BS 2484.

The covers shall have the legend "ELECTRIC CABLE" cast into the upper surface and shall be installed in accordance with these Specifications.

6.5.9 Stand By Diesel Generator Sets

General

A diesel generator set rated 100 KVA, 400 V/230 V three phase A.C is required which will serve the purpose for the Powerhouse for emergency power supply, in case of power failure and feed station auxiliaries.

In case of main failure or transformer fault, the emergency generating unit will start automatically and will provide the emergency supply power to station auxiliaries.

- Unit auxiliaries of one unit till the restoration of voltage from the AC Auxiliary Transformer,
- Essential power plant auxiliaries.

The 100 KVA Generating set shall have an incorporated tank of 110 liters capacity and a storage tank of 2000 liters capacity.

Standards and Codes

The internal combustion engines shall comply with ISO standard 3046 (1981) and BS 5514 (1982) or approved equivalent.

The electrical parts of generator shall comply with IEC 34-1 recommendations.

General Characteristics of Diesel – Generating Set

▪ Type/Output	Diesel Generating Sets; three phase, 400/230 V A.C. supply
▪ Installation	Indoor
▪ Power Factor	0.85
▪ Rated Power	100 KVA
▪ Nominal voltage	400 V
▪ Frequency	50 Hz
▪ Connection	YN
▪ Insulation class	H

Diesel generating unit shall have the following accessories:

- 1 (one) control panel with AVR, protection including minimum of phase over current and ground over current relays, negative phase sequence relay, thermal relay. supervision equipment and indicating instruments.
- 1 (one) fuel system consisting of:
  - Long-term oil storage tank
  - Oil day tank with a capacity of full load running of 12 hours
  - Necessary interconnecting pipes an refilling system
  - Fuel level indicator
- 1 (one) starter battery with charger
- 1 (one) complete exhaust and venting equipment with necessary grilles and louvers for inclusion in the outer building walls.

Control System

All voltage, current, faults and other data needed for operation shall be relayed in the same way and using the same equipment.

A specific cabinet shall be provided with generator and include the following equipment.

- Voltmeter
- Ammeter
- Frequency meter
- Phase selector switch
- Hour meter
- Alarm annunciator with adequate pushbuttons
- Running mode key selector switch and lamps
- Emergency stop pushbutton and lamp
- Battery status indication lamps
- Run-off/reset-auto switch (engine start) which will allow the following facilities.

OFF Position

With the key switch in the OFF position, the generating set shall not start, and all control and signaling circuits shall be de-energized. If the generating set is running it shall stop immediately when the switch is turned to the OFF position.

RUN Position

With the key switch in the RUN position, the generating set shall start.

AUTOMATIC Position

With the key switch in the Automatic Position, the generating set shall start automatically. If the set fails to starts, a second and third attempt shall be made automatically.

The generating set shall stop automatically if any of the following faults occur.

- Low oil pressure
- High water temperature

- Over speed
- Over-crank

Installation

The generating set shall be trolley mounted.

Assemblys

The engine and generator frames shall be rigidly bolted together to form a single unit. The drive shall be transmitted through a semi-flexible coupling.

Fuel Tank

The generating set shall be designed for continuous duty at full load for four hours, and shall therefore be provided with a buffer fuel tank of 110 litres capacity, corresponding to four hours of operation.

This tank shall be refilled by means of an automatic electric pump or with manual standby pump, from a buried steel storage tank.

6.5.10 Earthing System

General

This section describes the earthing system for the Power House and other installations.

REFERENCES

The design, installation and testing shall comply with the below listed recommendations:

WAPDA	Specification P-190: 91 Grounding Sets
WAPDA	Specification P-116: 81 Earth Rods
IEEE 80	Earthing
IEC	Safety handbook
IEC 950	Safety of information technology equipment, including electrical business equipment.
IEC 364	Electrical installations in buildings
ANSI/IEEE 665	Generation station grounding

Earthing Conductors

All risers from the earthing electrode system shall be connected to the main bars (at minimum 30 m intervals and at least 2 risers to each bar) by removable screw connections.

The conductors for the main earthing bars shall be of electrolytic flat copper bar with a cross-section of at least 185 mm2.

With the exception of the earthing bars and internal connections in panels and boards, all other earth conductors shall consist of electrolytic, stranded copper conductors. For connection to other metal parts the ends of such conductors shall be fitted with cable lugs, rigidly fastened to the earth conductor by means of a hydraulic press. Interconnections between earth conductors are to be performed with straight joints or T- joints terminated in the same manner.

Main mesh conductors shall have a minimum section of 95 mm2.

The conductors shall be reliably protected against mechanical damage and corrosion.

The following equipment shall be connected directly to the earth electrodes or the risers:

- The turbine casing and inlet valves.
- The generator housings. Each housing shall be connected to two separate risers, connected opposite each other.
- All power transformer neutrals and transformer tanks. Main transformer tanks shall be earthed in two points, by different risers.
- All steel structures in the outdoor switchyard and grid station.
- All, lightning arresters. The earth conductor from the arrester to the counter, as well as the in terminal of the counter, shall be suitably insulated or screen - protected against accidental touching and shall be of minimum 2 x 95 mm2.

Each item shall be directly connected to an earthing conductor and not with a series connection through other metallic parts.

For the current and voltage transformers an earth connection to the housing shall be provided. Earthing of the cores and neutrals shall be done on the transformers and not on the terminal boxes.

The fence of the switchyard and grid station (if not separately grounded) and other fences for transformer cells, etc. shall be earthed to the earthing wire at intervals of not more than 20 m and to the earthing electrode system at all corners and gates. Gates shall be connected to earthed gateposts by a flexible copper braid or equivalent. Flexible copper braids of minimum 35 mm^2 shall also be used for connecting all sections of pipes, metal trays, conduits, rails, cable racks, etc., unless these are welded together or each section is separately earthed.

Earthing conductors for electronic systems shall be insulated and shall run separately from the systems, panels, etc., directly to a main earthing bus close to a connection to the earthing electrode system. These earthing conductors shall be of minimum 50 mm^2 and shall not be branch-off from the earthing of the power systems.

Earthing Conductor Connections

Connections between the main earth ring and the branch earth conductors shall be made with brass lugs hard soldered to the copper strand and tinned, riveted and sweated to the main earth bars or by exothermic welding or equal to the approval of the Engineer.

Stranded earthing conductors between any two points shall be in a continuous length and be straight. Through jointing is prohibited.

No reliance shall be placed on the conductivity of metal to metal joints in structural or equipment metalwork to provide earth continuity.

Frames Earthing

The frames of all electrical and lower voltage equipment shall be joined by auxiliary earth bar connections to the nearest point on the main earth or bars. The switchboards shall have two such connections to the earth bar on each switchboard.

Neutral Earthing

The neutral earthing points on the equipment shall be connected to earth in accordance with the single line diagrams or as directed by the Engineer.

The neutral earthing point on each transformer shall be solidly earthed.

Fence Earthing

All fences, hand railing, associated gates and posts, etc., shall be earthed to protect against electric shocks due to rise in potential as a result of direct contact of the fence with live electric conductors, due to indirect coupling with the energized equipment or due to lightning strikes. Fence shall be earthed by providing earth rods driven in the ground at suitable intervals and/or connecting these to the buried earthing conductor where provided. The final layout of the earthing system shall be to the approval of the Engineer.

Lightning Protection

Lightning protection system for the control building shall be designed by the Contractor and submitted to the Engineer for approval. All equipment shall be installed in accordance with the approved layout drawings. Connections to lightning points shall be taken by the shortest possible route without bends down to ground level or the earthing ring for connection to an earth electrode or the adjacent earthing system.

TESTS

After the on-site construction, the resistance to earth of each earthing electrode system shall be measured. The earthing system in all the installations shall be measured collectively under operation conditions and shall be disconnected into separate systems for measuring of the separate elements of the system. The Contractor shall suggest the measurement set-up for approval by the Engineer.

The earthing electrode systems shall be checked for resistance and reliable connections.

Complete underground earthing system shall be checked and tested to prove its adequacy as per relevant standards and these specifications and to the satisfaction of the Engineer. Test results shall be recorded.

6.5.11 Fire Fighting System

General

The fire protection system consists of the equipment to detect and extinguish fire in the most endangered zones of the power plant. Two systems of equipment for extinguishing fire will be used

- Portable fire fighting units
- Water spraying system (Sprinkler)

The detection will be realized by use of heat, flame or smoke detectors initializing the fire alarm system of the power station including the general fire siren and will triggering in-place fire extinguishing equipment. The detectors will be spread over the whole area of the power station mainly in the places where the danger of a fire to occur is given (generators, transformers, diesel unit, cable trenches and galleries, control and relay rooms). The protection will be provided through the installation of wall mounted portable extinguishers with suitable capacity and locations within the buildings.

Fire Protection for the Generators

Generators are to be protected against the outbreak of fire as they used to be the most endangered parts within the power house. WAPDA s standards foresee a portable fire extinguisher and shall be respected unless the standard of the manufacturer gives a better protection.

Fire Protection for the Transformers

The fire fighting equipment will consist of a water spray system (Sprinkler System), which will be initiated automatically by heat detectors. The auxiliary transformers will be protected by detectors for alarms and portable CO_2 extinguishers with sufficient capacity to be placed nearby the transformers; together with sets of heat and fire resistant clothing including helmets, gloves and boots.

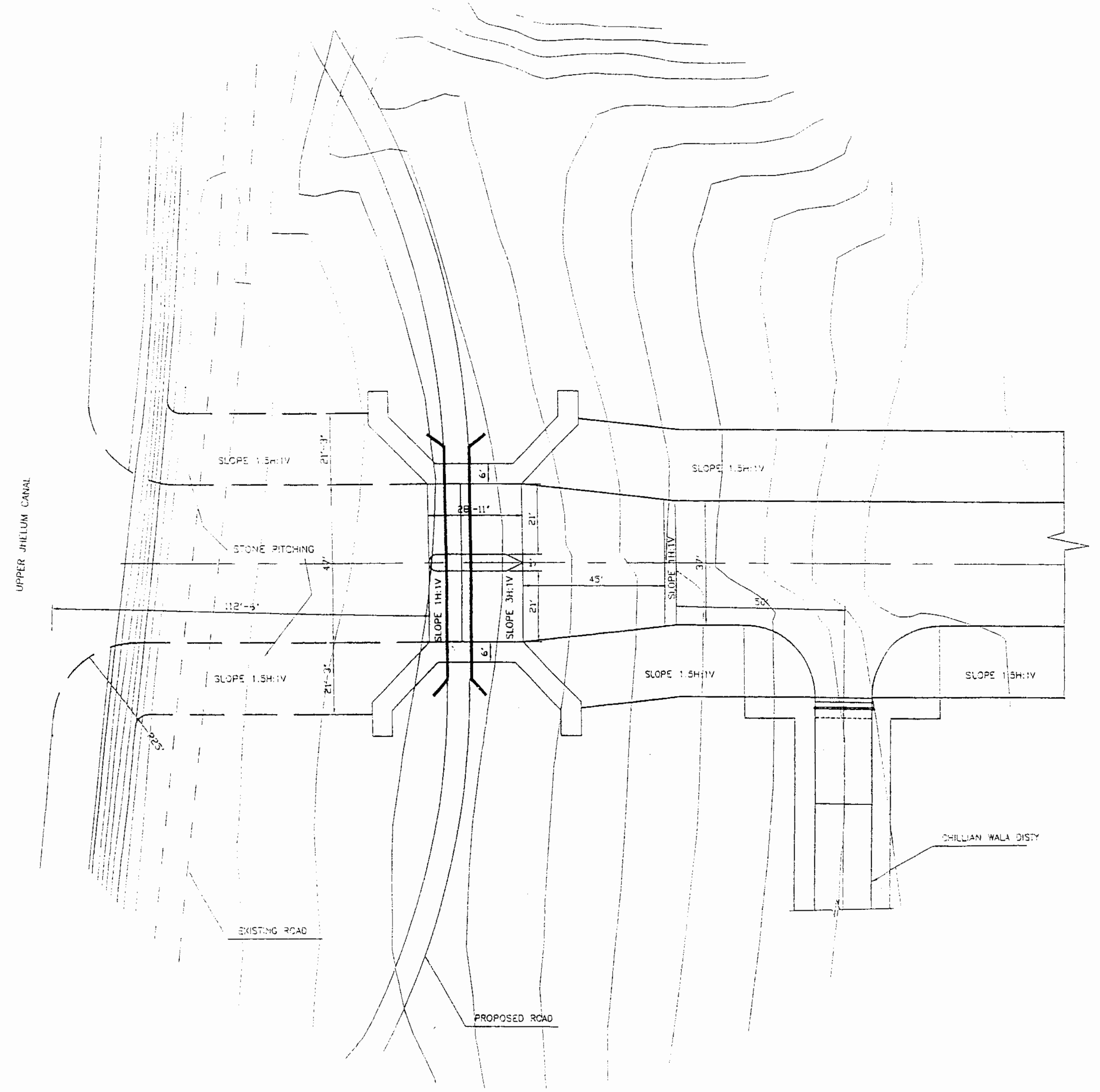
Fire Protection for the Emergency Diesel in Power House

The diesel generating unit will be protected by detectors for alarm and hand sets and portable extinguishers to be placed nearby the locations of the unit together with sets of heat and fire resistant clothing including helmets, gloves and boots. The tank area will be separated from the unit by heat resistant (1 hour) walls and/or doors.

General Fire Protection Measures for Cable Trenches

Cable trenches galleries and channels will be monitored constantly by fire detectors, portable fire extinguishers will be arranged such that a short distance to all sites is guaranteed. Power cable and control cable shall be placed on separate galleries.

DRAWINGS



S.NO.	DATE	DESCRIPTIONS	CHECK

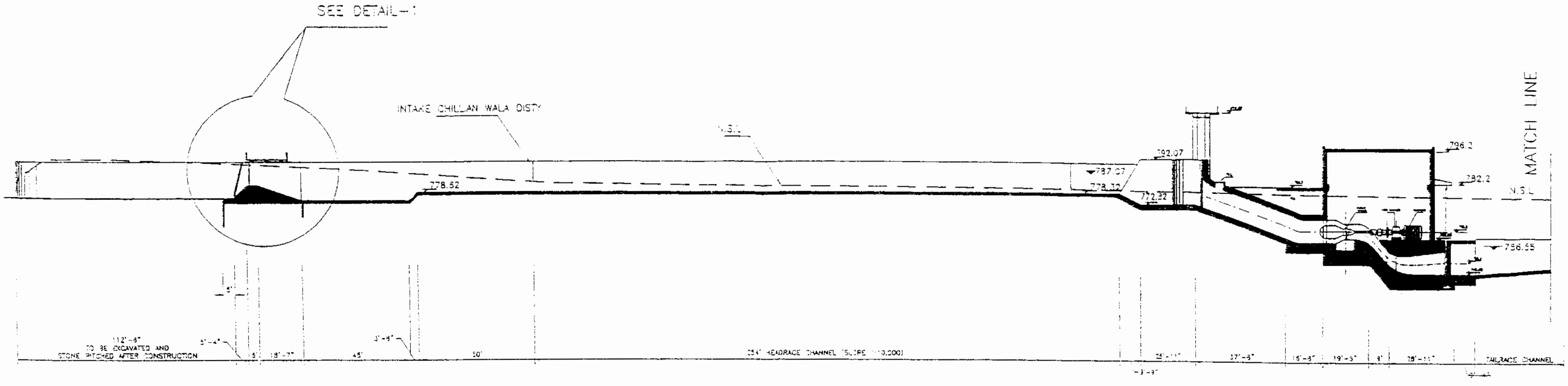
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

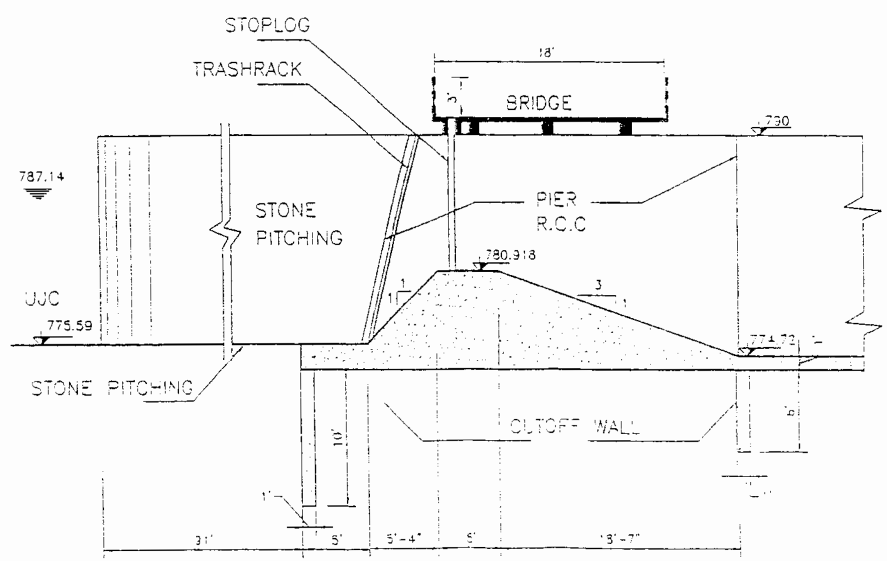
HEADRACE
INTAKE PLAN

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BAROAAB CONSULTANTS (PVT.) LTD.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV. No.
DESIGNED:	[illegible]	FIGURE NO.	
CHECKED:	RIASAT ALI	6.2	
APPROVED:	[illegible]		



LONGITUDINAL SECTION



DETAIL-1

SCALE 1"=10'

0 45 90 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

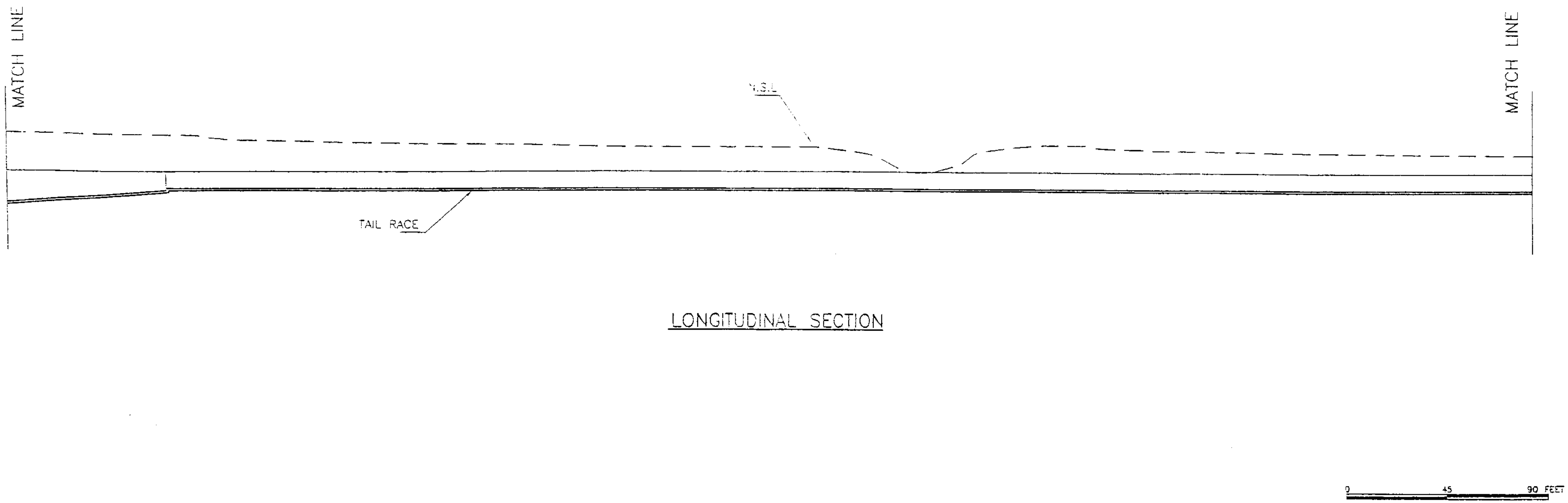
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

HEADRACE
LONGITUDINAL SECTION

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
COMMERCIAL AREA, PHASE-II, D.H.A. LAHORE.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV.
DESIGNED:		FIGURE NO.	
CHECKED:		6.3	
APPROVED:			



LONGITUDINAL SECTION

S.NO.	DATE	DESCRIPTIONS	CHECK

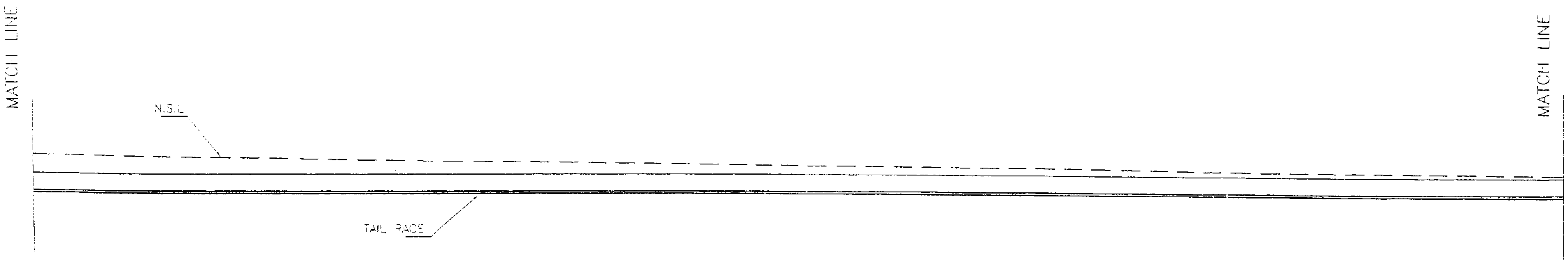
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

TAILRACE CHANNEL
LONGITUDINAL SECTION

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
[illegible] COMMERCIAL AREA, PHASE-[illegible] DHA LAHORE

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV. No.
DESIGNED:	ANJUM AMIN	FIGURE NO. 6.3	
CHECKED:	RIASAT ALI		
APPROVED:	JAMIL ANWER		



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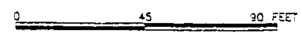


S.NO.	DATE	DESCRIPTIONS	CHECK

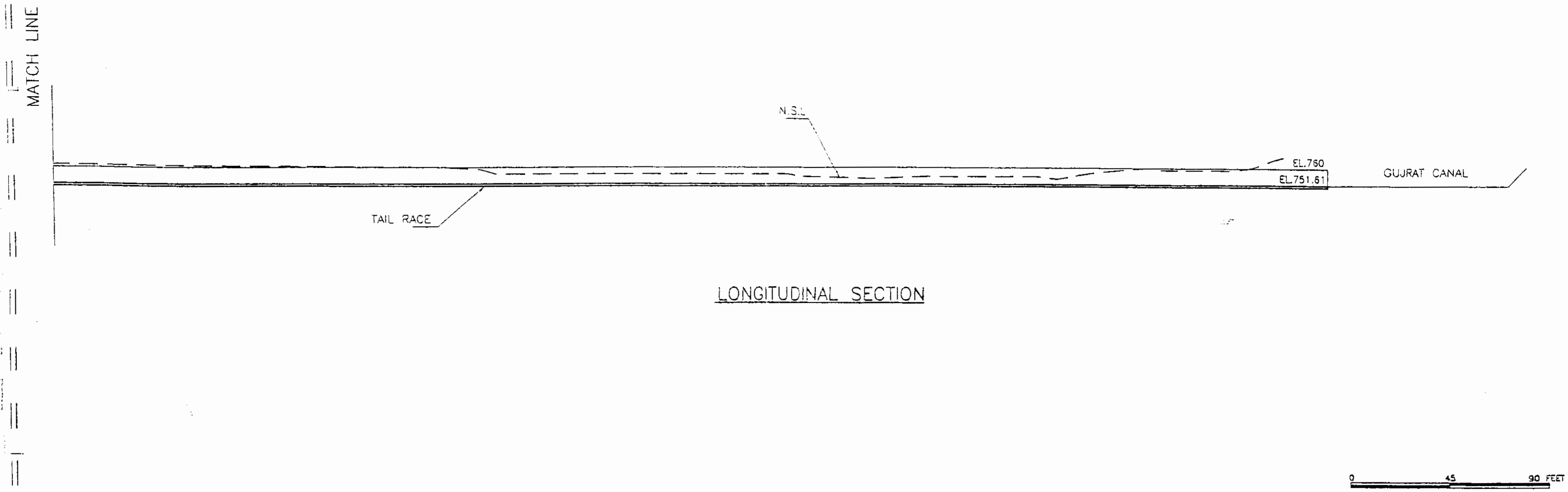
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

TAILRACE CHANNEL
LONGITUDINAL SECTION

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV. No.
DESIGNED:	ANJUM AMIN	FIGURE NO. 6.3	
CHECKED:	RASAT ALI		
APPROVED:	JAMIL ANWER		



LONGITUDINAL SECTION

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

TAILRACE CHANNEL
LONGITUDINAL SECTION

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
SARQAAB CONSULTANTS (PVT.) LTD.
188 -Y, COMMERCIAL AREA, PHASE-III, D.H.A. LAHORE.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV. No.
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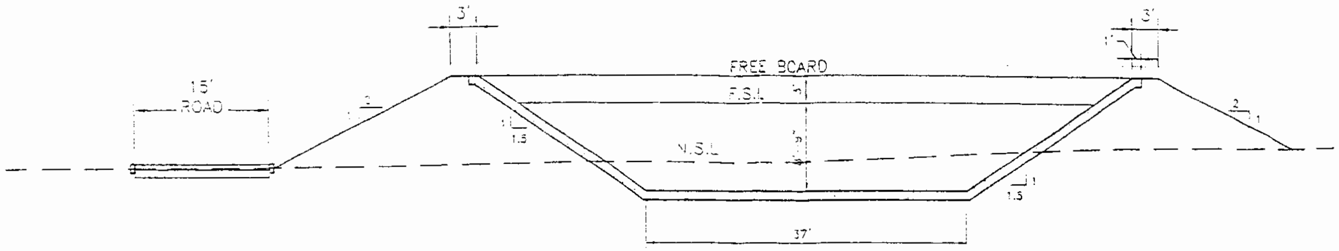
CHECKED:	RIASAT ALI		
APPROVED:	JAMIL ANWER		



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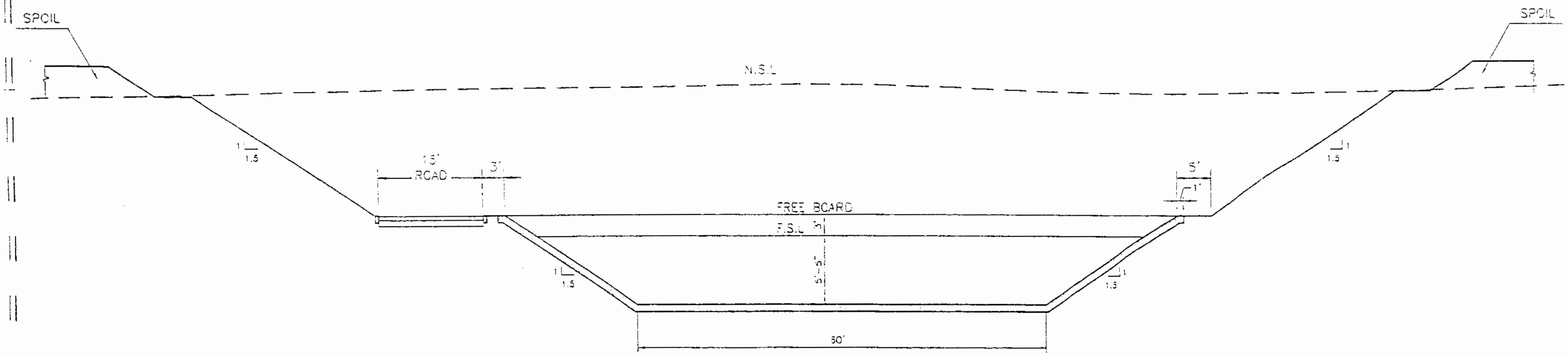

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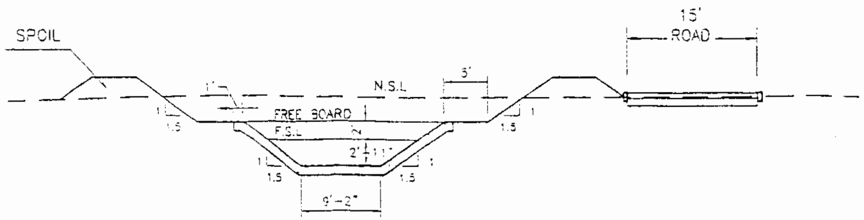


TYP. X-SECTION CHILLIAN WALA DISTY

0 15 30 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

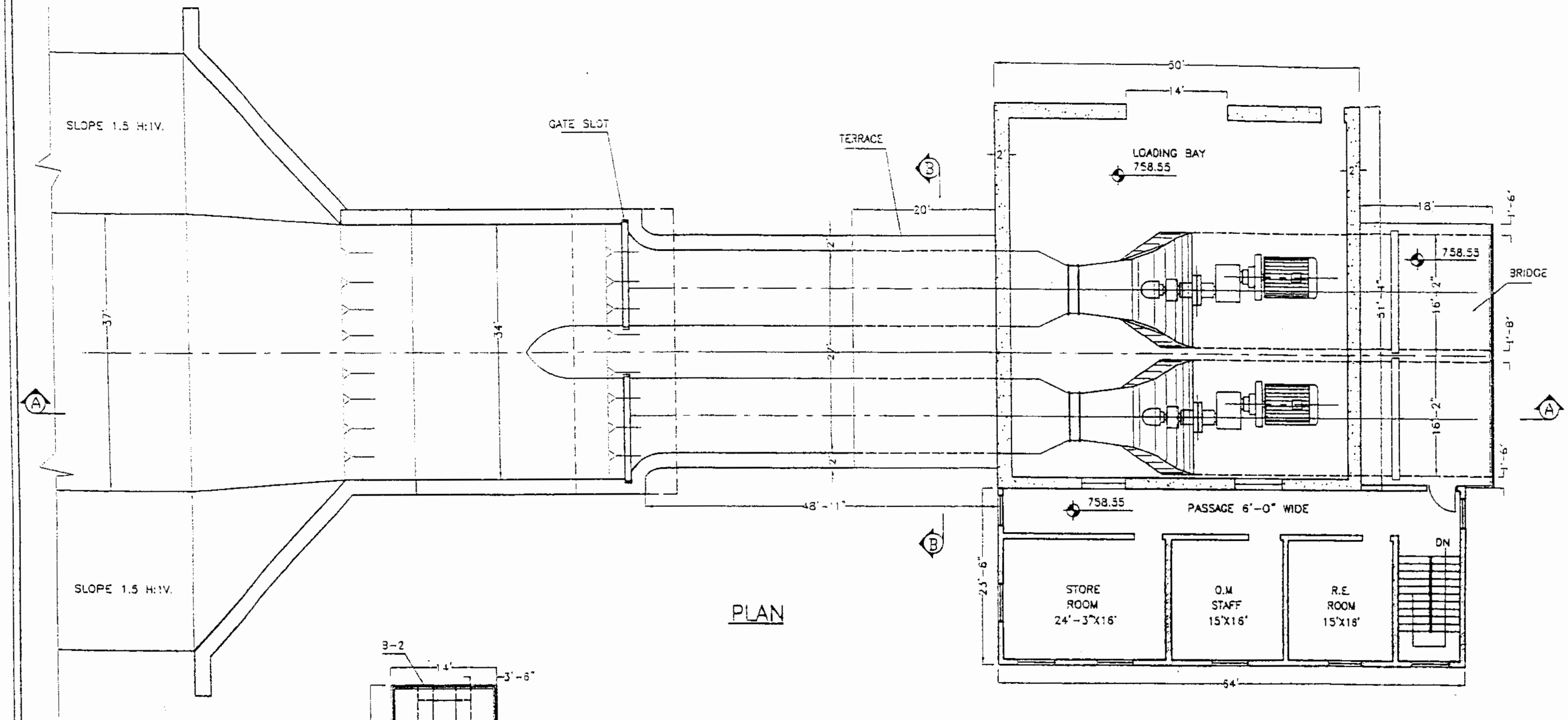
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

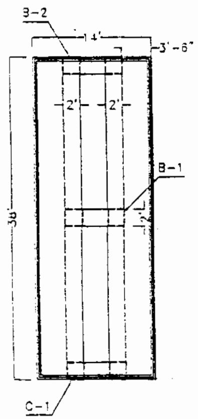
HEADRACE CHANNEL, TAILRACE CHANNEL AND CHILLIAN WALA DISTY CROSS SECTIONS

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
188 -Y, COMMERCIAL AREA, PHASE-4, D.H.A. LAHORE

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV. No.
DESIGNED:	CH. RIASAT	FIGURE NO. S.4	
CHECKED:	CH. RIASAT		
APPROVED:	JAMIL ANWER		



PLAN



PLAN AT ELEV. 812.07

0 16 32 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

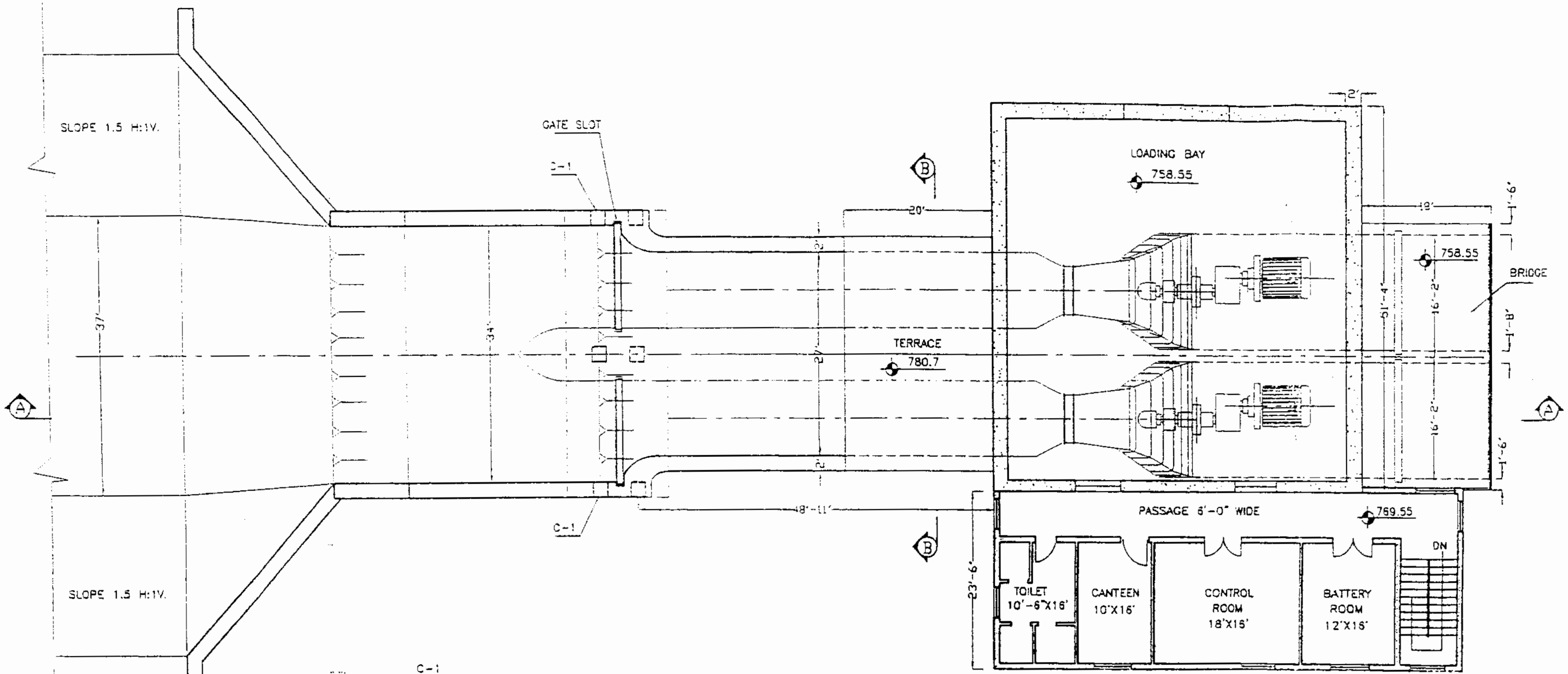
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

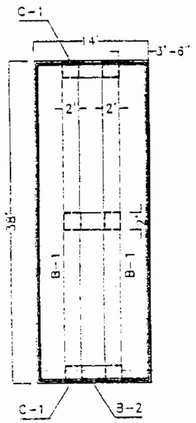
POWER HOUSE
PLAN AT EL. 758.55
2X1.6 MW S KAPLAN TURBINE

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
186 -Y, COMMERCIAL AREA, PHASE-III, D.H.A. LAHORE.

DRAWN:	SAIF ULLAH	DATE: OCT. 2004	REV. No.
DESIGNED:	MUHAMMAD PERVAIZ	FIGURE NO. 6.5	
CHECKED:	MUHAMMAD PERVAIZ		
APPROVED:	JAMIL ANWER		



PLAN



PLAN AT ELEV. 812.07

0 16 32 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

POWER HOUSE
PLAN AT EL. 769.55
2X1.6 MW S KAPLAN TURBINE

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
[illegible] COMMERCIAL AREA, PHASE-II, D.H.A. LAHORE.

DRAWN:	SAIF ULLAH	DATE: OCT. 2004	REV. No.
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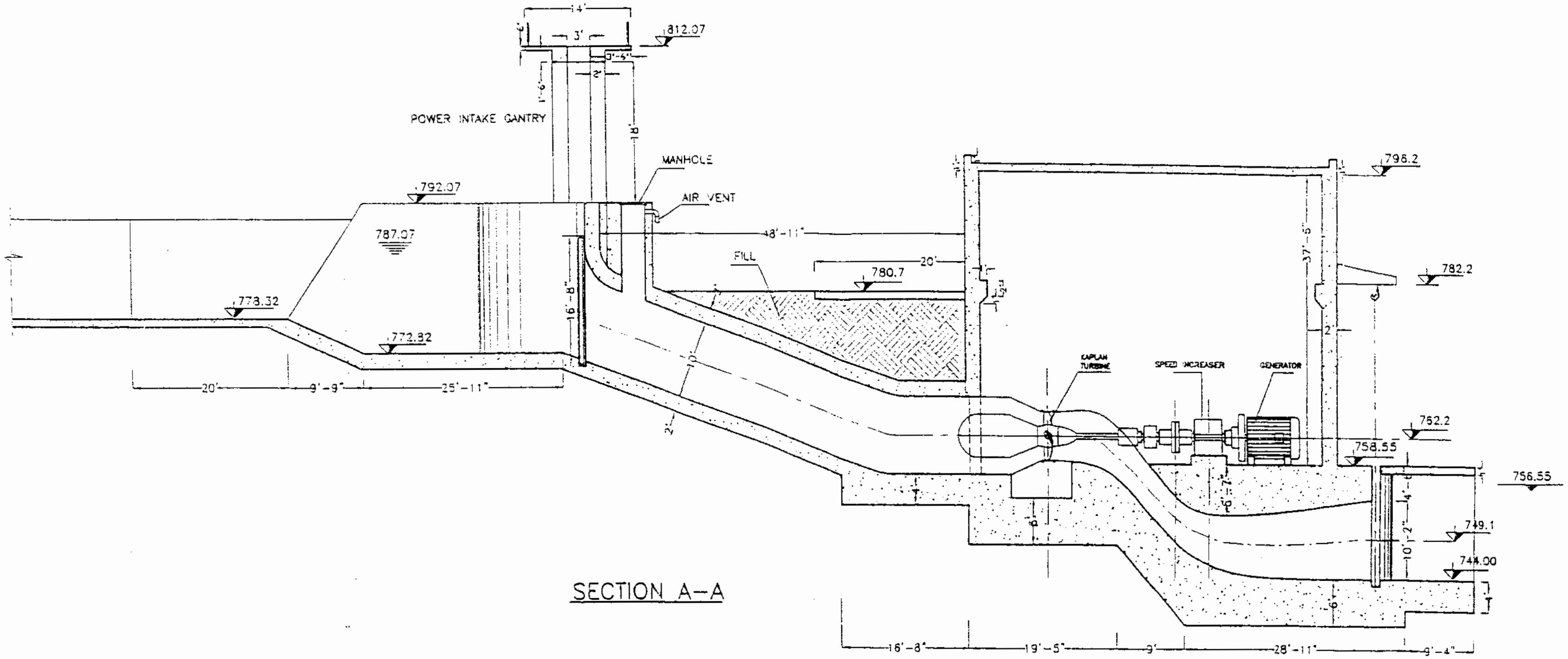
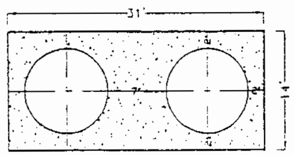
CHECKED:	MUHAMMAD PERVAIZ		
APPROVED:	JAMIL ANWER		



SECTION A–A



SECTION B–B

0 16 32 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

POWER HOUSE
SECTIONS
2X1.6 MW S KAPLAN TURBINE

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
188 -Y, COMMERCIAL AREA, PHASE-II, D.H.A. LAHORE.

DRAWN:	SAIF ULLAH	DATE: OCT. 2004	REV. No.
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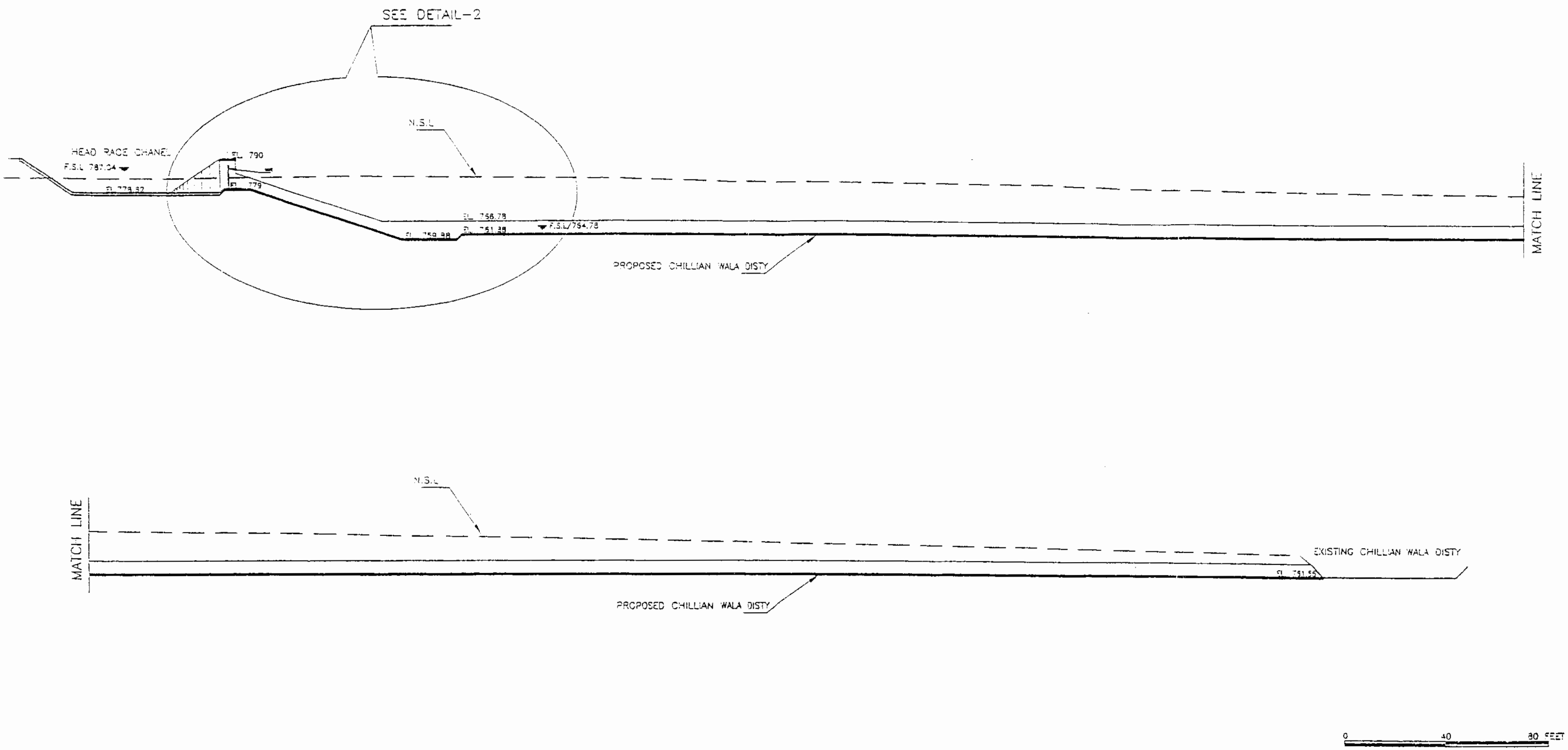
CHECKED:	MUHAMMAD PERVAIZ		
APPROVED:	JAMIL ANWER		



S.NO.	DATE	DESCRIPTIONS	CHECK

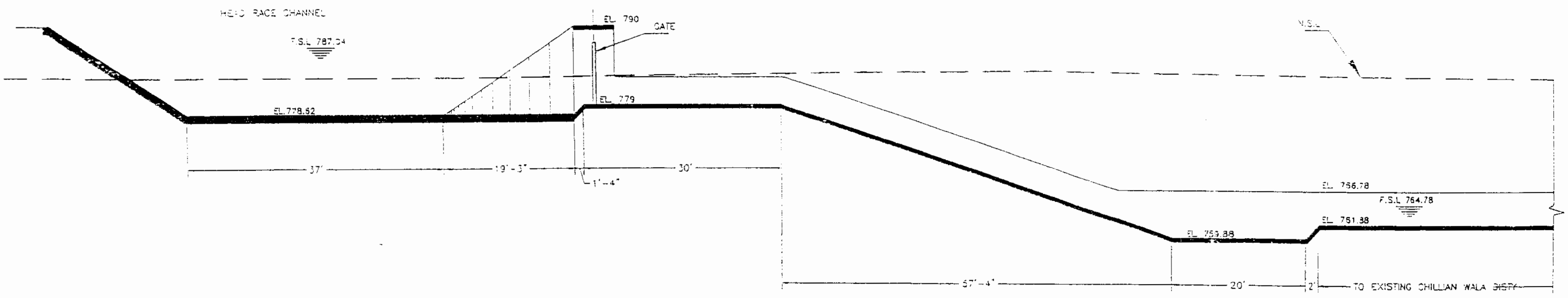
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

CHILLIAN WALA DISTY
LONGITUDINAL SECTION

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	REV. No.
DESIGNED:	ANJUM AMIN	FIGURE NO. 6.8	
CHECKED:	RIASAT ALI		
APPROVED:	JAMIL UNVER		



DETAIL-2

0 15 30 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

CHILLIAN WALA DISTY
LONGITUDINAL SECTION

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BAROAAB CONSULTANTS (PVT.) LTD.

DRAWN:	AKRAM RAFI	DATE: OCT 2004	
DESIGNED:	ANJUM AMIN	FIGURE NO.	6.9
CHECKED:	RIASAT ALI		
APPROVED:	JAMIL ANWER		

LEGEND

SYMBOL	DESCRIPTION
	GENERATOR
	CIRCUIT BREAKER
	DISCONNECTOR
	SURGE ARRESTER
	DISCONNECT LINK
	TRANSFORMER
	CURRENT TRANSFORMER
	LINE TRAP
	COUPLING CAPACITOR VOLTAGE TRANSFORMER
	GROUNDING TRANSFORMER WITH RESISTOR
	VOLTAGE TRANSFORMER
	GENERATOR CIRCUIT BREAKER
AVR	EXCITATION EQUIPMENT
REF	RESTRICTED EARTH FAULT PROTECTION
UAT	UNIT AUXILIARY TRANSFORMER

SYMBOL	DESCRIPTION
21	IMPEDANCE RELAY
32	REVERSE POWER SUPPLY
40	LOSS OF EXCITATION RELAY
46	NAGATIVE PHASE SEQUENCE RELAY
49/UT	UNIT AUX. TRANSF. THERMAL RELAY
49/GT	GEN. TRANSF. THERMAL RELAY
49/G	GENERATOR THERMAL RELAY
50/BF	BREAKER FAILURE RELAY
50/51	TIME/INSTANTANEOUS O/C RELAY
50/51N	O/C & EARTH FAULT RELAY
51/N	EARTH FAULT O/C RELAY
59	OVER VOLTAGE RELAY
59/51	OVER FLUXING RELAY
59/81	OVER FLUXING RELAY
60	VOLTAGE BALANCE RELAY
63	BUCHHOLZ RELAY

SYMBOL	DESCRIPTION
64	EARTH FAULT RELAY
64/C	11kV CONN. EARTH FAULT RELAY
64/F	ROTOR EARTH FAULT RELAY
64/S	STATOR EARTH FAULT RELAY
79	AUTO RECLOSING RELAY
87	DIFFERENTIAL RELAY
87/B1	BUS DIFFERENTIAL RELAY
87/B2	BUS DIFFERENTIAL RELAY
BF	BREAKER FAILURE
87/REF	RESTRICTED EARTH FAULT RELAY
87/GT	GEN. TRANSF. DIFFERENTIAL RELAY
87/G	GEN. DIFFERENTIAL RELAY
PW	PILOT WIRE PROTECTION
SS	SELECTOR SWITCH
FL	FAULT LOCATION
TD	TRANSDUCER

SYMBOL	DESCRIPTION
V	VOLTMETER
W	WATT METER
A	AMMETER
Wh	WATT HOUR METER
Var	VAR METER
Varh	VAR HOUR METER
DCS	DISTRIBUTED CONTROL SYSTEM
ULCP	UNIT LOCAL CONTROL PANEL
SLCP	S/YARD LOCAL CONTROL PANEL
MP-RR-PH	METERING PANEL RELAY ROOM POWER HOUSE
MP-RR(SCB)	METERING PANEL RELAY ROOM S/YARD CONTROL BUILDING

S.NO.	DATE	DESCRIPTIONS	CHECK

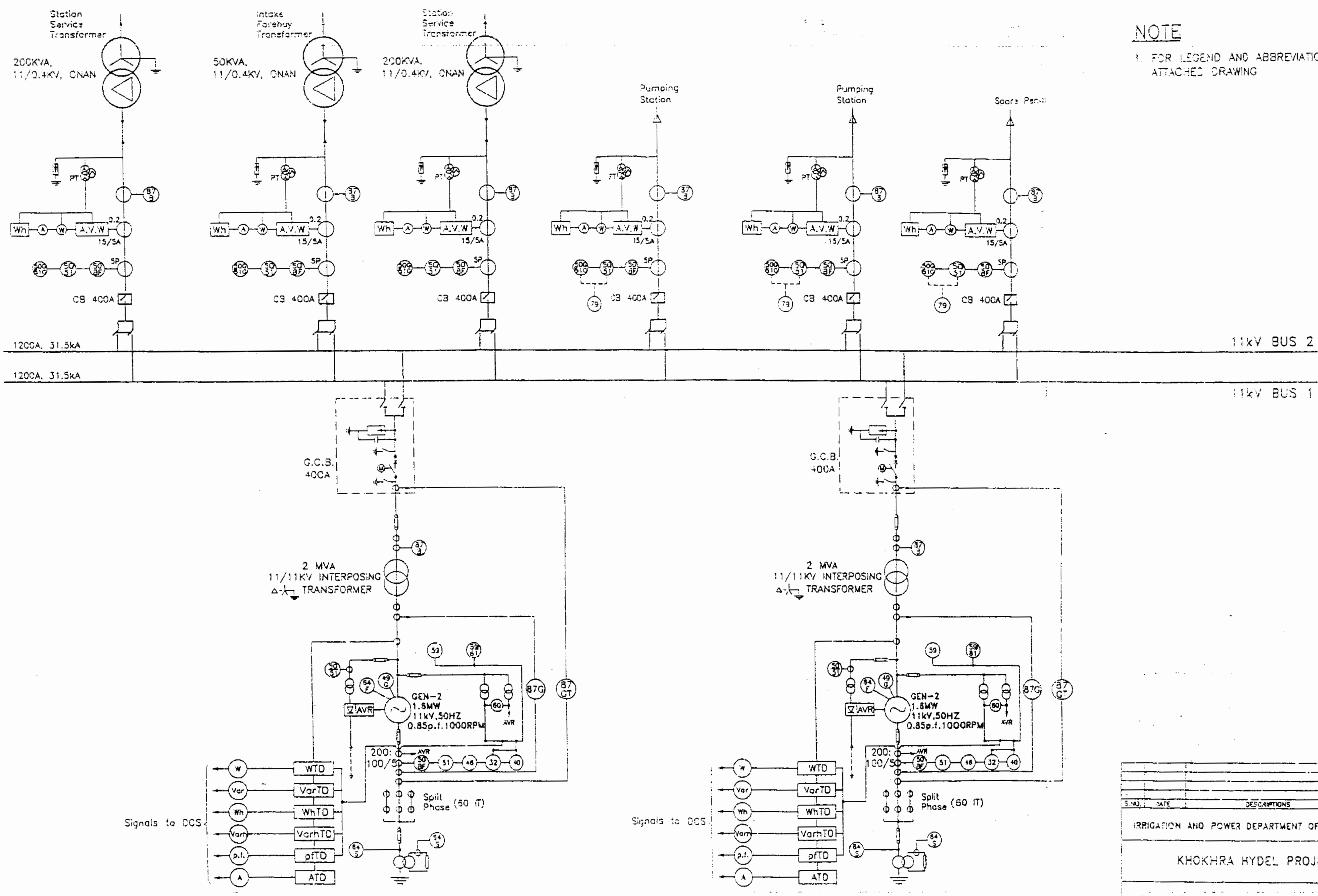
IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

POWER HOUSE AND PROTECTION SINGLE LINE DIAGRAM LEGEND

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
188 -Y, COMMERCIAL AREA, PHASE-II, D.H.A. LAHORE

DRAWN:	M. NADEEM	DATE: NOV. 2004	REV. No.
DESIGNED:	ABDUL QAYUM	DRAWING NO.	
CHECKED:	MOHAMMAD PERVAIZ	6.10	
APPROVED:	JAMIL ANWER		



NOTE

1. FOR LEGEND AND ABBREVIATIONS SEE ATTACHED DRAWING

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

POWER HOUSE AND PROTECTION SINGLE LINE DIAGRAM

PAKISTAN ENGINEERING SERVICES (PVT.), LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
128 -K, COMMERCIAL AREA, PHASE-II, D.H.A. LAHORE.

DRAWN:	M. NADEEM	DATE: NOV. 2004	REV. No.
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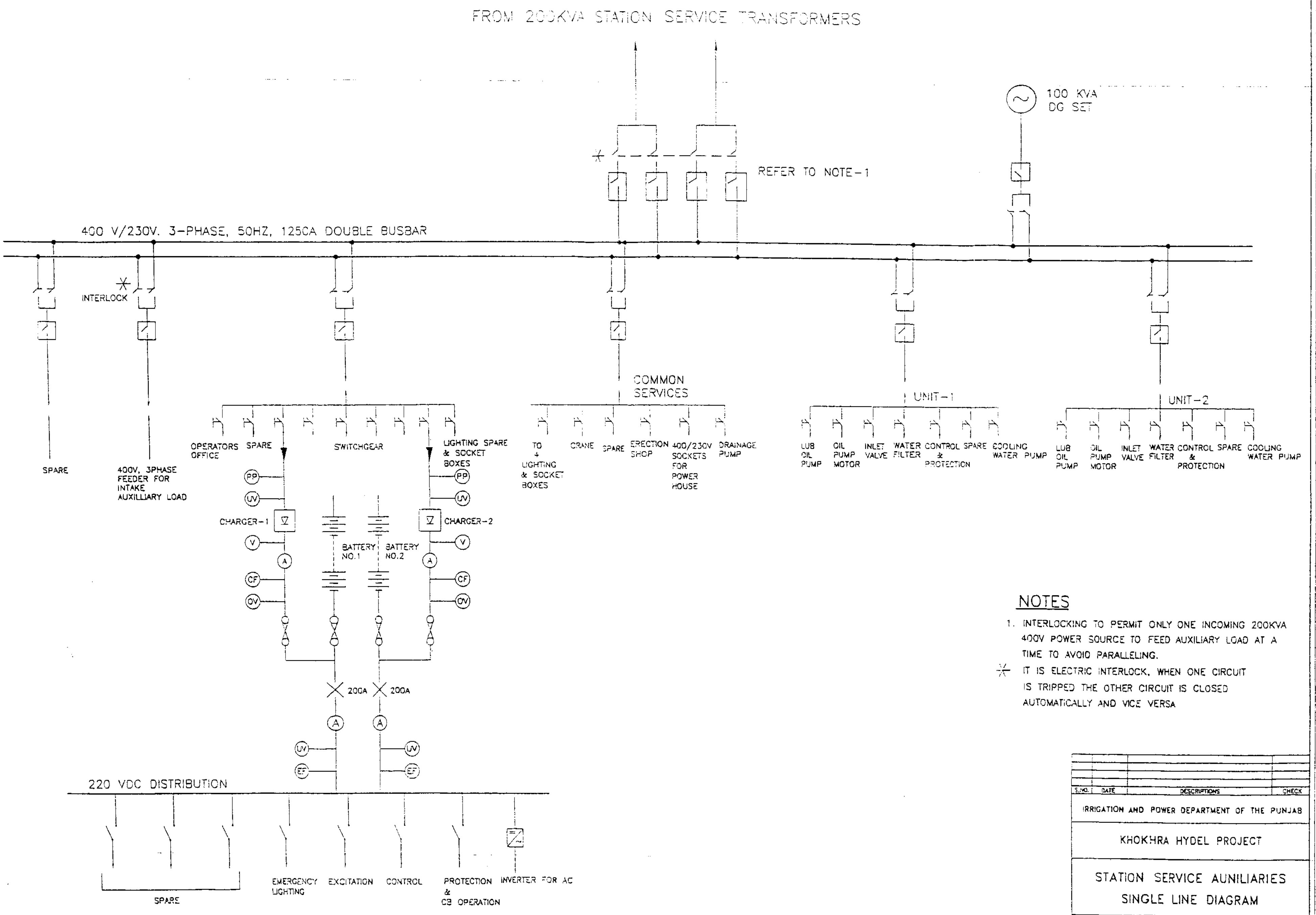
CHECKED:	MOHAMMAD PERVAIZ	6.11	
APPROVED:	JAMIL ANWER		



NOTES

1. INTERLOCKING TO PERMIT ONLY ONE INCOMING 200KVA 400V POWER SOURCE TO FEED AUXILIARY LOAD AT A TIME TO AVOID PARALLELING.

* IT IS ELECTRIC INTERLOCK, WHEN ONE CIRCUIT IS TRIPPED THE OTHER CIRCUIT IS CLOSED AUTOMATICALLY AND VICE VERSA

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

STATION SERVICE AUNILIARIES
SINGLE LINE DIAGRAM

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
188 -Y, COMMERCIAL AREA, PHASE-III, D.H.A. LAHORE

DRAWN:	M. NADEEM	DATE: NOV. 2004	REV. No.
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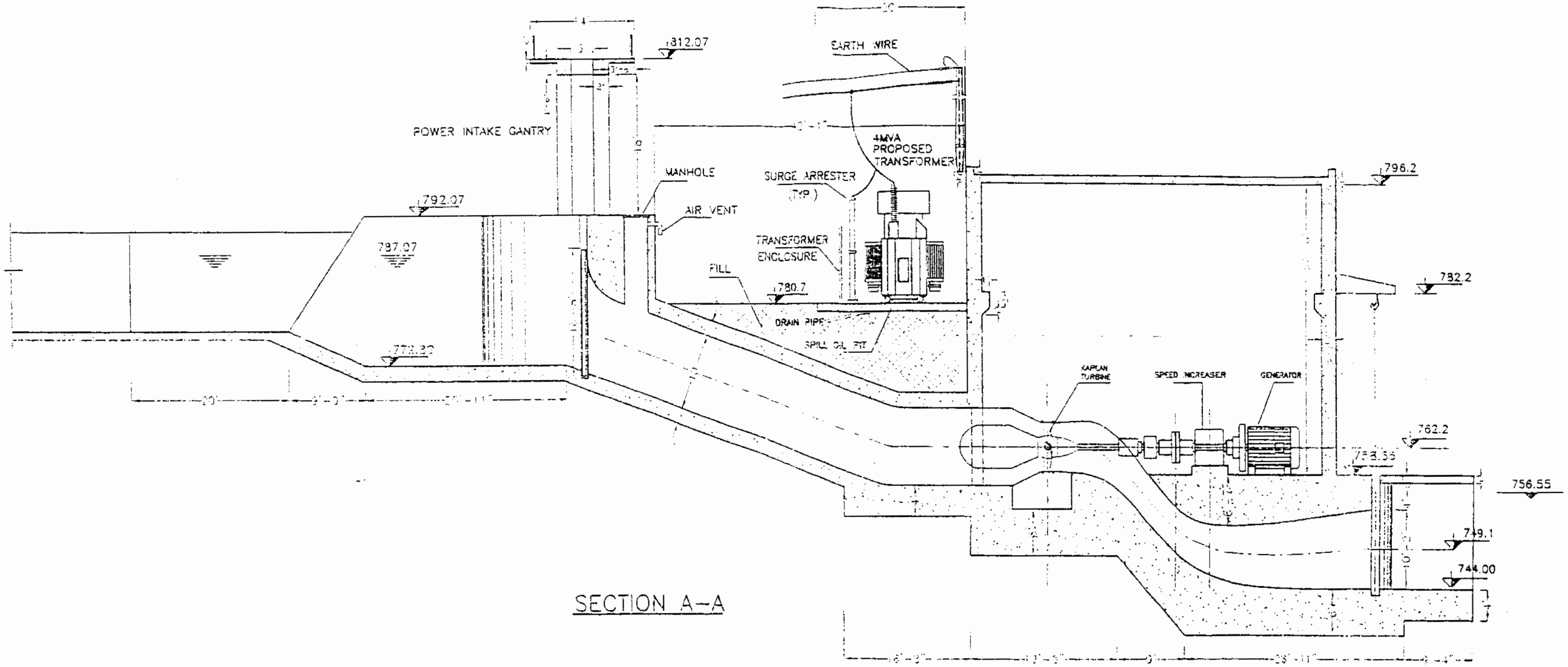
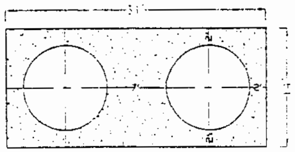
CHECKED:	MOHAMMAD PERVAIZ	6.12	
APPROVED:	JAMIL ANWER		



SECTION A–A



SECTION B–B

0 16 32 FEET

S.NO.	DATE	DESCRIPTIONS	CHECK

IRRIGATION AND POWER DEPARTMENT OF THE PUNJAB

KHOKHRA HYDEL PROJECT

POWER HOUSE
SECTIONS
2X1.6 MW S KAPLAN TURBINE

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.
188 -Y, COMMERCIAL AREA, PHASE-II, D.H.A. LAHORE

DRAWN:	SAIF/NADEEM	DATE: NOV. 2004	REV. No.
DESIGNED:	MUHAMMAD PERVAIZ	DRAWING NO. 6.13	
CHECKED:	MUHAMMAD PERVAIZ		
APPROVED:	JAMIL ANWER		

CHAPTER 7

Environmental Assessment

CHAPTER – 7

ENVIRONMENTAL ASSESSMENT

7.1 INTRODUCTION

This chapter presents a description of the environmental impact assessment of the proposed Khokhra Hydel Power Station. The project will harness the flows of Upper Jhelum Canal (UJC) to generate hydropower. UJC is part of the extensive irrigation system of the Punjab province completed in the year 1915. The canal had been originally designed for a discharge capacity of 12,500 cu. ft. per sec (cusec) taking its supply directly from Jhelum river through a head regulator at Mangla. With the commissioning of Mangla Dam Project in 1960, the tail water level of Mangla power units had to be lowered. As the canal head regulator and upper reach of UJC were both located next to Mangla Dam Project, this resulted in the abandonment of UJC head regulator and replacing of 2,500 ft. of head reactor of UJC with Bong Canal. The 2,500 ft. long Bong canal is designed for a flow of 49,000 cusecs. At the end of Bong Canal 41,000 cusecs can be passed from new Bong Escape into Jhelum river. With the commissioning of Mangla dam reservoir, UJC which had silting problem started scouring due to silt free water. As a result of this scour, the safety of UJC canal structures was threatened. Its discharge had, therefore, to be reduced to 8,500 cusecs which is its maximum carrying capacity.

Khokhra head regulator on UJC, the location of the proposed power station, is at RD 255+080 and is discharging 1537 cusecs into Gujrat Canal. Starting from Mangla Dam turbines outlet, UJC traverses over land areas belonging to Tehsils of Sarai Alamgir, Kharian and Gujrat in Gujrat District. From Tehsil Sarai Alamgir, UJC crosses into Mandi Bahauddin District near about Rasul. After straddling over a short distance in a semicircular form, the alignment of UJC re-enters District Gujrat. The proposed power station is located at a distance of about 1 Km from this re-entry.

7.2 PROJECT DESCRIPTION

7.2.1 Background

The Punjab province has a substantial low head power potential on its canals, with five power stations generating 45 MW of electricity from canal falls. The hydropower potential available at the falls of UJC along its alignment is already being mobilized by the existing two hydel power stations at Rasul (RD 244+000) and Shadiwal (RD 420+000). Khokhra Hydel Power Station (RD 255+000) will be constructed on UJC in between the two Classified as small capacity low head power station, it is expected to utilize variable flow of 1433 to 1191 cusecs of Gujrat Branch falling through a water head of about 26.74 ft. to produce upto 2.8 MW of electricity. Compared with the existing power stations at Rasul (22 MW) and Shadiwal (14 MW), it will be the smallest of the three hydel power stations based on flow in UJC.

7.2.2 Project Site

The project site is an area on the right bank of Upper Jhelum Canal at RD 255+080. Khokhra Head Regulator at this location allows Gujrat Branch Canal, also called Khokhra Distributary, to off-take from right bank of UJC. In and around this area, Gujrat Branch Canal has Khokhra village on its left bank and extensive farmland on its right. The farmland is irrigated by Chillianwala Distributary off taking from Gujrat Branch at RD 1+000. Starting from UJC Head Regulator, Gujrat Branch encounters three falls at RD's 0+600, 1+350 and 2+000. The total fall downstream of third fall is about 26.74 ft. which has led to the decision to build a power station at this site. The north latitude and east longitude of the site are 73° 37' 30" N and 32° 41' 50" E. The site is located in a well-defined and limited area inclusive of the right of way (ROW) for UJC, Gujrat Branch Canal the proposed power channel and tail race. The site is accessible from National Highway, also called Grand Trunk Road. UJC crosses National Highway near Rajar Canal Rest House. From this point the canal road on the right bank of UJC, proceeds to the power plant site. The canal road, metalled for most of its length, has some soft, bad stretches as well as un-metalled portions on the way. After necessary works for repair and maintenance, the canal road can be conveniently used for haulage of heavy equipment for the power station. Figure 7.1 shows location of proposed Khokhra Hydel Power Station in Tehsil Kharian of Gujrat District.

7.2.3 Power Plant Layout

The feasibility study describes the planning, design and layout of the components of the Khokhra Hydel Power Station. Chapter 6 deals with the power plant layout. Briefly the power plant will have a power channel off-taking from right bank of UJC upstream of the existing Khokhra Head Regulator. For this purpose an intake structure will be built on the right bank of UJC for the power channel. After working the turbines in the power house, water will be discharged into the tail race just downstream of third fall on the Gujrat Branch Canal. The existing outlet of Chillianwala Distributary, now off-taking at RD 1+000 of Gujrat Branch, will be shifted upstream to receive its flow directly from the power channel. Salient features of the layout are described below.

i) **Power Output**

Flow Rate

Maintaining the requisite flow in the Gujrat Branch Canal is the controlling factor in the operation of the power house. This depends upon the water availability in UJC and the downstream crop requirements in the two major cropping seasons of Kharif and Rabi.

Kharif Season

Discharge	1433 cusecs
Net Head	26.74 ft.
Power	2.8 MW

Rabi Season

Discharge	1191 cusecs
Net Head	26.74 ft.
Power	2.33 MW

The power house building would be located 500 ft. from the right bank of the UJC, and 500 ft. on right side of Gujrat Branch Canal.

ii) **Intake Structure**

Intake structure, 50 ft. wide and with a maximum depth of 8 ft. will allow main flow of UJC directly into the power channel. It will be located 500 ft. upstream of existing Khokhra Head Regulator.

iii) **Power Channel**

Power channel 304 ft. long and at a slope of 1 in 10,000 is trapezoidal in shape with a bed width 37 ft. and side slopes of 1 ½ to 1.

iv) **Bridge**

A bridge on intake structure will be built for smooth flow of traffic on right bank of UJC.

v) **Penstocks**

The water from the power channel will be guided through two penstocks into two turbines of the power house. Each penstock, made of steel, will be 10 ft. diameter and 50 ft. long.

vi) **Powerhouse**

The building for power house 50 ft. x 75 ft. will be constructed at a distance of about 500 ft. from UJC. A sluice will make it possible to close the entrance of water to the penstock. In front of every penstock a trash rack will be installed to prevent large particles to enter the penstock. Depending upon the head, flow and speed considerations, the number and type of turbines have been selected for the powerhouse. Two turbines each of 1.4 MW capacity alongwith hydro-generators will be installed in the power house.

vii) **Tail Race**

Tail race will be a channel 1600 ft. long. Immediately below the powerhouse the tail race will have 20 ft. R.C.C. transition with rest of its remaining length being brick-lined. It will convey turbines outflow back into Gujrat Branch Canal just downstream of the third fall at its RD 2+000.

viii) **Feeder Channel**

The alignment of power channel will necessitate shifting of intake of Chillianwala Distributary from its present location on Gujrat Branch. This will be done by constructing a feeder channel off-taking from power channel upstream of power house and re-joining the existing alignment of the Distributary, some 800 ft. downstream of its present location.

ix) **Accessibility**

Infrastructure in terms of road for accessibility of site of power station from National Highway already exists along the right bank of UJC. However, the canal road needs to be repaired/metalled at some spots as pointed out in Section 7.2.2 of this chapter. Within the bounds of the site itself, a short length of metalled road would be needed for accessibility and regular inspection of various components constituting the project complex.

7.3 ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Notwithstanding the social and economic benefits, every development project interacts, in varying degrees with physical, ecological and human environment of the project area and its environs. Environmental assessment studies, therefore, form an essential part of the feasibility studies of every project so as to make it environmentally acceptable besides being technically and economically feasible. In order to ensure the achievement of these objectives laws, regulations and standards have been formulated by the relevant institutions at the respective national level and by international agencies.

7.3.1 Pakistan Environmental Protection Act 1997

Government of Pakistan promulgated Environmental Protection Act 1997 (PEPA 1997). It lays down a comprehensive framework for protection, conservation, rehabilitation and improvement of natural environment, prevention and control of pollution, promotion of sustainable development and matters connected therewith. Under this Act, Environmental Protection Agency at federal level (Pak EPA) and one in each province are already working in the country. Under the Act Environmental Tribunals have been set up to try cases of contravention or failure to comply with designated provisions of PEPA-97. The Act requires preparation and submission of environmental impact assessment (EIA) reports by proponents of all development projects which are expected to result in significant environmental impacts (SEI's). This is to fulfill the requirements of Pakistan Environmental Protection Agency's Guidelines and National Environmental Quality Standards (NEQS).

7.3.2 Khokhra Hydel Power Station

Schedule 1B of "Policy and Procedure for Filing, Review and Approval of Environmental Assessments" issued by Pak-EPA August 2000 lists projects requiring IEE. "These projects include those where range of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. These are projects not generally located in environmentally sensitive areas or smaller proposals in sensitive areas. Under energy sector hydropower electric generation less than 50 MW is part of this schedule 1B". Khokhra Hydel Power Project falls in this category.

7.4 BASELINE CONDITIONS

7.4.1 Introduction

This section is devoted to the description of environmental conditions as they exist now in the Khokhra Hydropower Project area before the construction of the project. It consists of a description of physical, biological and human environment and includes topography, geology, hydrology, meteorology, population and socio-economics. The methodology adopted to determine baseline conditions included field visits, discussions with officials of the Irrigation Department as well as with local people living in the vicinity of project area, reports, documents, maps issued by departments organizations such as Population Census Organization, Government of Pakistan, Irrigation Department Government of Punjab, Pakistan Environmental Protection Agency Islamabad.

7.4.2 Topography

The project area on the UJC right bank which includes the site of the power house is flat and gently sloping to the south and southwest whereas the left bank is marked by low Pabbi hills. The location and elevations of some points relevant to the project area are given below:

Point	Location	Easting Ft.	Northing Ft.	Elevation Ft. a.s.l
1	Khokhra H/W on UJC	10724685.988	3118114.327	796.244
2	Gujrat Branch H/W on UJC	10724662.245	3117924.790	794.682
3	1st Fall on Gujrat Branch RD 0+600	10724903.040	3117409.560	783.220
4	2nd Fall on Gujrat Branch RD 1+350	10725243.260	3116755.915	774.621
5	3rd Fall on Gujrat Branch RD 2+000	10725602.460	3116200.984	770.096

7.4.3 Geology

The geology of the area consists of Siwalik Group. The Jhelum river valley, which includes the project area, is mainly composed of unconsolidated strata, and largely consists of fine to medium grained sand and clay of both eolian and fluvial origin. Sedimentary rocks ranging in age from Pliocene to Recent are exposed in the project region and were deposited in continental environment. Those are represented by the Nagri, Dhok Pathan and Soan Formations. The last of these, Soan Formation, is recent and consists of sand stone, conglomeratic sand stone and clay stone. Westwards from Dinga town the alluvium of Doaba results in an alteration of clay and sand and eastwards it is a mixture of sand, clay and conglomerates.

7.4.4 Hydrology

The water resources of the project region are marked by the presence of Jhelum river, Upper Jhelum Canal and groundwater all of which are exploited for irrigation. A full description of hydrological aspects of the project area is given in the chapter on hydrology of this feasibility report.

7.4.5 Meteorology

The climate of the project region is healthy. By October the hot weather ends. The cold weather is dry and clear with splendid views of the distant snow-clad hills of

Kashmir. In January and February frost is common and on a few nights the temperature falls below the freezing point. The weather gets warmer after the end of March. The hottest months are May, June, July and August.

There is no meteorological station in Gujrat. Detailed data on temperature, precipitation and humidity recorded at Jhelum Meteorological Station as close proxy are given below:

Table – 7.1

Monthly Mean Meteorological Data at Jhelum 1961-90

Month	Mean Temperature (°C)		Precipitation (millimeters)	Relative Humidity (%)
	Maximum	Minimum		
January	19.7	5.0	33.8	66.2
February	21.6	7.7	50.0	60.2
March	26.6	12.5	60.6	53.8
April	33.0	17.7	36.6	41.9
May	38.1	22.0	31.8	32.5
June	40.6	25.8	51.9	37.2
Jult	35.7	25.8	237.3	62.3
August	34.4	25.3	221.2	70.8
September	35.0	23.0	77.7	65.5
October	33.1	16.6	12.2	55.6
November	27.6	9.9	9.9	62.9
December	21.5	5.7	30.4	68.9
Annual	**30.6**	**16.4**	**853.4**	**56.2**

Source: Meteorological Department, Government of Pakistan, Karachi, 1998.

7.4.6 Biology

The left bank of UJC in the project region is marked by low Pabbi hills with reserved forest. On the right bank some villages and extensive farmland exist.

Flora

The extensive area of Pabbi is the government property. The principal tree species found in the forests are Van (*Salvadora oleoides*). Jand (*Prosopis specigera*), Karif (*Capparis aphylla*), Mala (*Zizy phus nummularia*), Chichhra (*Butea trendosa*), Saddar (*Feronia elephantum*), Lasura (*leccoma undulate*), Phulahi (*Acacia modesta*), Beri (*Zizyphus jajaba*), Kikar (*Acticia arbica*), Toot (*Moras alba*), Drek (*Acacia*), Meha (*Azedarach*), Shisham (*Dalbergia sissoo*), Ganger (*Lycium europeeum*) and Frash (*Lamarix articulate*). The grass found in the district are Palwan Dhaman, Chhimar, Khabal and Madhana.

Mention is made here of six banyan trees (*Ficus bengalensis*) growing within and around the project site, one of them the biggest and the oldest, has girth of 31 ft. planning has taken and so that the power channel alignment avoids this tree.

Two others on the left bank of UJC will remain untouched. Other four of them are on the right bank of UJC. Steps should be taken so that these four trees are preserved rather than cut or damaged during construction phase.

Fauna

The wild animals are rarely found in the district. However jackal, wolf and fox are found in some parts of the district. Wild bear is also found near the river banks. The important livestock species in Gujrat District includes cattle, buffalo, sheep, goat, camel, horse, mule and domestic poultry.

7.5 SOCIO ECONOMICS

7.5.1 Population

The project area was surveyed for villages in and around the project site. The project site falls in Tehsil Kharian of Gujrat District. The human settlements on the right bank are more numerous than on the left because of the reserved forest there; Pabbi forest on low hills has sheesham and tahli trees along the UJC left bank. Table 7.2 below lists names of human settlements likely to interact or be impacted by the project showing populations of respective settlements. Ten villages belonging to three Patwar Circles (PC) of Panjan Shahana, Khori and Amra Kalan are on the right bank of UJC while eleven villages belonging to Parwar Circle Randheer in the Pabbi Reserve Forest are on the left bank of UJC. The present (2004) total population of these villages is 34,423. Figure 7.2 shows UJC alignment in and around project area showing villages, farmland, reserved forest (R.F), Gujrat Branch (Khokhra Distributary) and Chillianwala Distributary. The details of villages and population are given in Table 7.2 below.

Table – 7.2
Land Area, Census Population 1998 and Present Population in Projected at 2.41% pa.

Sr. #	Village Name	Area (Acres)	Population	
			1993 Census	Projected 2004
Amra Kalan PC			**8,934**	**10,310**
1	Amra Kolan	3,284	6,274	7,240
2	Amra Khurd	808	1,725	1,991
3	Bajarwala	446	935	1,079

Sr. #	Village Name	Area (Acres)	Population	
			1993 Census	Projected 2004
Khori PC			**8,366**	**9,654**
1	Khori	2,186	3,073	3,546
2	Noor Jamal	1,112	2,835	3,273
3	Rajoo Bhand	2,180	2,457	2,835
Panjan Shahana PC			**4,802**	**5,541**
1	Budhowal	1,154	872	1,006
2	Khokhra	1,195	1,494	1,724
3	Panjan Shahana	2,858	2,007	2,316
4	Rajoo	1,272	429	495
Randheer PC			**7,726**	**8,918**
1	Bido	1,004	578	667
2	Chak Miana	203	383	442
3	Chimber	527	879	1,019
4	Dik Gujran	404	686	792
5	Dinga Khurd	474	725	837
6	Hasan Karim	206	315	364
7	Iswal	191	516	596
8	Rai Chand	224	303	350
9	Randheer	1,960	2,685	3,099
10	Sango	236	392	452
11	Thalla	288	264	305

PC* Patwar Circle

People

The main tribes among the people in the project region largely located is Tehsil Kharian of District Gujrat, are Jat, Gujar, Arain and Awan. Many of the villages are named after their founders or notable personalities. The people are generally religious-minded. The staple food is wheat and rice.

7.5.2 Social Sector Parameters

The human population in and around the project area lives in 21 villages on both sides of UJC. According to National Population Census 1998, these villages are grouped in four Patwar Circles (PC's) as indicated in Table 7.2. Some of the important social sector parameters relating to the populations of these PC's are listed in Table 7.3 below:

Table – 7.3
1998 Census Population and Some Socio-economic Parameters of Human Settlements (Patwar Circles) in the Vicinity of Khokhra Hydel Power Station

Name of Human Settlement	Popula-tion	No. of Houses	Family Size	Literacy Ratio % 10+	Housing Facilities	
					Potable Water	Electricity
Panjan Shahana PC*	4802	801	6	45.4	41	682
Khori PC*	8366	1391	6	38.0	61	1241
Randheer PC*	7726	1096	7	42.2	161	1029
Amra Kalan PC*	8,934	1,280	7	46.6	24	1,123

PC* Patwar Circle

Education

Overall Literacy Ratio for age group 10 years and above is 43.1%. The literacy ratio in female population is lower than in male population. Gujrat District had 1,991 education institutions in 1998 including schools and degree colleges, including very famous Zamidara College in Gujrat City.

Health Facilities

According to 1998 Census Report there were 167 health units in Gujrat District. These health institutions included hospitals (11 nos.), dispensaries, RHC's, BHU's and MCH Centres.

7.5.3 Economy

Agriculture is, by far, the dominant sector of economy in the region. Industrial activity has been expanding over the last three decades. The largest group of active population belongs to elementary occupations, like small time shopkeepers and other similar avocations. This group is followed by skilled agricultural workers, technicians, crafts and related trades.

Agriculture

Agriculture is by far, the dominant profession of the people. Canal irrigation followed by tubewells and rainfed irrigation in that order is practiced. Rabi crops are sown following the heavy rains in July, August and September. The winter rains are important for maturing of Rabi crops. Cultivation in the district is not of high order and people are not as good cultivators as elsewhere. The method of cultivation depends largely on the pressure on the soil. In the eastern part of the district holdings are small. It is common for fields especially those dependent on rains to be cultivated for two harvests in succession and then left fallow for two harvests. A field which has grown wheat or cotton must be left fallow for at least six months. But sowing of Kharif crop is generally done after the first monsoon rain although cotton is sown in April. The millets and pulses are reaped in November while cotton picking lasts until the end of December and sugarcane remains on the ground till March. The Kharif crops require ample rain which should come in September. Wheat and gram are sown in October, but if the rain is late they can be sown in December. Rabi crops need rain in January and February. Harvesting of wheat is done in April, but gram and barley are cut earlier. Green wheat for fodder is cut as needed. The principal crops are wheat and rice which are by far the most important crops in the districts followed by barley, gram, massor, bajra, jowar, maize, cotton, rice, sugarcane, oil seeds, tobacco and miscellaneous cereals like Mash, Kangni, etc.

Industry

Over the last five decades Gujrat District has developed significantly in industrial sector. It is now the biggest centre of production for electrical goods, table ware, china ware and other pottery goods.

7.6 ENVIRONMENTAL IMPACTS

7.6.1 Impact Evaluation

Planning for environmental assessment depends upon reliably predicting project impacts on resources and managing those impacts to achieve the greatest gain or the smallest loss. The basis of the prediction is the knowledge of the proposed project and of local resources with which it is expected to interact. Two types of information are, therefore, needed: a comprehensive description of all resources likely to be affected by each of the project components, and an understanding of the project component itself. The baseline information given in the previous section includes all resources, natural and human and all aspects of those resources that may be expected to be touched, directly or indirectly, by the project. Conversely, project information will include all aspects of construction or operation that might affect the environment.

7.6.2 Approach to Impact Assessment

Various components of the project will interact with local resources in different ways. Therefore, it is useful to divide the project into units small enough that the interactions may be examined individually as well as collectively.

For the project as a whole a matrix, Table 7.4, has been prepared to identify project / environment interaction. This matrix is based on Asian Development Bank Guidelines. The main components of the Khokhra Hydropower Project are water intake, power channel, the powerhouse with penstocks and tailrace channel. Each of these is in effect a project in itself. Various aspects of each component are treated separately. They are examined both in terms of construction period and much longer period of project operation.

7.7 CONSTRUCTION PHASE IMPACTS

The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction.

7.7.1 Land

The land area required for the construction of the intake structure, power channel, power house and tail race channel amounts to about 5 acres. This includes about 3 acres already in the possession and ownership of the government by way of ROW for UJC and Gujrat Branch Canal. The land to be acquired is agricultural land.

7.7.2 Soils

The soil-related issues include slope stability, and effects on agricultural soils due to fugitive dust created through excavation activities at site and spoil areas. The quantities of excavation and fill material have been calculated and the construction of project has been planned in such a way that all the excavated material will be utilized filling of low lying areas and stabilization of slopes along the power channel and other structures. Therefore, construction of this project will neither involve bringing in of fill material from outside the project site area nor will there be any need for disposal of material outside project site area. The contract documents will also include specific clauses to impose environment protection practices on the part of the contractor.

7.7.3 Biological Environment

Biological environment of the area will have a negligible impact due to construction activity because all the effects will be limited to the proposed site area.

7.7.4 Safety Hazards

Safety hazards are associated with the operation of construction machinery, equipment and tools, transportation, blasting, land cutting and slides, fires etc. The causes of safety hazards are usually complex involving human errors, operational faults of machinery and unforeseen incidences. The majority of the causes are controllable with efficient management, staff training, machinery maintenance and other preventive measures. Accident prevention is essentially an engineering and administrative problem and rests mainly on strict compliance with established safety rules and regulations. The equipment will include drag line, dozers, dumpers, excavators etc. Proper management and utilization will minimize the hazards during construction.

7.7.5 Public Health

Health hazards arise through many sources. The source of concern during construction is dust. The sanitation of the construction camp and work place will have to be proper. The workers will be provided with proper protection materials. In addition to the preventive and precautionary measures, construction camp will have a dispensary equipped with first-aid material, dressing material etc.

7.7.6 Noise Pollution

Noise pollution due to operation and movement of construction equipment may be significant depending upon the intensity of noise produced. Precautionary measures for the construction workers e.g. protective ear muffs will be provided where needed.

7.7.7 Resettlement

No human settlements would be overtaken as a result of project construction, therefore, no resettlement issues of any kind exist in this case.

7.7.8 Construction Phase Benefits

The project construction will enhance employment opportunities for the local people. This will be a welcome development in the project area.

7.8 OPERATIONAL PHASE IMPACTS

The effects of the Khokhra Hydel Power Station during its operational phase are mostly beneficial. Besides the generation of electrical energy proposed to be used in an industry, the project will benefit by way of employment opportunities created as a result of the project both during construction and over the operational life of the project. A discussion of project impacts on land resources, water resources, biological resources and socio-economic environment follows.

7.8.1 Land Resources

The land resources of the project area will be directly affected in terms of overtaking of land areas for installation of project components. These components include power channel and its intake, feeder channel for Chillianwala Distributary, penstocks, power house complex, tail race and a small length of road and a bridge for accessibility within the project site. An area of about 70 acres of land will be required for these project components. Large part of this land area is under private ownership. All of this privately owned land is cultivated farm land. Some of this land is government property falling within the right of way (ROW) of UJC and Gujrat Branch Canal.

There are no human habitations on this land area. No resettlement issues exist as no population displacement is foreseen due to the project.

7.8.2 Intake Structure

The intake structure to be constructed for allowing UJC water to flow directly into the power channel at 500 ft. upstream of Khokhra Head Regulator, will have no effect on environment except for overtaking of land area.

7.8.3 Power Channel, Tail Race Channel and Feeder Channel

The bodyof water created in the form of power channel,tail race channel and feeder channel for Chillianwala Distributary will have no effect on environment except for overtaking of land area. Similarly the bridge on power channel and a short length of road will not affect the environment.

7.8.4 Power House

Besides power channel and tail race channel, major land area (about 20 kanals) will be taken up by the power house building which will be located at RD 254+508 of UJC and 500 ft. away from its right bank. The area required for power house building will result in a land use change. The operation of the turbines and generators in the power house will raise noise level at project site. It will not be significant in terms of environmental pollution. The NEQS level for noise is 85 dBA and it is not likely to be exceeded during power house operation.

7.8.5 Effect on Irrigation

As stated earlier there is no effect on existing irrigation system. The intake of Chillianwala Distributary has been shifted for supply of water from Power Channel in place of the present intake at Gujrat Branch. The farmland currently commanded by the distributary remains unchanged.

7.8.6 Effect on Water Quality

None of the villages within the project area has a proper sewerage and drainage system. The local population has use of out-house facilities or open field for defecation. The situation, therefore, shows that there is almost no pollution from village waste waters into any of water bodies like UJC or Gujrat Branch. This project will not change the already existing water quality in anyway.

7.8.7 Effect on Flora

There is reserve forest in Pabbi hills on the left bank of UJC at the project site. This forest will remain un-affected by the project operation. It will not be disrupted. Steps have been taken during project planning to preserve six banyan trees (*Ficus bengalensis*) growing in close proximity to the project site.

7.8.8 Effect on Fauna

The construction of the project will pose a minor hazard to reptiles, in case they are inhabiting the site. These will, however, survive by shifting to nearby vegetation or land areas.

7.8.9 Social and Cultural Resources – Overall Effects of the Project

Generally the negative effects of the project on the local population will be insignificant. However, there will be positive effects of the project on those who live and work in the surrounding villages. The contribution such a project will make to the energy sector should be a welcome development in the sustainable use of natural resources. The project will have substantial social, occupational and economic effects on the local population. In one degree or another, socio-economic effects will occur in the construction phase, the early operational phase and in the longer term period of the project. Some effects will be evident immediately, some will take time to alter current social and economic conditions, while still others are probably as yet unforeseen.

The project region is not in any way thickly populated area. The infrastructure facilities are not developed. However, the completion of the project may promote more rapid population growth and new work opportunities.

7.8.10 Cultural Resources

There are no cultural resources like shrines or archaeological sites which will be affected directly or indirectly by the project components.

7.8.11 Resettlement

There will be no danger of any human habitations or dwellings having to be taken over or done away with for the project. As a result, no resettlement issues are involved.

7.8.12 Impact Assessment Matrix

Table 7.5 is a project impact matrix for both construction and operation phases of the project.

7.9 MITIGATION MEASURES

The purpose of a mitigation programme and monitoring plan is to manage environmental effects in a manner that minimizes adverse impacts, maximizes secondary benefits and ensures monitoring of parameters that directly affect the environment in terms of land resources, biological resources and socio-economic aspects for remedial action. This is achieved through modification of project incorporating changes in its planning, design, construction or operation.

It is generally acknowledged that some environmental effects are difficult to identify and evaluate prior to project construction or operation. Even effects that have been mitigated may be misjudged, or the success of the mitigation measure may not be upto expectations. Thus, a general environmental monitoring programme should always be considered, as a back-up to environmental assessment and mitigation.

7.9.1 Resettlement

As there are no human settlements at the project site. As such no resettlement problems/issues requiring mitigation are involved.

7.9.2 Spoil Disposal

The major components of the project requiring excavation are power channel, powerhouse complex, tailrace channel feeder channel. All of this earthwork is proposed to be spread on the land area lying between the Gujrat Branch and power channel / tail race channel. This will involve excavation of about 5 million cu.ft. of earthwork.

7.9.3 Construction Materials

The main considerations will be to utilize the local materials available in the surrounding area of the proposed project site. Coarse aggregate (gravel or crushed stone) and fine aggregate (medium to coarse sand) will be obtained from the deposits from banks of rivers Jhelum, Kohan and Bunha flowing in the region. There are 8 stone crushers already working in the Malot area. Cement and reinforcement steel is readily available in local market.

7.9.4 Cultural Properties

Cultural properties include shrines, graveyards, archaeological monuments and historical buildings. However, there are no cultural properties threatened by the construction of the project and as such no preservation and salvage measures are called for.

7.9.5 Employment

The construction period of the project will provide the region with important benefits, particularly in employment on a priority basis to local population. It should also be key part of the monitoring programme. It provides the means to create a positive interest in the project, helping to counter any opposition that may emerge. An important part of this commitment will be to hire local people for its permanent cadre to help staff in the operating and maintenance for the project. This would include jobs for malis, chowkidars, drivers and office assistants as well as openings for skilled and professional cadres.

7.9.6 Public Safety and Convenience

The aspects of public safety and convenience during construction have been discussed earlier with regard to protection of the site, protection from injuries, control of dust fumes and noise. The aspects of public health have also been discussed where emphasis has been laid on adopting efficient management and engineering practices by contractors and supervisory engineers to minimize the construction related hazards. Specific clauses would be included in the contract documents to impose requirements related to public safety and convenience.

7.10 MONITORING PROGRAMME

The monitoring programme is always a basis of information in identifying environmental and socio-economic impacts for use in informed decision-making. During the study socio-environmental issues as well as mitigation measures during planning phase have been identified. Some area, however, will require monitoring during construction and operation of the project. it, therefore, becomes necessary to include a monitoring programme as part of the project. The land resources would require monitoring. In particular landscaping of the area to be used for spoil disposal would require monitoring during project construction and project operation phase. Water resources monitoring will include both surface water and ground water. This will involve both quantitative and qualitative aspects of water resources.

Development projects bring social change in their wake. Much of this is beneficial, particularly that which promotes economic and social development. But there is always another side to development: of wage earners, families, or skill groups left behind by new methods of production, of micro-economics destroyed by new technologies, or the disintegration of village communities by population growth and a capitalizing economy. Some of this can be foreseen in a general way. Much of it would occur, even in the project area, whether or not Project is built. It seems clear that longer a project is in place, the more difficult it becomes to separate the social effects of that project from the wider processes of social change already at work in a region. Monitoring of social impacts may therefore be of value for similar project in future.

7.11 CONCLUSIONS

The Khokhra Hydropower Project is seen to be environment friendly. It has minimal environmental impacts. Environmental considerations have formed an integral part of the evaluation of layout and design alternatives with the result that almost all of the potential effects of the project have been mitigated. Aspects requiring further attention during the construction and operation phases of the project have been identified. A monitoring programme to ensure the effectiveness of the mitigation measures has been proposed. Project impacts, mitigation and monitoring have been shown in Table 7.6.

TABLES

Table 7.4: Environmental Parameters for Analysis of Khokhra Hydel Power Station, Gujrat

Environment / Project Interaction	Land	Environmental Resources												Socio-Economic															
		Physical Resources							Ecological Resources					Human Use Value										Quality of Life Values					
		Surface Water Hydrology	Surface Water Quality	Groundwater Hydrology	Groundwater Quality	Soils	Geology / Seismology	Erosion / Sedimentation	Climate	Fisheries	Aquatic Biology	Terrestrial Wildlife	Forests	Agriculture / Irrigation	Aquaculture	Water Supply	Recreation	Power	Flood Control	Dedicated Area Uses	Industry	Agro-Industry	Land Use	Socio-Economic	Resettlement	Culture / Historical	Aesthetic	Archaeological	Public Health
A	2	2	--	--	--	1	2	--	--	--	--	1	--	1	--	--	--	(3)	--	--	2	3	(3)	(2)	--	1	1	--	1
B	--	--	--	1	--	1	3	--	--	--	--	--	--	1	--	--	--	(2)	--	--	--	--	1	--	--	--	--	--	--

Notes:
(a) (A) means significant impact of project on environmental resources, whereas (B) means impact of the environment on the project.
(b) Number value of 3 means probable major impact, 2 means intermediate and 1 means significant but relatively minor
(c) Number in parentheses indicate effects are mostly enhancement of environment.
Numbers in double parentheses represent combination of adverse and beneficial effects
Numbers without parentheses represent either adverse or beneficial effects.

Table 7.5: Impact Matrix for Analysis of Khokhra Hydel Power Station, Gujrat

ENVIRONMENTAL COMPONENTS	PHYSICAL ENVIRONMENT										BIOLOGICAL ENVIRONMENT										SOCIO-ECONOMIC ENVIRONMENT									
PROJECT COMPONENTS	Land/Agri.Land	Soils (Erosion/Stability)	Housing/Infrastructure	Energy Resources	Surface Water Quantity	Surface Water Quality	Groundwater Quantity	Groundwater Quality	Air Quality	Noise	Aquatic Ecosystem	Wetland Ecosystem	Terrestrial Ecosystem	Endangered Species	Migratory Species	Beneficial Plants	Beneficial Animals	Pest Plants	Pest Animals	Disease Vectors	Public Health	Resource/Land Use	Communication System	Employment	At-Risk Population/Safety	Population Disruption	Community Stability	Cultural and Religious Values	Recreation/Tourism	Nutrition
CONSTRUCTION PHASE																														
Power Channel, Tailrace Channel and Feeder Channel	O	LA	O	NA	O	O	O	O	LA	LA	NA	NA	LA	O	O	O	LA	O	O	O	LA	LA	LA	HB	O	O	LA	O	O	O
Intake Structure	O	LA	LB	O	LB	LA	O	O	NA	LA	LA	NA	NA	NA	LB	NA	NA	O	O	O	NA	LB	LA	HB	NA	NA	NA	NA	LB	NA
	O	LA	O	NA	LA	O	LB	LB	NA	LA	NA	NA	LB	O	LB	O	O	NA	NA	O	LA	LA	O	LB	LA	O	O	O	O	O
Construction Camp	O	O	O	NA	O	O	O	O	O	O	NA	NA	LA	O	O	O	O	O	O	O	O	LA	O	HB	O	O	MA	LA	O	O
	LA	O	O	O	O	O	O	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	LA	O	HB	O	O	O	O	O	O
Overall	MA	MA	LA	O	O	LA	O	O	LA	LA	NA	NA	LA	O	O	O	LA	O	O	O	LA	MA	LA	HB	MA	MA	LA	LA	O	O
Power Complex	O	LA	O	NA	O	O	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	LA	LA	O	HB	O	O	O	O	O	O
OPERATIONAL PHASE																														
Power Channel, Tailrace Channel and Feeder Channel	O	O	O	O	O	O	LB	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	O	O	MB	O	O	O	O	LB	O
Overall	LB	LB	O	O	O	O	LB	O	O	O	NA	NA	MB	O	O	LB	O	O	O	O	O	HB	HB	HB	O	O	MB	O	LB	HB
Power Complex	O	O	O	HB	O	O	O	O	O	O	O	NA	O	O	O	O	O	O	O	O	O	O	O	HB	O	O	O	O	O	O
Overall	O	O	O	HB	LB	O	LB	O	O	O	LB	NA	O	O	O	O	LB	O	O	O	O	O	O	HB	O	O	O	O	O	MB
Project Overall	MB	LB	O	HB	O	O	LB	O	O	O	LB	O	LB	O	LB	LB	LB	O	O	O	O	MB	MB	MB	LA	O	LA	LA	O	O

NA: Not Applicable
HA: High Adverse
MA: Medium Adverse
LA: Low Adverse
O: None or Insignificant
LB: Low Beneficial
MB: Medium Beneficial
HB: High Beneficial

Table 7.6 Khokhra Hydropower Project Impacts, Mitigation and Monitoring

RESOURCE	PROJECT COMPONENT	IMPACTS	MITIGATION	MONITORING
Land Resources	Power Channel, Tailrace Channel, Feeder Channel and Power House Complex	Land taking about 25 acres and conversion to project components	Land about 5 acres belongs to government, about 20 acres subject to acquisition at Rs.0.15	Monitoring of land filling and later for land scaping
Water Resources	Upper Jhelum Canal, Gujrat Branch Canal and Chillianwala Distributary Power Channel, Tailrace Channel, Feeder Channel and Power House Complex	No change in quantity of flow and no change in flow pattern except for shifting of inlet of Chillianwala Distributary	No mitigation measures needed	Monitoring of discharges in all the canals/channels
		In the longer term potential of environmental pollution due to population growth in the area	Estimation of and mitigation for environmental pollution according to NEQS	
		Future population growth may result in ground water exploitation for community water supply and sewerage services in the area		Monitoring of canal water quality at site necessary in accordance with NEQS (National Environmental Quality Standards)
Biological Resources	Power Channel, Tailrace Channel, Feeder Channel and Power House Complex	No significant biological impacts	Project planning has taken care so that six bayan trees (Ficus benghalensis) growing close to project site are preserved	--
Social / Cultural Resources	Power Channel, Tailrace Channel, Feeder Channel and Power House Complex	In the longer term possible population growth in project area can result in stressing community services and facilities	Planning assistance for local administration	Project authority and local community to meet periodically

FIGURES

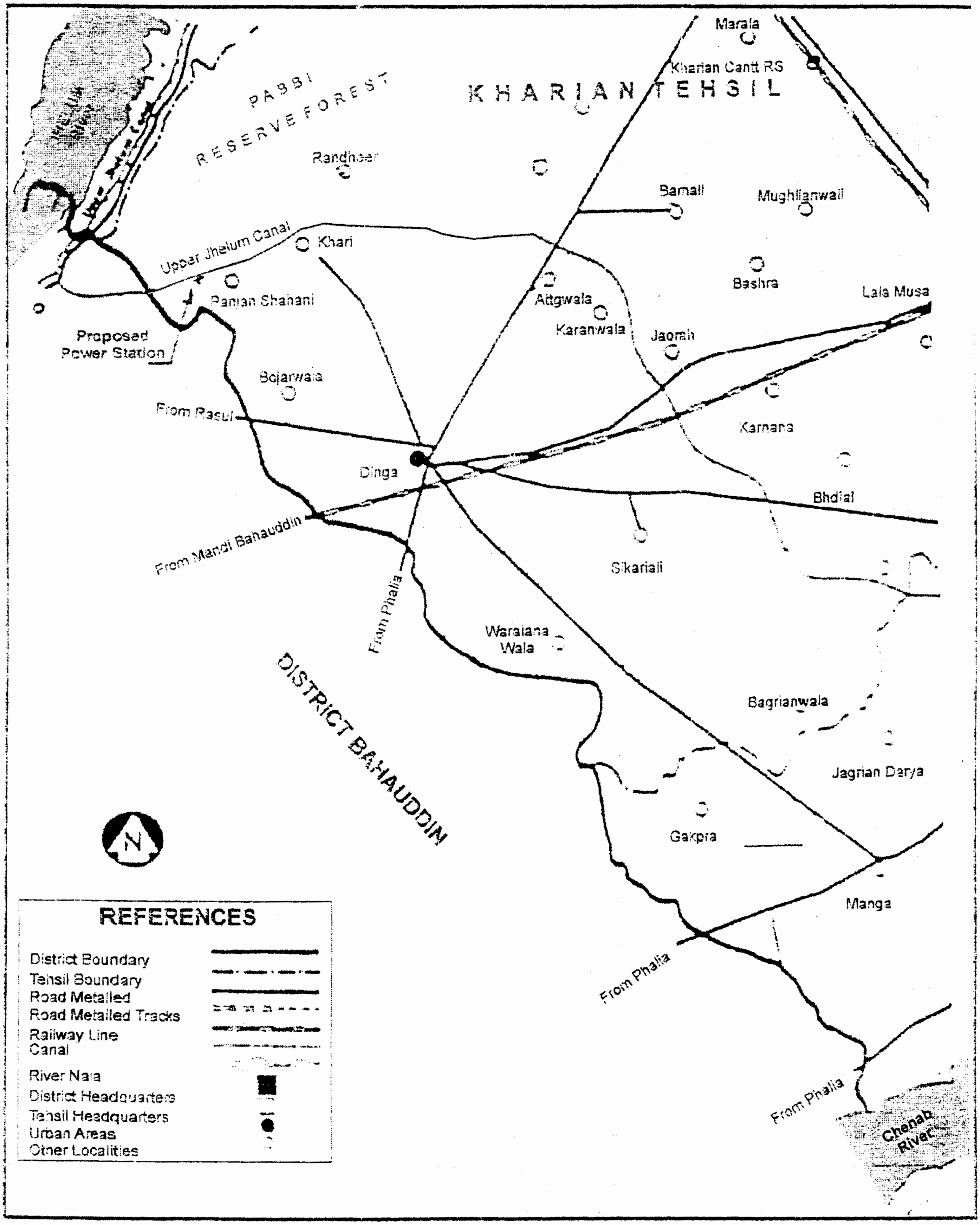


Figure 7.1 : Location of Khokhra Hydel Power Station

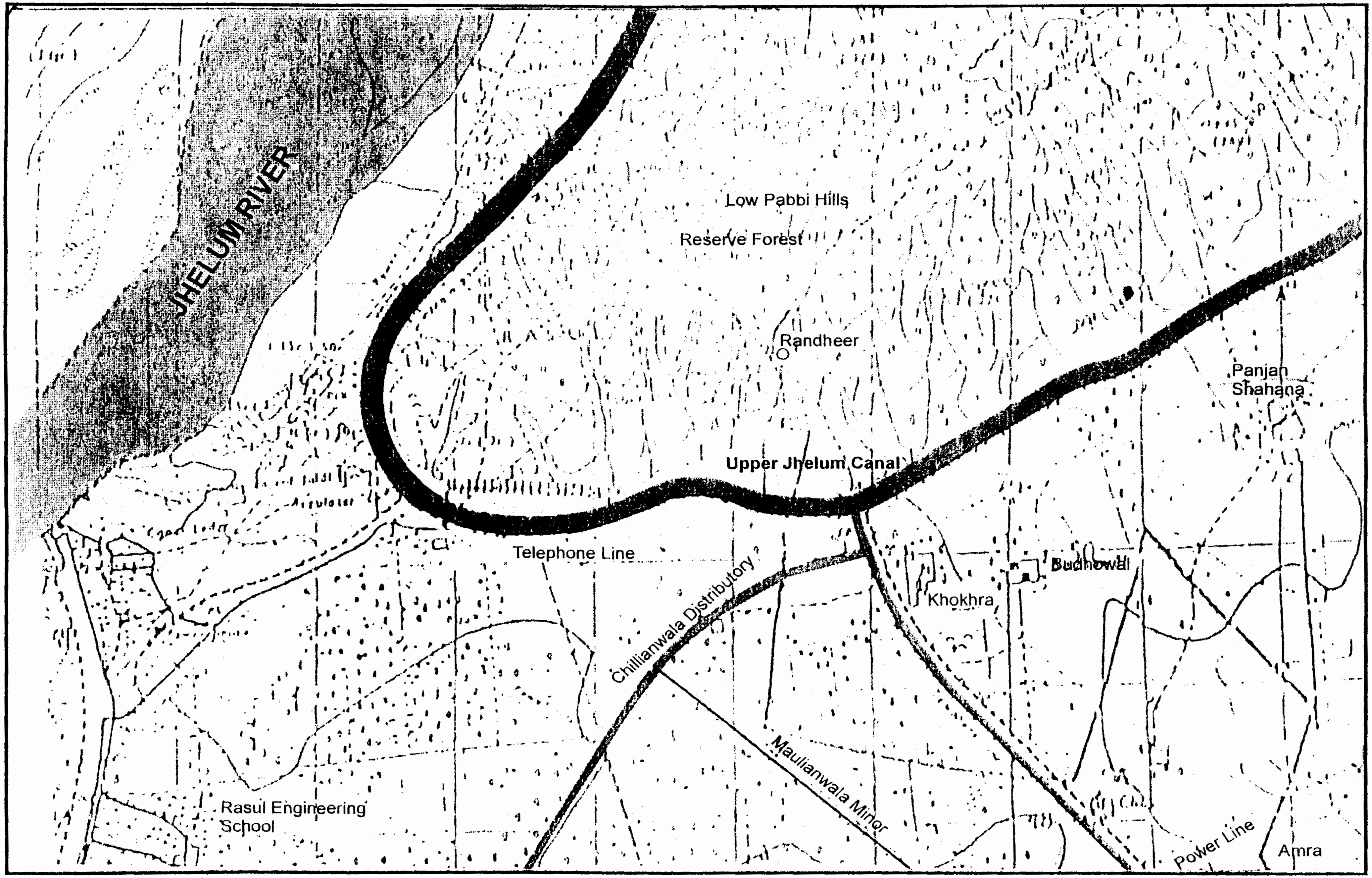


Figure 7.2 : UJC Alignment In and Around Project area showing villages, Farmland, Reserve Forest (RF)

CHAPTER 8

Construction Planning & Scheduling

CHAPTER – 8

CONSTRUCTION PLANNING & SCHEDULING

8.1 GENERAL

The project area is bounded by UJC on North and by Gujrat Branch canal on East. Head race and power house are at a distance of 500ft from right bank of Gujrat Branch canal. Tail race ultimately joins the Gujrat Branch at R.D 2+150.Water for Chillianwala distributary shall be diverted from Head Race of the proposed project.

8.2 CONSTRUCTION PLANNING

The project area is spread in a length of about 2500 ft while width of the area varies from 800 ft to 120 ft from UJC to junction of tail race with Gujrat branch. While planning the construction of the project, the following consideration have been given top priority. To ensure that there is

i) No interference with irrigation supply

ii) No damage to right bank of UJC and Gujrat Branch canal.

iii) Regular supply to Gujrat branch and Chillianwala distributary during construction of the project as well as after construction of the project.

For location of different components of the project please refer drawing 8.1 attached at the end of chapter.

8.3 SEQUENCE OF CONSTRUCTION

From Project Layout Drawing, it is evident that the construction work on all the project components can be started simultaneously. However the following precautions are recommended.

i) The 50 ft portion between UJC, and Intake Structure of Head race designated as Plug.1 (P-1), will be excavated at the last stage of project completion

ii) The portions shown as Plug-2(P-2), Plug-3 and Plug-4(P-4) shall also be excavated at the last stage.

8.3.1 Power House

The excavation of power house shall be taken up first of all. The depth of pit of power house is about 40 ft. Excavation shall be carried out by giving proper slopes to the excavated pit and providing berms to avoid any land sliding.

The water depth is at about 18 ft from G.L. At EL. 758 ft an area of 100 ft x 100 ft shall be excavated. At this stage the dewatering system shall be installed. Calculation of inflow of water comes out as 1.8 ft^3 / sec. Therefore 8 tube wells each with minimum capacity of 0.5 Cusecs shall be installed. The tube wells will be required to lower the water water table by at least 20 ft.

The underground water shall be got tested. If found clean it shall be released in to existing Chillianwala distributary. The dewatering system has been planned on the basis of following data:-

Co-efficient of permeability (K)	=	$1.6x10^{-4}$ ft/sec
Total discharge	=	1.80 Cusecs
No of tube wells of 0.25 Cusecs capacity	=	8 Nos
Ground Level	=	E 778 ft
Water Table Level	=	E 758.0 ft
Depth of Ground to be dewatered	=	E 738 ft (20 Ft)

The El. Of 738 ft shall be kept dry till the foundation structure is above EL758 ft. As soon as dewatering system is in operation, further excavation shall be carried out. The excavation shall be completed down to EL. 738. As soon as excavation is completed. The lowest portion of turbine foundation shall be concreted. Before concreting the next stage, steel penstocks will be placed in position and concreting up to El. 758.55 shall be completed. Care shall be taken to fix all embedded parts of Generator, turbine, in position.

After completion up to El. 758, the Intake portion of power house shall be constructed. Simultaneously the superstructure of power house shall be constructed. The whole activity for construction of civil works of power house shall be completed from months 3 to 16 as detailed in construction schedule.

8.3.2 Intake Structure for Head Race

The Intake structure for head race is proposed on right side of UJC about 50 ft away from edge of the bank. The excavation shall be carried out down to El. 773.72. Two cut off walls one 10 ft deep and other 6' deep shall be constructed. After completion of cut off walls the foundation shall be concerted. After foundation, the central pier and Wing walls shall be construction. Care shall be taken to provide and install the embedded parts for trashrack and stop log. Next step would be to construct the road bridge on Intake Structure of Headrace.

This activity of construction of item 8.3.2 shall take about 9 months i.e months 5 to 13 as detailed in construction schedule. However the excavation of Plug 1 and pitching in bed and side slopes shall take about 60 days i.e months 21 & 22 during canal closure.

8.3.3 Head Race

Head race has the following feature

Bed width	=	37'
Side slopes	=	1.5 H: 1 V
Full supply depth	=	8'-9"
Free board	=	3'

The Head race (power Channel) is partly in cut and partly in fill. The volume of cut is 130,000 Cft, while volume of fill is 110,000 Cft. The construction of head race can be started simultaneously along with other components of the project. Excavation and filling is anticipated to consume 4 months, while 3 months are required for brick lining in the bed and side slopes. The work will start from 7th month and completed by the end of 13th month.

8.3.4 Tail Race

Water after generating power shall pass through tail race and ultimately will convey the water to Gujrat Branch at R.D 2+150. The length of tail race is 1600 ft, the bed width 60' full supply level depth is 5' – 5" while free board is 3'. The total excavation is about 4,300,000 Cft. The expected time for completion of tail race is about 1 year, while 3 more months would be required for brick lining. The activity shall be started from 3rd month and completed by the end of 17th month.

8.3.5 Chillianwala Distributary

The length of diverted portion of Chillianwala Distributary is nearly 1,000 ft. The bed width is 9'-2". Side slopes are 1.5 H: 1 V F.S.D = 2'-11" while free board is 2'. The total excavation is 380,000 Cft. The excavation of canal and bricklining shall take about 6 months. The activity shall start from 13th month and completed by end of 18th month.

8.3.6 Disposal of Surplus Excavated Material

The total excavated material is as under:-

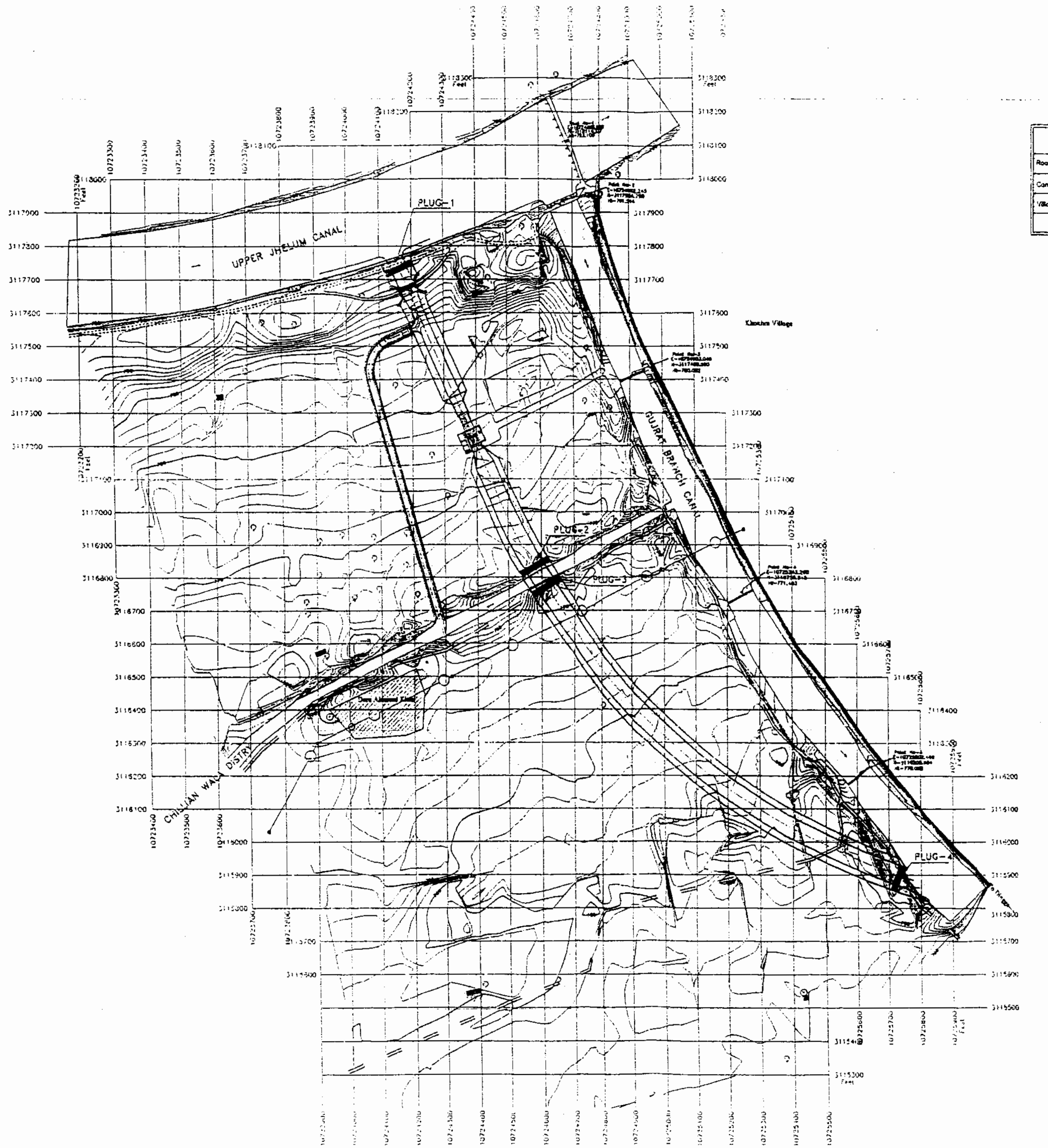
1)	Power House	617,000 Cft
2)	Power Channel	130,000 Cft
3)	Tail race	4313,000 Cft
4)	Chillianwala Distributary	380,000 Cft
	Total	**5,440,000 Cft**

Out of the above 10% excavated material shall be used for backfilling of structure	544,000 Cft
10% excavated material to be dumped on both ends of tail race	544,000 Cft
Fill material for head race	110,000 Cft
The fill between right bank of Gujrat Branch and left side of Head race and tail race	2,687,500 Cft
Backfill of Chillianwala Distributary 700 ft length	380,000 Cft
Total disposed	**4,265,500 Cft**

The remaining 1 174 500 Cft shall be disposed on the direction of Engineer in consultation with client.

8.3.7 Erection of E & M Equipment

The equipment shall reach the site before 15 months of schedule. The Gantry Crane shall be installed by the end of 18th month. Turbine, generator and transformer shall be installed by the end of 22 months. The transmission line shall also be completed by end of 22 months. Trial run shall be started and completed during 23 months. Defects if any shall be removed by end of 24 months. Commercial operation shall start from the 25th month.



LEGEND

Road, Track, Bridge	
Canal, Tw, Contours, Tree	
Village, Building, Power Line	

Contour interval = 1 Ft

0 300 600

S.NO.	DATE	DESCRIPTIONS

IRRIGATION AND POWER DEPARTMENT OF THE PU

KHOKHRA HYDEL PROJECT

CONSTRUCTION PLANNING

PAKISTAN ENGINEERING SERVICES (PVT.) LTD.
AND
BARQAAB CONSULTANTS (PVT.) LTD.

DRAWN:	AKRAM RAFI	DATE: OCT 2004
DESIGNED:	MUJUM AMIN	FIGURE NO. 8.1
CHECKED:	RIASAT ALI	
APPROVED:	JAMIL ANWER	

KHOKHRA HYDRO POWER PROJECT
CONSTRUCTION SCHEDULE - 8.2

Sr.#	COMPONENTS	Months																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.0	MOBILIZATION	■	■																												
2.0	POWERHOUSE (Civil Wroks)			■	■	■	■	■	■	■	■	■	■	■	■	■	■														
2.1	Excavation 1st Stage			■	■																										
2.2	Installation of Dewatering System					■																									
2.3	Excavation 2nd Stage						■	■																							
2.4	Concreting Foundation								■	■																					
2.5	Placing of Penstock and Draft Tube										■	■																			
2.6	Concreting upto EL 758.55												■	■																	
2.7	Construction of Superstructure														■	■	■														
3.0	E & M EQUIPMENT										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
3.1	Erection of Main Crane																	■	■												
3.2	Erection of Turbine, Generator and Transformer																		■	■	■	■	■								
3.3	Completion of Transmission System										■	■	■	■	■	■	■	■	■	■	■	■	■								
3.4	Trial Run																							■							
3.5	Removal of defects																								■						
3.6	Commercial Operation																														
4.0	INTAKE STRUCTURE FOR HEADRACE					■	■	■	■	■	■	■	■	■																	

KHOKHRA HYDRO POWER PROJECT
CONSTRUCTION SCHEDULE - 8.2

Sr.#	COMPONENTS	Months																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4.1	Excavation					▬	▬																								
4.2	R.C.C. Cut-Off Walls							▬	▬																						
4.3	Foundation Concreting									▬	▬																				
4.4	Super Structure Including Bridge											▬	▬	▬																	
4.5	Excavation for Joining UJC with Intake including Pitching during closure period of UJC																					▬	▬								
5.0	HEAD RACE (Power Channel)							▬	▬	▬	▬	▬	▬	▬																	
5.1	Excavation							▬	▬																						
5.2	Embankments including Compaction									▬	▬																				
5.3	Brick Lining - Bed and Side Slopes											▬	▬	▬																	
6.0	TAIL RACE			▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬													
6.1	Excavation			▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬																
6.2	Brick Lining															▬	▬	▬													
6.3	Removal of Plug-4																						▬								
7.0	CHILLIAN WALA DISTRIBUTARY													▬	▬	▬	▬	▬	▬												
7.1	Excavation													▬	▬	▬	▬														
7.2	Brick Lining																	▬	▬												
7.3	Removal of Plug 2 and 3																						▬								

CHAPTER 9

Project Cost Estimate

CHAPTER - 9

PROJECT COST ESTIMATE

9.1 GENERAL

The sponsors i.e. M/S Blue Star Energy Private Limited hereby undertake that they shall opt for unconditional acceptance of Upfront Tariff announced by NEPRA on 14th October 2015 for Small Hydro Power Generation Projects upto 25 MW installed capacity.

The project is expected to be based on 100% local financing. As such the cost for 2.809 MW Khokhra Hydropower Project, as determined by NEPRA, comes out to be 11.815 million USD with a conversion rate of 1 US $ = 101.95 PKR.

The reference upfront tariff for Low Head Hydro Power Projects (1 to 25 MW) based on 100% Local Financing and 100% Foreign Financing is shown in Annexures I and III respectively.

Similarly, the debt servicing schedule based on 100% Local Financing and 100% Foreign Financing for the purpose of indexation of Debt component of such Tariff is shown in Annexures II and IV respectively.