THE ISLAMIC REPUBLIC OF IRAN
MINISTRY OF AGRICULTURE

# THE FEASIBILITY STUDY
# ON
# THE IRRIGATION AND DRAINAGE DEVELOPMENT PROJECT
# IN
# THE HARAZ RIVER BASIN

# APPENDIXES (A,B)

JULY 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

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## A. 1. 1 Meteorological Observation Network and Data

### 1. Meteorological Observation Network

In the Haraz Plain and its adjacent area, meteorological observation is proceeded by the Iranian Meteorological Organization (IMO) and the Ministry of Energy (MOE). The meteorological observation network is shown in Figure A. 1. 1 - 1.

### 2. Data Used for the Study

For the study, following data were collected and analyzed.

**Collected Data**

| Station | Location | | | Start of Observation | Collected Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Location Latitude | Altitude Longitude | Altitude (PGD, m) | | P | T | R.H. | W.S | S.H. | C.N. |
| Babolsar | 36° 43' | 52° 39' | -21 | 1951- | 51-90 | 51-76 | 51-76 | 51-75 | 59-76 | 51-75 |
| Babol | 36° 33' | 52° 41' | 2 | 1958- | 58-76 | 58-76 | 58--76 | | | |
| Amol Rice Station | 36° 28' | 52° 23' | 29 | 1964- | 64-84[1/] | 64-84[1/] | 64--84 | | | |
| Karehsang | 36° 19' | 52° 22' | 500 | 1951-79 | 54-90 | 56-76 | 57--76 | | | |
| Shirgah | 36° 17' | 52° 54' | 223 | 1964- | 64-76 | 63-76[2/] | 63-76[2] | | | |
| Qarantalar | 36° 20' | 52° 47' | 90 | 1951- | | | | | | |
| Mahmud Abad | 36° 37' | 52° 16' | -23 | 1966- | 66-90 | | | | | |
| Sorkh Rud | 36° 40' | 52° 27' | -23 | 1976- | 76-84 | | | | | |
| Charmestan | | | | 1971- | 71-90 | | | | | |
| Miandasht Babolsar | 36° 42' | 52° 39' | -21 | 1966- | 66-82 | | | | | |
| Diva | | | | 1981- | 81-90 | | | | | |

Note: P : Precipitation T : Temperature, P.H. : Relative Humidity
W.S. : Wind Speed S.H. : Sunshine Hours C.N. : Cloudiness

1/ : 1977 not informed 2/ : Observed from December in 1963

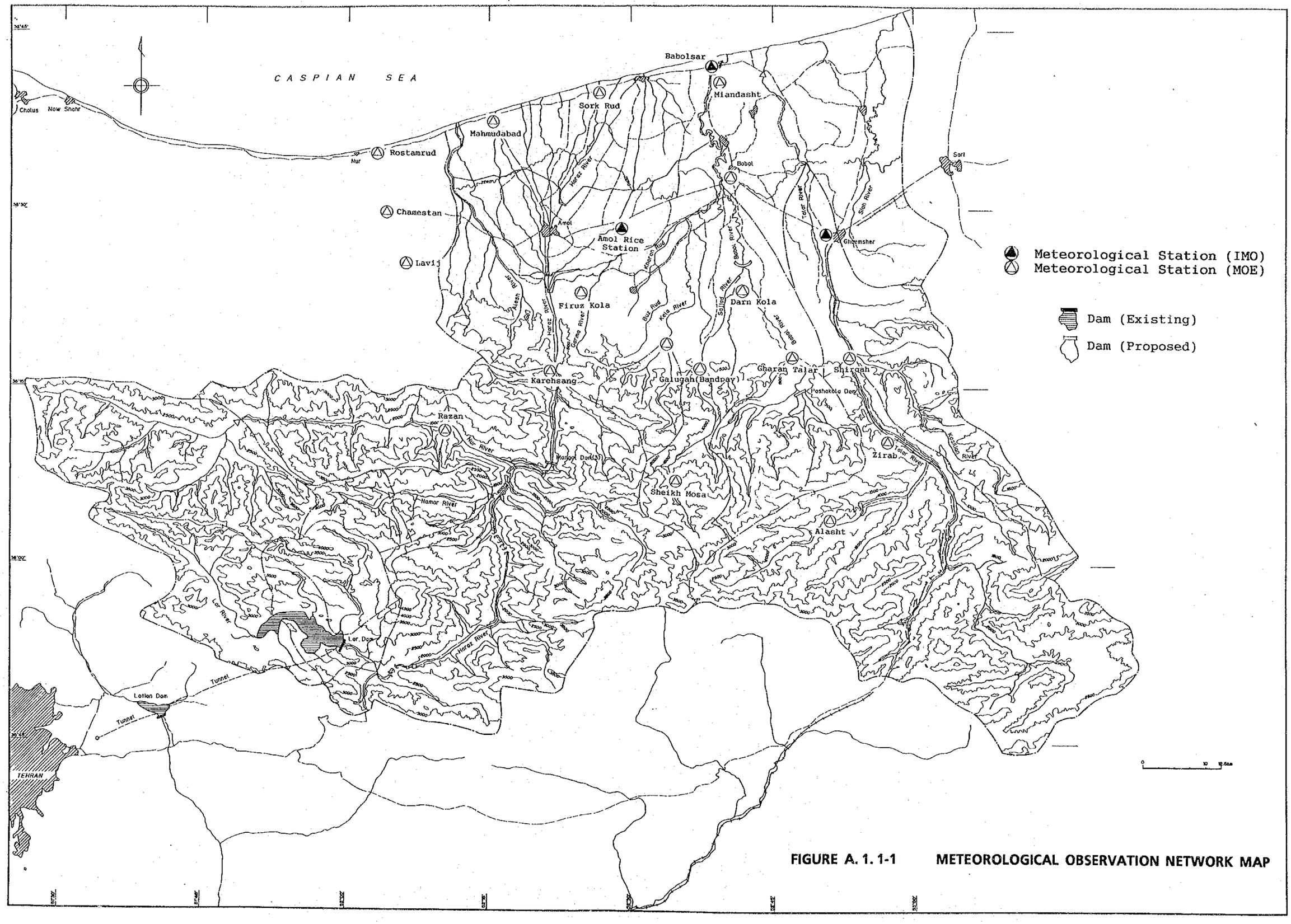



**FIGURE A. 1. 1-1 METEOROLOGICAL OBSERVATION NETWORK MAP**

## A. 1. 2 Precipitation

### 1. Monthly and Annual Precipitation

(1) General

Monthly and annual precipitation in this region is as follows;

**Monthly and Annual Precipitation in the Region**

(Unit : mm)

| Station | Dey Jan | Bah Feb | Esf Mar | Far Apr | Ord May | Kho Jun | Tir Jul | Mor Aug | Sha Sep | Meh Oct | Aba Nov | Aza Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Babolsar | 88.5 | 66.9 | 70.3 | 31.8 | 19.4 | 22.7 | 30.2 | 56.1 | 84.8 | 153.2 | 123.3 | 122.0 | 869.2 |
| Miandasht | 87.3 | 82.2 | 63.8 | 40.2 | 20.7 | 16.7 | 28.0 | 48.3 | 74.5 | 126.5 | 110.7 | 104.7 | 803.6 |
| Sorkh Rud | 148.5 | 132.1 | 104.2 | 51.4 | 36.1 | 31.0 | 40.1 | 65.2 | 118.7 | 157.4 | 171.0 | 157.1 | 1,212.8 |
| Mahmudabad | 115.1 | 98.8 | 69.9 | 43.6 | 24.8 | 28.1 | 32.7 | 57.8 | 109.3 | 157.7 | 139.5 | 138.1 | 1,015.4 |
| Amol | 70.5 | 64.5 | 63.8 | 46.4 | 33.9 | 32.5 | 34.1 | 48.2 | 58.9 | 98.7 | 81.7 | 91.4 | 724.6 |
| Babol | 64.0 | 57.0 | 62.8 | 42.4 | 29.8 | 37.2 | 29.0 | 34.3 | 54.2 | 83.0 | 89.7 | 83.0 | 666.4 |
| Chamestan | 58.5 | 62.8 | 64.3 | 48.4 | 45.1 | 33.2 | 54.5 | 47.1 | 63.9 | 129.8 | 81.5 | 82.1 | 771.2 |
| Diva | 71.6 | 69.7 | 90.2 | 46.5 | 61.3 | 41.4 | 52.8 | 97.7 | 87.8 | 134.3 | 69.6 | 73.9 | 896.8 |
| Karehsang | 63.8 | 75.3 | 87.4 | 75.7 | 63.0 | 56.9 | 59.9 | 54.7 | 92.9 | 120.0 | 88.1 | 71.1 | 908.8 |
| Project Area | 78.4 | 65.5 | 66.6 | 40.0 | 27.5 | 28.2 | 32.4 | 51.6 | 70.3 | 122.6 | 100.0 | 104.8 | 787.9 |

(Note) Representative precipitation of the project is estimated by weighed average, as below:
Amol : 0.562
Babolsar : 0.438

Monthly records of the precipitation at Amol and Babolsar are shown in Table A1. 2 - 1 and 2, respectively. Records of other stations are described in the DATABOOK - I. As shown in above Table, the precipitation is higher at the coastal range, and slightly lower as going to the upper range of the Project Area, and slightly higher at the foot of the Alborz.

Mean annual precipitation of the Project Area is estimated at 788 mm by the weighed average of data Amol and Babolsar. Monthly weighed precipitation of the Project Area is presented in Table A. 1. 2 - 3.

(2) Interpolation of the Monthly Precipitation of Amol

Since the data period of Amol is only 20 years as shown in Table A. 1. 2 - 4, precipitation of Amol has been interpolated using linear correlation by the

precipitation of Babolsar for deriving the precipitation of the Project Area. Interpolated precipitation of Amol is presented Table A. 1. 2 - 1.

Correlation equation used for interpolation is as follows;

$Pa = 0.461 * Pb + 27.0$

where;

Pa : Monthly precipitation at Amol (mm)
Pb : Monthly precipitation at Babolsar (mm)
r : Correlation coefficient = 0.600
Data number used for analysis = 218

(3) Statistic Analysis of Precipitation of the Project Area

Statistic analysis has been conducted using log-normal distribution both for annual and seasonal precipitations. Seasonal precipitation is selected for the period of irrigation from April to August. The results are as follows;

Probable Precipitation

(Unit : mm)

| | Exceedance | | | Non-Exceedance | | | |
|---|---|---|---|---|---|---|---|
| | 1/20 | 1/10 | 1/5 | 1/2 | 1/5 | 1/5 | 1/20-yr |
| Annual | 1001 | 980 | 886 | 779 | 685 | 641 | 620 |
| Irrigation Period (Apr - Aug) | 369 | 338 | 303 | 244 | 194 | 170 | 153 |

From above result, the year-1990 is selected as a representative drought year taking the amount of 170 mm for 1/10-year in irrigation period into consideration.

## 2. Daily Rainfall

(1) Probable Daily Rainfall

Consecutive daily rainfall for 1-day to 5-day has been analyzed both annually and seasonally at 8 stations, and probable daily rainfalls are derived for different seasons and for different consecutive days. (see Table A. 1. 2 - 5)

(2) Procedure of Analysis

Since the daily rainfall data of Babolsar were given as the monthly maximum basis (25-statistic data), it is not possible to derive the consecutive rainfall. Therefore, consecutive rainfall has been derived referring to the consecutive rainfalls at other stations. Procedure of analysis is as follows;

1. Selection of annual and monthly maximum daily rainfall at each station. (see DATABOOK-I)
2. Probability analysis on annual and seasonal maximum daily rainfall at each station. (see Table A. 1. 2 - 6)
3. Selection of similar station to Babolsar on its probable value, and Mahmudabad has been selected. (see Table A. 1. 2 - 5)

Similarity is as follows;

Probable Annual Maximum Daily Rainfall

(Unit : mm)

| | Probability of Exceedance | | | | | |
|---|---|---|---|---|---|---|
| | 1/2 | 1/5 | 1/10 | 1/15 | 1/20 | 1/25-yr |
| Babolsar | 71 | 102 | 128 | 144 | 156 | 166 |
| Mahmudabad | 71 | 102 | 128 | 138 | 148 | 157 |

4. Deriving the probable daily and consecutive rainfall using the ratio to 1-day rainfalls at Mahmudabad (Table A. 1. 2 - 5)

## 3. Rainfall Intensity of Short Duration

Rainfall intensity of short duration is one of essential factors for studying the floods. Rainfall intensity was studied on Babolsar Station by the HWDP-1 Study. As seeing in the Figure A. 1. 2 - 2, the intensity curve is likely linear on the log-log sheet, so that the intensity curve can be presented by Sherman Type Intensity Equation. Sherman Type Equation is as follows;

$$I = a/t^c$$

Where;

I : Rainfall intensity for t hours (mm/hr)

t : Time duration (hr)

a,c : Constants

For 1/25-year $I_{25} = 61.7/t^{0.665}$

For 1/10-year $I_{10} = 47.8/t^{0.670}$

Above equations give similar values which are obtained in Table A. 1. 2 - 5, as below;

For 1/25-year $I_{25} = 61.7/24^{0.665} = 7.33$ mm/hr = 176 mm/day : 166 mm

For 1/10-year $I_{25} = 47.8/24^{0.670} = 5.70$ mm/hr = 137 mm/day : 128 mm

## TABLE A. 1. 2 - 1 MONTHLY PRECIPITATION AT AMOL RICE STATION

## (INTERPOLATED BY BABOLSAR STATION)

(Unit : mm)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total | Apr-Aug | (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1951 | 61.0 | 63.9 | 48.4 | 29.4 | 37.6 | 36.0 | 28.0 | 39.6 | 82.1 | 139.3 | 53.2 | 67.6 | 686.1 | 170.6 | 24.9 |
| 1952 | 48.9 | 61.8 | 77.2 | 59.4 | 41.3 | 38.2 | 40.6 | 50.1 | 42.7 | 38.1 | 62.1 | 59.5 | 619.9 | 229.6 | 37.0 |
| 1953 | 53.0 | 35.8 | 84.8 | 45.5 | 47.4 | 29.3 | 56.3 | 29.5 | 121.0 | 87.9 | 84.4 | 81.4 | 756.3 | 208.0 | 27.5 |
| 1954 | 60.7 | 62.1 | 48.0 | 42.8 | 37.2 | 27.0 | 71.8 | 30.2 | 73.6 | 37.1 | 117.0 | 58.3 | 665.8 | 209.0 | 31.4 |
| 1955 | 43.0 | 34.8 | 61.7 | 39.3 | 29.2 | 45.6 | 28.8 | 55.2 | 57.1 | 72.8 | 125.3 | 77.3 | 670.1 | 198.1 | 29.6 |
| 1956 | 46.4 | 97.4 | 70.0 | 42.9 | 31.4 | 27.0 | 51.5 | 31.3 | 89.4 | 49.7 | 72.6 | 100.3 | 709.9 | 184.1 | 25.9 |
| 1957 | 92.6 | 59.6 | 68.9 | 34.2 | 37.5 | 81.8 | 57.9 | 76.1 | 36.2 | 132.8 | 87.9 | 63.4 | 828.9 | 287.5 | 34.7 |
| 1958 | 41.2 | 47.7 | 44.8 | 50.5 | 27.3 | 44.9 | 81.1 | 44.7 | 43.4 | 106.4 | 123.3 | 41.0 | 696.3 | 248.5 | 35.7 |
| 1959 | 97.1 | 96.4 | 49.9 | 36.5 | 46.5 | 31.9 | 30.8 | 56.0 | 69.0 | 119.6 | 90.4 | 91.5 | 815.6 | 201.7 | 24.7 |
| 1960 | 32.1 | 42.5 | 82.0 | 34.8 | 28.2 | 30.1 | 35.6 | 41.8 | 86.0 | 57.6 | 103.6 | 78.2 | 658.5 | 170.5 | 25.9 |
| 1961 | 63.2 | 35.7 | 55.7 | 46.9 | 34.9 | 29.3 | 50.3 | 51.8 | 108.2 | 42.2 | 61.3 | 54.3 | 633.8 | 213.2 | 33.6 |
| 1962 | 85.6 | 47.1 | 43.0 | 44.6 | 30.2 | 73.7 | 28.4 | 53.3 | 42.7 | 102.6 | 45.4 | 52.9 | 649.5 | 230.2 | 35.4 |
| 1963 | 50.2 | 53.2 | 67.7 | 31.4 | 43.7 | 43.2 | 33.2 | 60.5 | 34.7 | 123.6 | 72.9 | 125.1 | 739.4 | 212.0 | 28.7 |
| 1964 | 255.4 | 151.4 | 49.9 | 201.2 | 11.7 | 23.8 | 12.5 | 46.4 | 69.2 | 86.8 | 58.7 | 87.0 | 1054.0 | 295.6 | 28.0 |
| 1965 | 71.2 | 42.7 | 42.1 | 44.2 | 35.4 | 6.0 | 12.9 | 8.4 | 54.0 | 92.1 | 47.6 | 96.6 | 553.2 | 106.9 | 19.3 |
| 1966 | 80.1 | 57.3 | 71.3 | 34.7 | 35.0 | 2.0 | 32.4 | 5.5 | 13.0 | 17.9 | 0.4 | 8.0 | 357.6 | 109.6 | 30.6 |
| 1967 | 73.0 | 41.0 | 62.5 | 65.0 | 17.5 | 55.5 | 3.0 | 33.0 | 69.0 | 110.2 | 66.0 | 82.0 | 677.7 | 174.0 | 25.7 |
| 1968 | 67.0 | 68.6 | 90.0 | 131.0 | 32.0 | 34.4 | 52.4 | 83.0 | 8.0 | 28.0 | 138.0 | 371.0 | 1103.4 | 332.8 | 30.2 |
| 1969 | 81.0 | 61.4 | 119.5 | 95.0 | 33.0 | 38.0 | 42.0 | 47.8 | 140.0 | 243.0 | 117.0 | 46.0 | 1063.7 | 255.8 | 24.0 |
| 1970 | 71.0 | 100.0 | 106.0 | 37.0 | 31.0 | 22.0 | 0.0 | 92.0 | 107.0 | 37.0 | 117.0 | 41.0 | 761.0 | 182.0 | 23.9 |
| 1971 | 58.0 | 59.0 | 60.0 | 47.0 | 27.4 | 28.8 | 0.0 | 0.0 | 36.7 | 97.0 | 63.0 | 87.0 | 563.9 | 103.2 | 18.3 |
| 1972 | 85.0 | 71.0 | 81.0 | 30.0 | 57.0 | 20.0 | 44.0 | 75.0 | 50.0 | 94.0 | 68.0 | 244.5 | 919.5 | 226.0 | 24.6 |
| 1973 | 68.0 | 53.0 | 46.5 | 20.5 | 25.0 | 36.0 | 7.0 | 72.0 | 46.0 | 55.0 | 70.0 | 121.5 | 620.5 | 160.5 | 25.9 |
| 1974 | 70.0 | 70.0 | 31.0 | 46.5 | 0.0 | 33.0 | 138.0 | 16.0 | 56.5 | 15.0 | 36.0 | 46.0 | 558.0 | 233.5 | 41.8 |
| 1975 | 74.0 | 73.0 | 62.0 | 60.0 | 68.0 | 29.0 | 7.4 | 69.8 | 17.1 | 83.0 | 103.6 | 104.7 | 751.6 | 234.2 | 31.2 |
| 1976 | 17.0 | 101.4 | 82.7 | 39.1 | 26.4 | 15.1 | 18.0 | 2.6 | 67.7 | 267.3 | 68.2 | 83.7 | 789.2 | 101.2 | 12.8 |
| 1977 | 102.0 | 35.1 | 40.1 | 26.1 | 25.3 | 8.0 | 23.1 | 61.6 | 26.5 | 151.2 | 72.9 | 105.2 | 677.1 | 144.1 | 21.3 |
| 1978 | 53.5 | 61.4 | 54.2 | 45.9 | 65.7 | 48.2 | 27.1 | 51.0 | 34.5 | 113.8 | 220.6 | 57.6 | 833.5 | 237.9 | 28.5 |
| 1979 | 50.0 | 79.0 | 56.2 | 35.5 | 26.0 | 18.5 | 15.4 | 30.4 | 48.5 | 185.7 | 59.4 | 205.3 | 809.9 | 125.8 | 15.5 |
| 1980 | 65.7 | 70.8 | 77.5 | 19.3 | 8.6 | 5.7 | 2.7 | 58.2 | 40.4 | 85.0 | 110.2 | 54.7 | 598.8 | 94.5 | 15.8 |
| 1981 | 44.0 | 81.2 | 52.0 | 60.9 | 60.1 | 2.6 | 70.9 | 7.6 | 98.2 | 77.2 | 75.4 | 59.5 | 689.6 | 202.1 | 29.3 |
| 1982 | 121.5 | 127.2 | 104.8 | 22.6 | 47.9 | 51.3 | 17.6 | 26.0 | 42.8 | 87.1 | 113.3 | 65.5 | 827.6 | 165.4 | 20.0 |
| 1983 | 88.3 | 18.8 | 45.6 | 14.3 | 26.1 | 60.6 | 6.0 | 43.0 | 40.5 | 59.0 | 55.0 | 92.0 | 549.2 | 150.0 | 27.3 |
| 1984 | 34.0 | 91.0 | 32.0 | 13.0 | 42.0 | 30.0 | 0.0 | 62.0 | 8.0 | 150.6 | 90.8 | 131.4 | 684.8 | 147.0 | 21.5 |
| 1985 | 48.7 | 87.1 | 59.9 | 30.1 | 28.7 | 29.8 | 31.7 | 60.7 | 36.4 | 122.1 | 46.6 | 69.6 | 651.4 | 181.0 | 27.8 |
| 1986 | 67.1 | 56.1 | 72.6 | 32.4 | 28.0 | 46.0 | 34.7 | 33.7 | 73.2 | 86.1 | 140.2 | 80.9 | 751.0 | 174.8 | 23.3 |
| 1987 | 33.8 | 30.2 | 56.1 | 47.7 | 28.6 | 27.5 | 32.3 | 120.8 | 45.3 | 196.4 | 62.7 | 111.8 | 793.2 | 256.9 | 32.4 |
| 1988 | 85.7 | 50.3 | 51.6 | 55.3 | 36.2 | 31.7 | 77.9 | 97.1 | 41.5 | 88.0 | 80.1 | 61.6 | 737.0 | 298.2 | 40.5 |
| 1989 | 75.4 | 52.4 | 83.3 | 29.0 | 27.6 | 28.0 | 27.0 | 57.8 | 163.6 | 97.5 | 37.6 | 111.5 | 790.7 | 169.4 | 21.4 |
| 1990 | 104.3 | 50.4 | 59.7 | 36.2 | 33.6 | 28.8 | 32.5 | 46.0 | 35.7 | 111.2 | 65.1 | 80.3 | 683.8 | 177.1 | 25.9 |
| Mean | 70.5 | 64.5 | 63.8 | 46.4 | 33.9 | 32.5 | 34.1 | 48.2 | 58.9 | 98.7 | 81.7 | 91.4 | 724.6 | 195.1 | 26.9 |
| S.D. | 36.8 | 26.4 | 19.8 | 32.2 | 13.6 | 17.1 | 27.2 | 26.1 | 34.1 | 54.7 | 37.7 | 60.9 | 141.3 | 56.5 | 6.4 |
| Max | 255.4 | 151.4 | 119.5 | 201.2 | 68.0 | 81.8 | 138.0 | 120.8 | 163.6 | 267.3 | 220.6 | 371.0 | 1103.4 | 332.8 | 41.8 |
| Min | 17.0 | 18.8 | 31.0 | 13.0 | 0.0 | 2.0 | 0.0 | 0.0 | 8.0 | 15.0 | 0.4 | 8.0 | 357.6 | 94.5 | 12.8 |

(Note) 1. interpolated by linear coorelatation, as below;

Paml=0.461*Pbls+27.0 (mm)

Paml= Monthly precipitation at Amol

Pbls= Monthly precipitation at Babolsar

# TABLE A. 1. 2 - 2 MONTHLY PRECIPITATION AT BABOLSAR (1951-90)

(Unit : mm)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total | Apr-Aug | (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1951 | 73.7 | 80.0 | 46.5 | 5.2 | 23.0 | 19.5 | 2.1 | 27.3 | 119.6 | 243.5 | 56.8 | 88.0 | 785.2 | 196.7 | 25.1 |
| 1952 | 47.6 | 75.5 | 109.0 | 70.2 | 31.0 | 24.3 | 29.5 | 50.0 | 34.0 | 24.1 | 76.1 | 70.5 | 641.8 | 239.0 | 37.2 |
| 1953 | 56.4 | 19.0 | 125.3 | 40.1 | 44.3 | 5.0 | 63.5 | 5.5 | 204.0 | 132.0 | 124.5 | 118.0 | 937.6 | 362.4 | 38.7 |
| 1954 | 73.0 | 76.1 | 45.6 | 34.2 | 22.1 | 0.1 | 37.1 | 7.0 | 101.1 | 22.0 | 195.2 | 68.0 | 741.5 | 261.6 | 35.3 |
| 1955 | 34.6 | 17.0 | 75.2 | 26.7 | 4.7 | 40.4 | 4.0 | 61.2 | 65.3 | 99.3 | 213.3 | 109.1 | 750.8 | 202.3 | 26.9 |
| 1956 | 42.0 | 152.7 | 93.2 | 34.5 | 9.6 | 0.0 | 53.1 | 9.3 | 135.4 | 49.3 | 99.0 | 159.0 | 837.1 | 241.9 | 28.9 |
| 1957 | 142.4 | 70.8 | 90.8 | 15.6 | 22.8 | 118.9 | 67.0 | 106.5 | 20.0 | 229.4 | 132.0 | 79.0 | 1095.2 | 350.8 | 32.0 |
| 1958 | 30.9 | 45.0 | 38.6 | 50.9 | 0.7 | 38.9 | 117.4 | 38.5 | 35.5 | 172.2 | 209.0 | 30.4 | 808.0 | 281.9 | 34.9 |
| 1959 | 152.0 | 150.5 | 49.6 | 20.7 | 42.4 | 10.7 | 8.3 | 62.9 | 91.0 | 200.9 | 137.5 | 140.0 | 1066.5 | 236.0 | 22.1 |
| 1960 | 11.1 | 33.7 | 119.3 | 16.9 | 2.7 | 6.7 | 18.7 | 32.2 | 128.0 | 66.3 | 179.1 | 111.0 | 725.7 | 205.2 | 28.3 |
| 1961 | 78.6 | 18.9 | 62.3 | 43.1 | 17.1 | 5.0 | 50.5 | 53.7 | 176.2 | 33.0 | 74.3 | 59.3 | 672.0 | 345.6 | 51.4 |
| 1962 | 127.2 | 43.6 | 34.8 | 38.1 | 7.0 | 101.4 | 3.0 | 57.0 | 34.1 | 163.9 | 40.0 | 56.2 | 706.3 | 240.6 | 34.1 |
| 1963 | 50.3 | 56.9 | 88.2 | 9.5 | 36.3 | 35.2 | 13.4 | 72.6 | 16.8 | 209.6 | 99.6 | 212.9 | 901.3 | 183.8 | 20.4 |
| 1964 | 138.3 | 48.9 | 32.6 | 68.6 | 3.0 | 5.1 | 6.0 | 23.6 | 51.5 | 129.7 | 68.7 | 130.2 | 726.2 | 157.8 | 21.7 |
| 1965 | 95.8 | 34.0 | 78.8 | 40.3 | 9.3 | 18.5 | 59.1 | 11.0 | 71.7 | 188.2 | 44.6 | 151.0 | 802.3 | 209.9 | 26.2 |
| 1966 | 52.3 | 40.5 | 123.2 | 28.4 | 17.4 | 40.6 | 11.7 | 38.3 | 78.5 | 120.5 | 6.0 | 100.6 | 658.0 | 214.9 | 32.7 |
| 1967 | 115.1 | 91.6 | 79.6 | 27.6 | 6.6 | 39.3 | 13.4 | 6.3 | 141.8 | 157.3 | 146.5 | 156.0 | 981.1 | 235.0 | 24.0 |
| 1968 | 89.5 | 90.3 | 75.3 | 99.0 | 25.0 | 16.1 | 55.0 | 48.5 | 9.0 | 138.3 | 178.4 | 111.3 | 935.7 | 252.6 | 27.0 |
| 1969 | 87.5 | 74.6 | 66.3 | 55.7 | 16.1 | 2.2 | 3.3 | 8.9 | 165.1 | 128.0 | 162.0 | 79.2 | 848.9 | 251.3 | 29.6 |
| 1970 | 91.6 | 18.4 | 97.5 | 12.8 | 2.2 | 12.3 | 65.5 | 32.4 | 127.0 | 50.3 | 48.4 | 151.4 | 709.8 | 252.2 | 35.5 |
| 1971 | 58.0 | 100.4 | 52.6 | 51.2 | 0.9 | 4.0 | 0.0 | 8.3 | 21.0 | 372.3 | 67.0 | 223.4 | 959.1 | 85.4 | 8.9 |
| 1972 | 110.0 | 110.0 | 59.2 | 14.8 | 36.1 | 46.2 | 7.0 | 83.9 | 38.0 | 28.2 | 233.1 | 288.6 | 1055.1 | 226.0 | 21.4 |
| 1973 | 62.0 | 48.0 | 51.4 | 2.0 | 7.8 | 21.7 | 0.3 | 66.1 | 108.5 | 59.0 | 172.4 | 201.7 | 800.9 | 206.4 | 25.8 |
| 1974 | 100.4 | 72.9 | 56.9 | 46.4 | 13.4 | 28.1 | 140.9 | 29.2 | 108.0 | 0.0 | 127.0 | 115.2 | 838.4 | 366.0 | 43.7 |
| 1975 | 53.6 | 84.7 | 39.8 | 17.8 | 24.0 | 4.0 | 0.0 | 167.0 | 56.0 | 232.6 | 151.7 | 87.6 | 918.8 | 268.8 | 29.3 |
| 1976 | 25.8 | 122.2 | 80.7 | 33.0 | 20.4 | 33.0 | 24.4 | 0.1 | 87.0 | 256.3 | 59.5 | 129.2 | 871.6 | 197.9 | 22.7 |
| 1977 | 217.0 | 28.7 | 31.4 | 11.5 | 39.3 | 14.7 | 22.6 | 90.8 | 26.9 | 275.5 | 95.0 | 109.1 | 962.5 | 205.8 | 21.4 |
| 1978 | 57.4 | 74.6 | 59.1 | 41.1 | 84.0 | 46.0 | 0.3 | 52.0 | 16.3 | 188.2 | 420.0 | 66.3 | 1105.3 | 239.7 | 21.7 |
| 1979 | 67.7 | 83.0 | 52.0 | 21.4 | 34.1 | 10.3 | 12.5 | 12.6 | 84.0 | 179.2 | 61.0 | 160.0 | 777.8 | 174.9 | 22.5 |
| 1980 | 125.8 | 92.3 | 39.5 | 14.0 | 7.6 | 4.4 | 0.0 | 64.3 | 150.4 | 110.0 | 97.2 | 105.0 | 810.5 | 240.7 | 29.7 |
| 1981 | 108.0 | 69.2 | 67.0 | 102.0 | 31.0 | 6.2 | 67.6 | 46.2 | 280.0 | 272.4 | 152.0 | 26.6 | 1228.2 | 533.0 | 43.4 |
| 1982 | 181.4 | 117.1 | 78.3 | 2.6 | 45.3 | 28.8 | 19.6 | 66.6 | 34.2 | 91.6 | 269.4 | 41.0 | 975.9 | 197.1 | 20.2 |
| 1983 | 133.0 | 12.8 | 91.5 | 19.7 | 23.0 | 28.8 | 8.0 | 140.7 | 62.9 | 67.6 | 56.0 | 151.3 | 793.3 | 281.1 | 35.4 |
| 1984 | 81.9 | 66.9 | 39.9 | 6.8 | 20.1 | 25.6 | 4.9 | 111.8 | 8.0 | 268.1 | 138.4 | 226.5 | 998.9 | 177.2 | 17.7 |
| 1985 | 47.1 | 130.3 | 71.4 | 6.8 | 3.6 | 6.0 | 10.1 | 73.0 | 20.4 | 206.2 | 42.5 | 92.4 | 709.8 | 119.9 | 16.9 |
| 1986 | 86.9 | 63.2 | 98.9 | 11.8 | 2.2 | 41.2 | 16.6 | 14.5 | 100.3 | 128.1 | 245.5 | 117.0 | 926.2 | 186.6 | 20.1 |
| 1987 | 14.7 | 6.9 | 63.2 | 44.8 | 3.5 | 1.0 | 11.6 | 203.5 | 39.8 | 367.4 | 77.5 | 183.9 | 1017.8 | 304.2 | 29.9 |
| 1988 | 127.3 | 50.5 | 53.3 | 61.3 | 20.0 | 10.2 | 110.4 | 152.1 | 31.4 | 132.3 | 71.7 | 75.1 | 895.6 | 385.4 | 43.0 |
| 1989 | 104.9 | 55.0 | 122.2 | 4.4 | 1.3 | 2.2 | 0.0 | 66.9 | 296.3 | 153.0 | 23.0 | 183.4 | 1012.6 | 371.1 | 36.6 |
| 1990 | 167.6 | 50.7 | 70.9 | 20.0 | 14.4 | 3.8 | 12.0 | 41.2 | 18.8 | 182.7 | 82.7 | 115.6 | 780.4 | 110.2 | 14.1 |
| Mean | 88.5 | 66.9 | 70.3 | 31.8 | 19.4 | 22.7 | 30.2 | 56.1 | 84.8 | 153.2 | 123.3 | 122.0 | 869.2 | 245.0 | 28.2 |
| S.D. | 46.7 | 36.3 | 26.2 | 24.1 | 16.8 | 24.8 | 36.2 | 46.6 | 68.9 | 90.1 | 79.9 | 56.9 | 137.6 | 82.9 | |
| Max | 217.0 | 152.7 | 125.3 | 102.0 | 84.0 | 118.9 | 140.9 | 203.5 | 296.3 | 372.3 | 420.0 | 288.6 | 1228.2 | 533.0 | 43.4 |
| Min | 11.1 | 6.9 | 31.4 | 2.0 | 0.7 | 0.0 | 0.0 | 0.1 | 8.0 | 0.0 | 6.0 | 26.6 | 641.8 | 85.4 | 13.3 |

(Data Source)

1951-75 : 25-year Data Book published from IMO

1976-83 : Year Books

1984-90 : IMO

# TABLE A. 1.2 - 3 MONTHLY WEIGHTED PRECIPITATION OF THE PROJECT

Weight : Amol 0.562 (interpolated)
Babolsar 0.438 (Unit:mm)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total | Apr-Sep | (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1951 | 66.6 | 71.0 | 47.6 | 18.8 | 31.2 | 28.8 | 16.7 | 34.2 | 98.5 | 184.9 | 54.8 | 76.5 | 729.6 | 228.2 | 31.3 |
| 1952 | 48.3 | 67.8 | 91.1 | 64.1 | 36.8 | 32.1 | 35.7 | 50.1 | 38.9 | 32.0 | 68.2 | 64.3 | 629.4 | 257.7 | 40.9 |
| 1953 | 54.5 | 28.4 | 102.5 | 43.1 | 46.0 | 18.7 | 59.5 | 19.0 | 157.4 | 107.2 | 102.0 | 97.4 | 835.7 | 343.7 | 41.1 |
| 1954 | 66.1 | 68.2 | 46.9 | 39.0 | 30.6 | 15.2 | 82.9 | 20.0 | 85.6 | 30.5 | 151.3 | 62.5 | 698.8 | 273.3 | 39.1 |
| 1955 | 39.3 | 27.0 | 67.6 | 33.8 | 18.5 | 43.3 | 17.9 | 57.8 | 60.7 | 84.4 | 163.8 | 91.2 | 705.3 | 232.0 | 32.9 |
| 1956 | 44.5 | 121.6 | 80.2 | 39.2 | 21.9 | 15.2 | 52.2 | 21.7 | 109.5 | 49.5 | 84.2 | 126.0 | 765.7 | 259.7 | 33.9 |
| 1957 | 114.4 | 64.5 | 78.5 | 26.1 | 31.1 | 98.0 | 61.9 | 89.4 | 29.1 | 175.1 | 107.2 | 70.2 | 945.5 | 335.6 | 35.5 |
| 1958 | 36.7 | 46.5 | 42.1 | 50.7 | 15.6 | 42.3 | 97.0 | 42.0 | 39.9 | 135.2 | 160.8 | 36.4 | 745.2 | 287.5 | 38.6 |
| 1959 | 121.1 | 120.1 | 49.8 | 29.6 | 44.7 | 22.6 | 20.9 | 59.0 | 78.6 | 155.2 | 111.0 | 112.7 | 925.3 | 255.4 | 27.6 |
| 1960 | 22.9 | 38.6 | 98.3 | 27.0 | 17.0 | 19.9 | 28.2 | 37.6 | 104.4 | 61.4 | 140.0 | 92.6 | 687.9 | 234.1 | 34.0 |
| 1961 | 69.9 | 28.3 | 58.6 | 45.2 | 27.1 | 18.7 | 50.4 | 52.6 | 138.0 | 38.2 | 67.0 | 56.5 | 650.5 | 332.0 | 51.0 |
| 1962 | 103.8 | 45.6 | 39.4 | 41.8 | 20.0 | 85.8 | 17.3 | 54.9 | 38.9 | 129.4 | 43.0 | 54.3 | 674.2 | 258.7 | 38.4 |
| 1963 | 50.2 | 54.8 | 76.7 | 21.8 | 40.5 | 39.7 | 24.5 | 65.8 | 26.9 | 161.3 | 84.6 | 163.6 | 810.4 | 219.2 | 27.0 |
| 1964 | 212.9 | 106.5 | 42.3 | 143.1 | 7.9 | 15.6 | 9.7 | 36.4 | 61.4 | 105.6 | 63.1 | 105.9 | 910.4 | 274.1 | 30.1 |
| 1965 | 82.0 | 38.9 | 58.2 | 42.5 | 24.0 | 11.5 | 33.1 | 9.5 | 61.8 | 134.2 | 46.3 | 120.4 | 662.4 | 182.4 | 27.5 |
| 1966 | 67.9 | 49.9 | 94.0 | 31.9 | 27.3 | 18.9 | 23.3 | 19.9 | 41.7 | 62.8 | 2.9 | 48.6 | 489.1 | 163.0 | 33.3 |
| 1967 | 91.4 | 63.2 | 70.0 | 48.6 | 12.7 | 48.4 | 7.6 | 21.3 | 100.9 | 130.8 | 101.3 | 114.4 | 810.6 | 239.5 | 29.5 |
| 1968 | 76.9 | 78.1 | 83.6 | 117.0 | 28.9 | 26.4 | 53.5 | 67.9 | 8.4 | 76.3 | 155.7 | 257.3 | 1030.0 | 302.1 | 29.3 |
| 1969 | 83.8 | 67.2 | 96.2 | 77.8 | 25.6 | 22.3 | 25.0 | 30.8 | 151.0 | 192.6 | 136.7 | 60.5 | 969.5 | 332.5 | 34.3 |
| 1970 | 80.0 | 64.3 | 102.3 | 26.4 | 18.4 | 17.8 | 28.7 | 65.9 | 115.8 | 42.8 | 87.0 | 89.4 | 738.8 | 273.0 | 37.0 |
| 1971 | 58.0 | 77.1 | 56.8 | 48.8 | 15.8 | 17.9 | 0.0 | 3.6 | 29.8 | 217.6 | 64.8 | 146.7 | 736.9 | 115.9 | 15.7 |
| 1972 | 96.0 | 88.1 | 71.5 | 23.3 | 47.8 | 31.5 | 27.8 | 78.9 | 44.7 | 65.2 | 140.3 | 263.8 | 978.9 | 254.0 | 25.9 |
| 1973 | 65.4 | 50.8 | 48.6 | 12.4 | 17.5 | 29.7 | 4.1 | 69.4 | 73.4 | 56.8 | 114.9 | 156.6 | 699.6 | 206.5 | 29.5 |
| 1974 | 83.3 | 71.3 | 42.3 | 46.5 | 5.9 | 30.9 | 139.3 | 21.8 | 79.1 | 8.4 | 75.9 | 76.3 | 681.0 | 323.5 | 47.5 |
| 1975 | 65.1 | 78.1 | 52.3 | 41.5 | 48.7 | 18.1 | 4.2 | 112.4 | 34.1 | 148.5 | 124.7 | 97.2 | 824.9 | 259.0 | 31.4 |
| 1976 | 20.9 | 110.5 | 81.8 | 36.4 | 23.8 | 22.9 | 20.8 | 1.5 | 76.2 | 262.5 | 64.4 | 103.6 | 825.3 | 181.6 | 22.0 |
| 1977 | 152.4 | 32.3 | 36.3 | 19.7 | 31.4 | 10.9 | 22.9 | 74.4 | 26.7 | 205.6 | 82.6 | 106.9 | 802.1 | 186.0 | 23.2 |
| 1978 | 55.2 | 67.2 | 56.3 | 43.8 | 73.7 | 47.2 | 15.4 | 51.4 | 26.5 | 146.4 | 307.9 | 61.4 | 952.4 | 258.0 | 27.1 |
| 1979 | 57.8 | 80.8 | 54.4 | 29.3 | 29.5 | 14.9 | 14.1 | 22.6 | 64.0 | 182.9 | 60.1 | 185.5 | 795.9 | 174.4 | 21.9 |
| 1980 | 92.0 | 80.2 | 60.9 | 17.0 | 8.2 | 5.1 | 1.5 | 60.9 | 88.6 | 96.0 | 104.5 | 76.7 | 691.6 | 181.3 | 26.2 |
| 1981 | 72.0 | 75.9 | 58.6 | 78.9 | 47.4 | 4.2 | 69.5 | 24.5 | 177.8 | 162.7 | 109.0 | 45.1 | 925.6 | 402.3 | 43.5 |
| 1982 | 147.7 | 122.8 | 93.2 | 13.8 | 46.8 | 41.4 | 18.5 | 43.8 | 39.0 | 89.1 | 181.7 | 54.8 | 892.6 | 203.3 | 22.8 |
| 1983 | 107.9 | 16.2 | 65.7 | 16.7 | 24.7 | 46.7 | 6.0 | 85.8 | 50.3 | 62.8 | 55.4 | 118.0 | 656.2 | 230.2 | 35.1 |
| 1984 | 55.0 | 80.4 | 35.5 | 10.3 | 32.4 | 28.1 | 2.1 | 83.8 | 8.0 | 202.1 | 111.6 | 173.1 | 822.4 | 164.7 | 20.0 |
| 1985 | 48.0 | 106.0 | 64.9 | 19.9 | 17.7 | 19.4 | 22.2 | 66.1 | 29.4 | 158.9 | 44.8 | 79.6 | 676.9 | 174.7 | 25.8 |
| 1986 | 75.8 | 59.2 | 84.1 | 23.4 | 16.7 | 43.9 | 26.8 | 25.3 | 85.1 | 104.5 | 186.3 | 96.7 | 827.8 | 221.2 | 26.7 |
| 1987 | 25.4 | 20.0 | 59.2 | 46.4 | 17.6 | 15.9 | 23.2 | 157.0 | 42.9 | 271.3 | 69.2 | 143.4 | 891.5 | 303.0 | 34.0 |
| 1988 | 103.9 | 50.4 | 52.3 | 57.9 | 29.1 | 22.3 | 92.1 | 121.2 | 37.1 | 107.4 | 65.2 | 67.5 | 806.4 | 359.7 | 44.6 |
| 1989 | 88.3 | 53.5 | 100.3 | 18.2 | 16.1 | 16.7 | 15.2 | 61.8 | 221.7 | 121.8 | 31.2 | 143.0 | 887.8 | 349.7 | 39.4 |
| 1990 | 132.0 | 50.5 | 64.6 | 29.1 | 25.2 | 17.8 | 23.5 | 43.9 | 28.3 | 142.5 | 72.8 | 95.8 | 726.0 | 167.8 | 23.1 |
| Mean | 78.4 | 65.5 | 66.6 | 40.0 | 27.5 | 28.2 | 32.4 | 51.6 | 70.3 | 122.6 | 100.0 | 104.8 | 787.9 | 250.0 | 31.7 |
| (%) | 10.0 | 8.3 | 8.5 | 5.1 | 3.5 | 3.6 | 4.1 | 6.5 | 8.9 | 15.6 | 12.7 | 13.3 | 100.0 | 31.7 | |
| S.D. | 37.7 | 27.3 | 19.8 | 26.4 | 13.6 | 18.7 | 29.5 | 32.4 | 47.4 | 63.3 | 53.9 | 51.0 | 115.5 | 64.4 | |
| Max | 212.9 | 122.8 | 102.5 | 143.1 | 73.7 | 98.0 | 139.3 | 157.0 | 221.7 | 271.3 | 307.9 | 263.8 | 1030.0 | 402.3 | 39.1 |
| Min | 20.9 | 16.2 | 35.5 | 10.3 | 5.9 | 4.2 | 0.0 | 1.5 | 8.0 | 8.4 | 2.9 | 36.4 | 489.1 | 115.9 | 23.7 |

(Note)

1. [ ] correspoding to the year of 1/10-year.
2. *The year 1990 has been selected as the representative year of Drought,* from a viewpoint of rainfall amount during April to September.

## TABLE A. 1. 2 - 4 MONTHLY PRECIPITATION AT AMOL RICE RESEARCH STATION (1964-84)

(Unit : mm)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total | Apr-Aug | Apr-Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 255.4 | 151.4 | 49.9 | 201.2 | 11.7 | 23.8 | 12.5 | 46.4 | 69.2 | | | | | 295.6 | |
| 1965 | | | 42.1 | 44.2 | 35.4 | 6.0 | 12.9 | 8.4 | 54.0 | 92.1 | | | | 106.9 | |
| 1966 | 80.1 | 57.3 | 71.3 | 34.7 | | 2.0 | | 5.5 | 13.0 | 17.9 | 0.4 | 8.0 | | | |
| 1967 | 73.0 | 41.0 | 62.5 | 65.0 | 17.5 | 55.5 | 3.0 | 33.0 | 69.0 | 110.2 | 66.0 | 82.0 | 677.7 | 174.0 | 25.7 |
| 1968 | 67.0 | | 90.0 | 131.0 | 32.0 | | | 83.0 | 8.0 | 28.0 | 138.0 | 371.0 | | | |
| 1969 | 81.0 | | 119.5 | 95.0 | 33.0 | 38.0 | 42.0 | 47.8 | 140.0 | 243.0 | 117.0 | 46.0 | | 255.8 | |
| 1970 | 71.0 | 100.0 | 106.0 | 37.0 | 31.0 | 22.0 | 0.0 | 92.0 | 107.0 | 37.0 | 117.0 | 41.0 | 761.0 | 182.0 | 23.9 |
| 1971 | 58.0 | 59.0 | 60.0 | 47.0 | | | 0.0 | 0.0 | | 97.0 | 63.0 | 87.0 | | | |
| 1972 | 85.0 | 71.0 | 81.0 | 30.0 | 57.0 | 20.0 | 44.0 | 75.0 | 50.0 | 94.0 | 68.0 | 244.5 | 919.5 | 226.0 | 24.6 |
| 1973 | 68.0 | 53.0 | 46.5 | 20.5 | 25.0 | 36.0 | 7.0 | 72.0 | 46.0 | 55.0 | 70.0 | 121.5 | 620.5 | 160.5 | 25.9 |
| 1974 | 70.0 | 70.0 | 31.0 | 46.5 | 0.0 | 33.0 | 138.0 | 16.0 | 56.5 | 15.0 | 36.0 | 46.0 | 558.0 | 233.5 | 41.8 |
| 1975 | 74.0 | 73.0 | 62.0 | 60.0 | 68.0 | 29.0 | 7.4 | 69.8 | 17.1 | 83.0 | 103.6 | 104.7 | 751.6 | 234.2 | 31.2 |
| 1976 | 17.0 | 101.4 | 82.7 | 39.1 | 26.4 | 15.1 | 18.0 | 2.6 | 67.7 | 267.3 | 68.2 | 83.7 | 789.2 | 101.2 | 12.8 |
| 1977 | 102.0 | 35.1 | 40.1 | 26.1 | 25.3 | 8.0 | 23.1 | 61.6 | 26.5 | 151.2 | 72.9 | 105.2 | 677.1 | 144.1 | 21.3 |
| 1978 | | | | | | | | | | | | | | | |
| 1979 | 50.0 | 79.0 | 56.2 | 35.5 | 26.0 | 15.5 | 15.4 | 30.4 | 48.5 | 185.7 | 59.4 | 205.3 | 809.9 | 125.8 | 15.5 |
| 1980 | 65.7 | 70.8 | 77.5 | 19.3 | 8.6 | 5.7 | 2.7 | 58.2 | 40.4 | 85.0 | 110.2 | 54.7 | 598.8 | 94.5 | 15.8 |
| 1981 | 44.0 | 81.2 | 52.0 | 60.9 | 60.1 | 2.6 | 70.9 | 7.6 | 98.2 | 77.2 | 75.4 | 59.5 | 689.6 | 202.1 | 29.3 |
| 1982 | 121.5 | 127.2 | 104.8 | 22.6 | | 51.3 | 17.6 | 26.0 | | 87.1 | 113.3 | 65.5 | | | |
| 1983 | | 18.8 | 45.6 | 14.3 | 26.1 | 60.6 | 6.0 | 43.0 | 40.5 | 59.0 | 55.0 | 92.0 | | 150.0 | |
| 1984 | 34.0 | 91.0 | 32.0 | 13.0 | 42.0 | 30.0 | 0.0 | 62.0 | 8.0 | | | | | 147.0 | |
| Mean | 78.7 | 75.3 | 65.6 | 52.1 | 30.9 | 25.4 | 23.4 | 42.0 | 53.3 | 99.2 | 78.4 | 106.9 | 731.3 | 173.8 | 23.8 |
| S.D. | 50.0 | 32.8 | 25.4 | 45.2 | 18.0 | 18.0 | 34.2 | 29.2 | 35.4 | 71.4 | 34.4 | 89.6 | 105.0 | 59.4 | 8.2 |
| Max. | 255.4 | 151.4 | 119.5 | 201.2 | 68.0 | 60.6 | 138.0 | 92.0 | 140.0 | 267.3 | 138.0 | 371.0 | 919.5 | 295.6 | 41.8 |
| Min. | 17.0 | 18.8 | 31.0 | 13.0 | 0.0 | 2.0 | 0.0 | 0.0 | 8.0 | 15.0 | 0.4 | 8.0 | 558.0 | 94.5 | 12.8 |

(Data Source)

1964-74 : IMO

1975-83 : Year Book

1984-84 : IMO

## TABLE A.1.2-5 DESIGN DAILY AND CONSECUTIVE RAINFALL

| Rainfall and Specified Period | Probable Rainfall by Return Period (mm) (year) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1/2 | 1/5 | 1/10 | 1/15 | 1/20 | 1/25 | 1/30 | 1/50 | 1/100 |
| 1-day Rainfall | | | | | | | | | |
| Annual | 71 | 102 | 128 | 144 | 156 | 166 | 174 | 198 | 234 |
| Apr-Aug | 36 | 49 | 56 | 60 | 63 | 65 | 66 | 70 | 76 |
| Sep-Mar | 71 | 102 | 128 | 144 | 156 | 166 | 174 | 198 | 234 |
| Apr-May | not analyzed | | | | | | | | |
| Aug-Sep | 43 | 66 | 82 | 91 | 98 | 104 | 108 | 120 | 138 |
| Sep-Oct | 61 | 91 | 114 | 127 | 137 | 145 | 151 | 170 | 196 |
| 2-day Rainfall | | | | | | | | | |
| (rate to 1-day) | 1.39 | 1.35 | 1.30 | 1.27 | 1.25 | 1.23 | 1.22 | 1.18 | 1.13 |
| Annual | 99 | 138 | 166 | 183 | 195 | 204 | 212 | 234 | 264 |
| Sep-Oct | 85 | 123 | 148 | 161 | 171 | 178 | 184 | 201 | 221 |
| 3-day Rainfall | | | | | | | | | |
| (rate to 1-day) | 1.47 | 1.44 | 1.40 | 1.37 | 1.35 | 1.34 | 1.33 | 1.30 | 1.25 |
| Annual | 104 | 147 | 179 | 197 | 211 | 222 | 231 | 257 | 293 |
| Sep-Oct | 90 | 131 | 160 | 174 | 185 | 194 | 201 | 221 | 245 |
| 5-day Rainfall | | | | | | | | | |
| (rate to 1-day) | 1.73 | 1.71 | 1.66 | 1.63 | 1.60 | 1.58 | 1.57 | 1.53 | 1.47 |
| Annual | 123 | 174 | 212 | 235 | 250 | 262 | 273 | 303 | 344 |
| Sep-Oct | 106 | 156 | 189 | 207 | 219 | 229 | 237 | 260 | 288 |

(Note) 1. Probable daily rainfall for September to March is almost same as annual value, so that the annual probable daily rainfall shall be also applied to the said period.

2. Consecutive rainfall are derived using the ratio in the table below because of similarity of 1-day rainfall values.

Ratio to Maximum 1 day Rainfall on Maximum 2 day, 3 day and 5 day Rainfalls at Mahmud Abad

| Probability | Maximum Rainfall (mm) | | | | Ratio to 1 day Rainfall | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 day | 2 day | 3 day | 5 day | 1 day | 2 day | 3 day | 5 day |
| 1 / 2 Year | 71.2 | 98.9 | 104.9 | 123.2 | 1.00 | 1.39 | 1.47 | 1.73 |
| 1 / 5 Year | 101.5 | 137.5 | 146.2 | 173.8 | 1.00 | 1.35 | 1.44 | 1.71 |
| 1 / 10 Year | 124.6 | 162.3 | 174.2 | 206.9 | 1.00 | 1.30 | 1.40 | 1.66 |
| 1 / 15 Year | 138.5 | 176.1 | 190.1 | 225.5 | 1.00 | 1.27 | 1.37 | 1.63 |
| 1 / 20 Year | 148.7 | 185.6 | 201.4 | 238.5 | 1.00 | 1.25 | 1.35 | 1.60 |
| 1 / 25 Year | 156.9 | 193.0 | 210.1 | 248.5 | 1.00 | 1.23 | 1.34 | 1.58 |
| 1 / 30 Year | 163.6 | 198.9 | 217.3 | 256.6 | 1.00 | 1.22 | 1.33 | 1.57 |
| 1 / 50 Year | 183.0 | 215.4 | 237.3 | 279.3 | 1.00 | 1.18 | 1.30 | 1.53 |
| 1 /100 Year | 211.1 | 237.6 | 264.9 | 310.1 | 1.00 | 1.13 | 1.25 | 1.47 |
| Average | | | | | 1.00 | 1.26 | 1.36 | 1.61 |

# TABLE A. 1. 2 - 6 PROBABLE DAILY PRECIPITATIONS IN THE PROJECT AREA

Annual maximum daily precipitation

( Unit: mm/day )

| Probability | Babol-sar | Babol | Mian-dasht | Diva | Kareh-sang | Chame-stan | Mahmud abad | Sork Rud | Max | Mean | Min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 year | 70.3 | 49.0 | 66.4 | 49.1 | 52.6 | 51.8 | 71.2 | 62.4 | 71.2 | 59.1 | 49.0 |
| 1/5 year | 101.1 | 67.4 | 92.6 | 59.7 | 79.6 | 74.4 | 101.5 | 78.1 | 101.5 | 81.8 | 59.7 |
| 1/10 year | 126.4 | 80.8 | 114.5 | 66.0 | 99.7 | 90.0 | 124.6 | 88.1 | 126.4 | 98.8 | 66.0 |
| 1/15 year | 142.3 | 88.7 | 128.4 | 69.5 | 111.7 | 98.9 | 138.5 | 93.6 | 142.3 | 109.0 | 69.5 |
| 1/20 year | 154.2 | 94.5 | 138.8 | 71.8 | 120.4 | 105.2 | 148.7 | 97.4 | 154.2 | 116.4 | 71.8 |
| 1/25 year | 163.9 | 99.0 | 147.2 | 73.6 | 127.3 | 110.2 | 156.9 | 100.3 | 163.9 | 122.3 | 73.6 |
| 1/30 year | 171.9 | 102.7 | 154.3 | 75.0 | 133.0 | 114.2 | 163.6 | 102.6 | 171.9 | 127.2 | 75.0 |
| 1/50 year | 195.8 | 113.4 | 175.3 | 78.9 | 149.3 | 125.6 | 183.0 | 109.1 | 195.8 | 141.3 | 78.9 |
| 1/100 year | 231.2 | 128.4 | 206.6 | 84.1 | 172.6 | 141.4 | 211.1 | 117.8 | 231.2 | 161.7 | 84.1 |
| Data Numbr | 34 | 36 | 26 | 9 | 36 | 18 | 26 | 26 | | | |

Maximum daily precipitation in Far-Mor (Apr-Aug)

( Unit: mm/day )

| Probability | Babol-sar | Babol | Mian-dasht | Diva | Kareh-sang | Chame-stan | Mahmud abad | Sork Rud | Max | Mean | Min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 year | 36.4 | 27.7 | 31.6 | 25.0 | 26.6 | 23.9 | 34.5 | 30.4 | 36.4 | 29.5 | 23.9 |
| 1/5 year | 49.1 | 45.7 | 44.1 | 29.5 | 44.8 | 37.7 | 47.2 | 45.1 | 49.1 | 42.9 | 29.5 |
| 1/10 year | 56.4 | 58.9 | 51.2 | 32.0 | 59.5 | 48.1 | 54.2 | 56.4 | 59.5 | 52.1 | 32.0 |
| 1/15 year | 60.2 | 66.7 | 55.0 | 33.3 | 68.8 | 54.4 | 57.7 | 63.3 | 68.8 | 57.4 | 33.3 |
| 1/20 year | 62.8 | 72.3 | 57.4 | 34.2 | 75.7 | 59.0 | 60.0 | 68.4 | 75.7 | 61.2 | 34.2 |
| 1/25 year | 64.7 | 76.8 | 59.3 | 34.8 | 81.2 | 62.7 | 61.8 | 72.4 | 81.2 | 64.2 | 34.8 |
| 1/30 year | 66.2 | 80.5 | 60.8 | 35.4 | 85.9 | 65.7 | 63.1 | 75.7 | 85.9 | 66.7 | 35.4 |
| 1/50 year | 70.3 | 91.0 | 64.8 | 36.7 | 99.6 | 74.4 | 66.8 | 85.5 | 99.6 | 73.6 | 36.7 |
| 1/100 year | 75.7 | 105.9 | 69.9 | 38.5 | 119.8 | 86.9 | 71.4 | 99.6 | 119.8 | 83.5 | 38.5 |
| Data Numbr | 34 | 35 | 26 | 10 | 36 | 18 | 26 | 26 | | | |

Maximum daily precipitation in Sha-Esf (Sep-Mar)

( Unit: mm/day )

| Probability | Babol-sar | Babol | Mian-dasht | Diva | Kareh-sang | Chame-stan | Mahmud abad | Sork Rud | Max | Mean | Min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 year | 71.3 | 46.7 | 63.6 | 50.9 | 51.6 | 50.5 | 74.4 | 61.5 | 74.4 | 58.8 | 46.7 |
| 1/5 year | 102.1 | 64.7 | 95.6 | 58.3 | 78.2 | 76.6 | 105.8 | 79.4 | 105.8 | 82.6 | 58.3 |
| 1/10 year | 127.6 | 75.8 | 117.4 | 62.7 | 96.8 | 93.2 | 126.8 | 90.1 | 127.6 | 98.8 | 62.7 |
| 1/15 year | 143.7 | 81.7 | 129.9 | 65.0 | 107.5 | 102.3 | 138.7 | 95.9 | 143.7 | 108.1 | 65.0 |
| 1/20 year | 155.7 | 85.8 | 138.7 | 66.5 | 115.1 | 108.7 | 147.1 | 99.8 | 155.7 | 114.7 | 66.5 |
| 1/25 year | 165.5 | 88.9 | 145.6 | 67.7 | 121.1 | 113.6 | 153.5 | 102.7 | 165.5 | 119.8 | 67.7 |
| 1/30 year | 173.6 | 91.4 | 151.2 | 68.6 | 125.9 | 117.5 | 158.8 | 105.1 | 173.6 | 124.0 | 68.6 |
| 1/50 year | 197.8 | 98.2 | 166.9 | 71.1 | 139.7 | 128.4 | 173.5 | 111.6 | 197.8 | 135.9 | 71.1 |
| 1/100 year | 233.8 | 107.2 | 188.6 | 74.4 | 158.8 | 143.0 | 193.7 | 120.1 | 233.8 | 152.5 | 74.4 |
| Data Numbr | 33 | 37 | 26 | 9 | 36 | 18 | 25 | 26 | | | |

Maximum daily precipitation in Mor-Sha (Aug-Sep)

( Unit: mm/day )

| Probability | Babol-sar | Babol | Mian-dasht | Diva | Kareh-sang | Chame-stan | Mahmud abad | Sork Rud | Max | Mean | Min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 year | 43.4 | 24.3 | 36.8 | 26.8 | 23.0 | 20.6 | 39.6 | 36.6 | 43.4 | 31.4 | 20.6 |
| 1/5 year | 65.9 | 39.8 | 62.6 | 37.9 | 40.3 | 37.4 | 66.2 | 62.7 | 66.2 | 51.6 | 37.4 |
| 1/10 year | 82.0 | 50.5 | 80.4 | 45.4 | 53.8 | 50.9 | 86.7 | 81.4 | 86.7 | 66.4 | 45.4 |
| 1/15 year | 91.4 | 56.7 | 90.8 | 49.7 | 62.0 | 59.3 | 99.2 | 92.4 | 99.2 | 75.2 | 49.7 |
| 1/20 year | 98.2 | 61.2 | 98.1 | 52.7 | 68.1 | 65.6 | 108.4 | 100.3 | 108.4 | 81.6 | 52.7 |
| 1/25 year | 103.5 | 64.6 | 103.8 | 55.0 | 72.9 | 70.7 | 115.7 | 106.5 | 115.7 | 86.6 | 55.0 |
| 1/30 year | 107.8 | 67.4 | 108.4 | 56.9 | 76.9 | 74.9 | 121.8 | 111.6 | 121.8 | 90.7 | 56.9 |
| 1/50 year | 120.2 | 75.5 | 121.6 | 62.2 | 88.6 | 87.3 | 139.5 | 126.2 | 139.5 | 102.6 | 62.2 |
| 1/100 year | 137.7 | 86.6 | 139.9 | 69.4 | 105.6 | 105.6 | 165.1 | 146.6 | 165.1 | 119.6 | 69.4 |
| Data Numbr | 34 | 31 | 25 | 10 | 35 | 18 | 26 | 26 | | | |

Maximum daily precipitation in Sha-Meh (Sep-Oct)

( Unit: mm/day )

| Probability | Babol-sar | Babol | Mian-dasht | Diva | Kareh-sang | Chame-stan | Mahmud abad | Sork Rud | Max | Mean | Min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 year | 61.3 | 36.3 | 51.0 | 48.6 | 39.0 | 44.5 | 61.8 | 56.4 | 61.8 | 49.9 | 36.3 |
| 1/5 year | 91.3 | 58.7 | 83.5 | 55.2 | 66.7 | 72.9 | 97.8 | 74.2 | 97.8 | 75.0 | 55.2 |
| 1/10 year | 113.7 | 74.3 | 107.1 | 59.0 | 89.5 | 92.7 | 123.3 | 85.1 | 123.3 | 93.1 | 59.0 |
| 1/15 year | 127.1 | 83.4 | 121.0 | 61.0 | 103.9 | 104.2 | 138.3 | 90.9 | 138.3 | 103.7 | 61.0 |
| 1/20 year | 136.9 | 89.9 | 130.9 | 62.4 | 114.7 | 112.4 | 149.0 | 95.0 | 149.0 | 111.4 | 62.4 |
| 1/25 year | 144.6 | 94.9 | 138.8 | 63.4 | 123.3 | 118.8 | 157.3 | 98.0 | 157.3 | 117.4 | 63.4 |
| 1/30 year | 151.0 | 99.0 | 145.3 | 64.2 | 130.6 | 124.1 | 164.2 | 100.4 | 164.2 | 122.4 | 64.2 |
| 1/50 year | 169.4 | 110.7 | 163.8 | 66.3 | 152.1 | 138.9 | 183.8 | 107.1 | 183.8 | 136.5 | 66.3 |
| 1/100 year | 195.6 | 127.0 | 189.9 | 69.1 | 184.1 | 159.7 | 211.1 | 115.9 | 211.1 | 156.6 | 69.1 |
| Data Number | 33 | 35 | 26 | 9 | 35 | 18 | 25 | 26 | | | |

## FIGURE A. 1. 2 - 1 RAINFALL INTENSITY CURVE

| Return Period (year) | Time Duration (min) | | | | | | | | | (hrs) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 150 | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
| 2 | 35 | 32 | 24 | 20 | 17 | 15 | 14 | 13 | 11 | 9 | 8 | 6 | 6 | 4 | 4 | 3 |
| 5 | 100 | 60 | 44 | 36 | 30 | 26 | 24 | 21 | 19 | 17 | 15 | 14 | 12 | 10 | 8 | 7 |
| 10 | 132 | 79 | 58 | 47 | 40 | 34 | 31 | 28 | 24 | 22 | 20 | 18 | 16 | 12 | 10 | 9 |
| 25 | 168 | 107 | 76 | 59 | 49 | 42 | 39 | 36 | 32 | 30 | 26 | 23 | 21 | 17 | 13 | 11 |
| 50 | 196 | 125 | 89 | 69 | 58 | 49 | 45 | 42 | 38 | 35 | 31 | 27 | 25 | 20 | 16 | 13 |
| 100 | 225 | 144 | 101 | 79 | 65 | 56 | 52 | 48 | 44 | 40 | 35 | 32 | 28 | 23 | 19 | 15 |

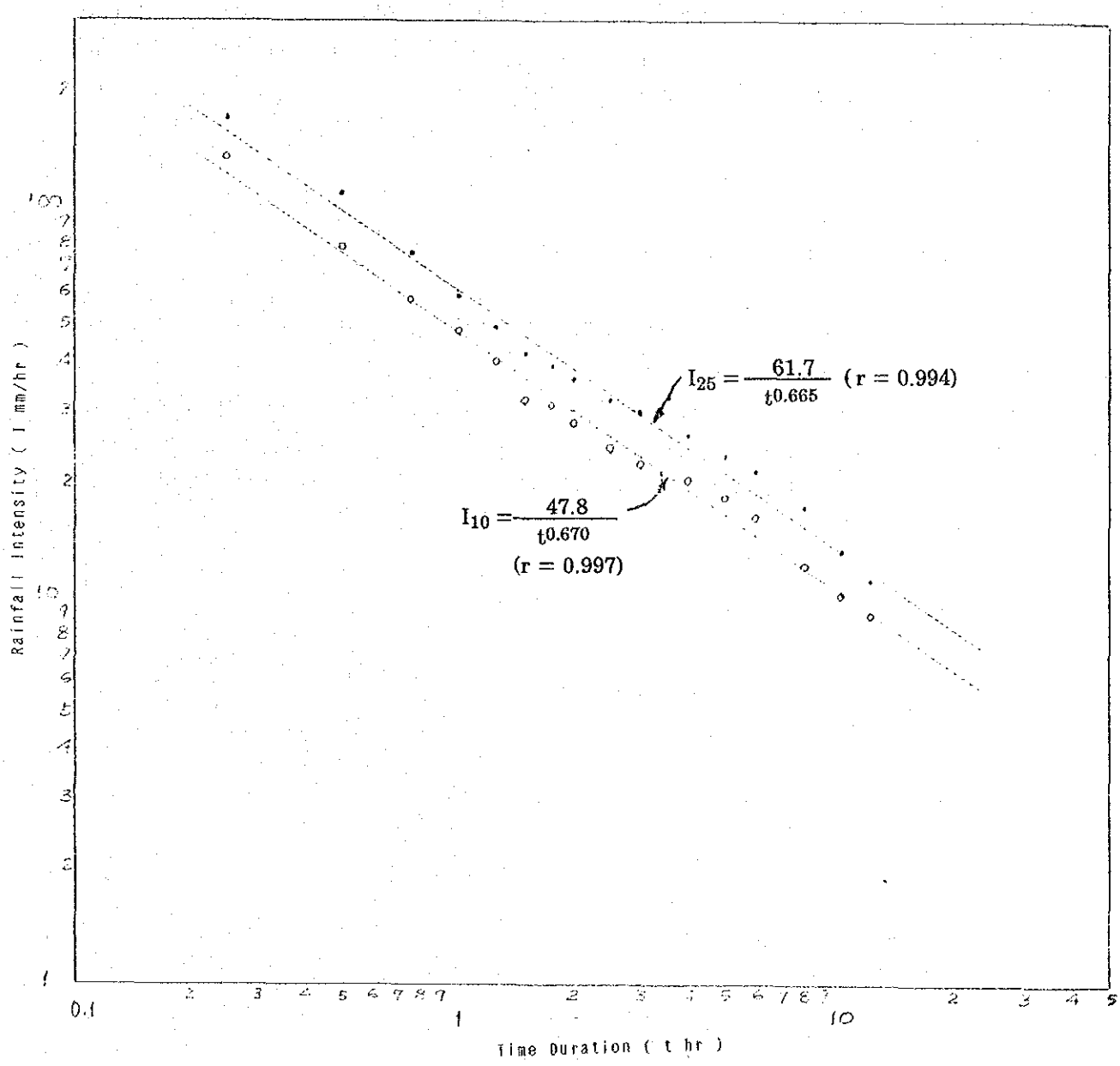
(Data Source) HWDP-1 Study Report, A-1 (Meteorological Study)

Computation of Intensity Curve

| Time | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 150 | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (hrs) | 0.25 | 0.5 | 0.75 | 1 | 1.25 | 1.5 | 1.75 | 2 | 2.5 | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
| 25 | 168 | 107 | 76 | 59 | 49 | 42 | 39 | 36 | 32 | 30 | 26 | 23 | 21 | 17 | 13 | 11 |
| Log(t) | -0.6 | -0.3 | -0.1 | 0 | 0.1 | 0.18 | 0.24 | 0.3 | 0.4 | 0.48 | 0.6 | 0.7 | 0.78 | 0.9 | 1 | 1.08 |
| Log(I) | 2.23 | 2.03 | 1.88 | 1.77 | 1.69 | 1.62 | 1.59 | 1.56 | 1.51 | 1.48 | 1.41 | 1.36 | 1.32 | 1.23 | 1.11 | 1.04 |
| Sxx | 0.36 | 0.09 | 0.02 | 0 | 0.01 | 0.03 | 0.06 | 0.09 | 0.16 | 0.23 | 0.36 | 0.49 | 0.61 | 0.82 | 1 | 1.16 |
| Sxy | -1.3 | -0.6 | -0.2 | 0 | 0.16 | 0.29 | 0.39 | 0.47 | 0.6 | 0.7 | 0.85 | 0.95 | 1.03 | 1.11 | 1.11 | 1.12 |
| Syy | 4.95 | 4.12 | 3.54 | 3.14 | 2.86 | 2.63 | 2.53 | 2.42 | 2.27 | 2.18 | 2 | 1.85 | 1.75 | 1.51 | 1.24 | 1.08 |

| | |
|---|---|
| N= | 16 |
| Xa= | 3.7188 |
| Ya= | 46.813 |
| log(Xa)= | 0.3578 |
| log(Ya)= | 1.5521 |
| ΣSxx= | 3.4327 |
| ΣSxy= | -2.282 |
| ΣSyy= | 1.5346 |
| r= | -0.994 |
| c= | -0.665 |
| a= | 61.668 |
| t= | 1 |
| I= | 61.668 |

(Note) 1. Intensity curve is derived by Sherman Type Equation.
2. Above computation is for the case of 1/25-year.



## A. 1. 3 Other Meteorological Factors

### 1. General Factors

General meteorological factors other than precipitation are not studied in detail in this Study, because the Master Plan Study already studied them. Consequently, this study follows the study of the Master Plan.

General factors are described in Table A. 1. 3 - 1.

### 2. Evapotranspiration

Evapotranspiration is also studied by the Master Plan Study. Evapotranspiration was estimated by the Modified Penman Method, which is believed to have the most reliable value among the methods, Evapotranspiration is shown in Table A. 1. 3 - 2.

### 3. Heavy Wind and Its Prevailing Direction

The recent up-coming of the Caspian Sea level causes several difficulties to the coastal area. For the purpose of studying the countermeasures to these difficulties, heavy wind and its prevailing direction has been studied. As seeing the Table A. 1. 3 - 3, range of prevailing direction of heavy wind is mostly between North and West. East and North-East are scarce.

## TABLE A.1.3-1 MONTHLY MEAN TEMPERATURE, RELATIVE HUMIDITY, WIND SPEED AND SUNSHINE HOURS

| Month | Monthly Mean Maximum Temperature (°C) | | | Monthly Mean Temperature (°C) | | | Monthly Mean Minimum Temperature (°C) | | | Monthly Mean Relative Humidity (%) | | | Monthly Mean (Babolsar) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Babolsar | Amol | Karehsang | Babolsar | Amol | Karehsang | Babolsar | Amol | Karehsang | Babolsar | Amol | Karehsang | Wind Speed (Knot) | Sunshine Hour (hr/day) |
| Jan. | 11.6 | 11.8 | 11.6 | 7.6 | 7.3 | 6.7 | 3.7 | 2.7 | 1.7 | 86 | 83 | 74 | 2.1 | 4.29 |
| Feb. | 11.4 | 11.1 | 11.9 | 7.9 | 6.6 | 7.1 | 4.2 | 2.1 | 2.3 | 85 | 84 | 75 | 2.6 | 4.35 |
| Mar. | 12.9 | 14.3 | 12.6 | 9.8 | 9.4 | 8.1 | 6.6 | 4.5 | 3.6 | 84 | 85 | 79 | 3.0 | 4.19 |
| Apr. | 17.3 | 19.2 | 18.5 | 13.9 | 14.1 | 12.9 | 10.5 | 8.9 | 7.2 | 83 | 82 | 74 | 2.9 | 5.21 |
| May | 23.3 | 24.6 | 23.4 | 19.5 | 19.0 | 17.8 | 15.8 | 13.4 | 12.2 | 80 | 82 | 75 | 3.0 | 7.30 |
| Jun. | 27.3 | 27.6 | 25.7 | 23.5 | 23.3 | 20.8 | 19.7 | 18.9 | 15.8 | 77 | 79 | 77 | 2.9 | 8.30 |
| Jul. | 29.8 | 28.9 | 26.6 | 25.9 | 24.5 | 22.0 | 22.0 | 20.0 | 17.3 | 78 | 81 | 82 | 2.8 | 7.87 |
| Aug. | 30.2 | 30.2 | 27.0 | 26.1 | 25.4 | 22.7 | 22.0 | 20.5 | 18.3 | 80 | 83 | 82 | 2.7 | 6.76 |
| Sep. | 27.2 | 26.9 | 23.7 | 23.2 | 22.6 | 19.7 | 19.3 | 18.2 | 15.6 | 82 | 83 | 84 | 2.5 | 5.59 |
| Oct. | 22.7 | 23.2 | 20.8 | 18.6 | 18.0 | 15.8 | 14.3 | 12.8 | 10.7 | 84 | 82 | 79 | 2.3 | 5.45 |
| Nov. | 17.7 | 18.0 | 16.8 | 13.4 | 13.1 | 11.5 | 8.9 | 8.2 | 6.2 | 86 | 82 | 78 | 2.1 | 4.90 |
| Dec. | 13.5 | 13.8 | 14.8 | 9.3 | 9.3 | 9.3 | 5.1 | 4.7 | 3.7 | 87 | 83 | 75 | 2.0 | 4.34 |
| Annual | 20.9 | 20.9 | 19.5 | 16.6 | 16.1 | 14.6 | 12.7 | 11.3 | 9.6 | 82 | 82 | 78 | 2.6 | 5.72 |

(Data Source) Master Plan Study Report (Appendix A.1)

## TABLE A.1.3-2 EVAPOTRANSPIRATION BY MODIFIED PENMAN METHOD

| | | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul.* | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T mean | (°C) 1/ | 7.4 | 7.2 | 9.6 | 14.0 | 19.2 | 23.4 | 25.1 | 25.7 | 22.9 | 18.3 | 13.2 | 9.3 | 16.3 |
| RH mean | (%) 1/ | 84 | 84 | 85 | 82 | 81 | 78 | 80 | 82 | 83 | 83 | 84 | 85 | 82.6 |
| $U_2$ | (knot) | 2.1 | 2.6 | 3.0 | 2.9 | 3.0 | 2.9 | 2.8 | 2.7 | 2.5 | 2.3 | 2.1 | 2.0 | 2.6 |
| n | (hours/day) | 4.29 | 4.35 | 4.19 | 5.21 | 7.30 | 8.30 | 7.87 | 6.76 | 5.59 | 5.45 | 4.90 | 4.34 | 5.72 |
| Ra | (mm/day) | 7.3 | 9.3 | 12.0 | 14.7 | 16.4 | 17.2 | 16.7 | 15.4 | 13.0 | 10.5 | 7.9 | 6.5 | |
| N | (hours/day) | 10.0 | 10.9 | 11.9 | 13.2 | 14.1 | 14.7 | 14.4 | 13.6 | 12.4 | 11.3 | 10.2 | 9.7 | |
| U day | (m/sec) | 1.1 | 1.3 | 1.55 | 1.49 | 1.55 | 1.49 | 1.44 | 1.39 | 1.29 | 1.18 | 1.08 | 1.03 | |
| Rs | (mm/day) | 3.39 | 4.2 | 5.11 | 6.58 | 8.35 | 9.16 | 8.74 | 7.68 | 6.18 | 5.16 | 3.87 | 3.08 | |
| (1) (1 - W) f(u) (es - ea) | | 0.42 | 0.46 | 0.51 | 0.70 | 0.87 | 1.09 | 1.01 | 0.90 | 0.77 | 0.66 | 0.51 | 0.41 | |
| (2) W·Rn | | 0.67 | 1.00 | 1.53 | 2.33 | 3.38 | 4.07 | 4.03 | 3.57 | 2.61 | 1.78 | 0.97 | 0.57 | |
| (3) = (1) + (2) | | 1.09 | 1.46 | 2.04 | 3.03 | 4.25 | 5.16 | 5.04 | 4.47 | 3.38 | 2.44 | 1.48 | 0.98 | |
| C | | 0.96 | 0.97 | 0.975 | 1.02 | 1.04 | 1.06 | 1.06 | 1.04 | 1.02 | 1.00 | 0.975 | 0.96 | |
| ETo = C*(3) | (mm/day) | 1.0 | 1.4 | 2.0 | 3.1 | 4.4 | 5.5 | 5.3 | 4.7 | 3.5 | 2.4 | 1.4 | 0.9 | |
| ETo | (mm/month) | 31 | 40 | 62 | 93 | 136 | 165 | 164 | 146 | 105 | 74 | 42 | 28 | 1.086 |

Note: 1) Location 36°30'N, Altitude 10m PGD at the center of the Project Area.
2) For estimating adjustment factor (c), assuming RH max = 90% and U day/U night = 1.0
3) 1/ weighted average by Babolsar (0.438) and Amol (0.562) by area ratio.
4) * sample computation is presented.
5) 1 knot = 0.515 m/sec.

(Data Source) Master Plan Study Report (Appendix A.1)

# TABLE A.1.3-3 MONTHLY AND ANNUAL MAXIMUM WIND SPEED AND DIRECTION AT BABOLSAR

(Unit of Speed: knot)

| Year | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1951 | Direction | 360 | 270 | 270 | 310 | 270 | 270 | 310 | 270 | 50 | 270 | 310 | 270 | |
| | Speed | 30 | 24 | 37 | 13 | 30 | 30 | 18 | 30 | 24 | 37 | 37 | 18 | 37 |
| | | N | W | W | NW | W | W | NW | W | NE | W | NW | W | |
| 1952 | Direction | 300 | 270 | 270 | 270 | 270 | 270 | 270 | 360 | 270 | 270 | 270 | 260 | |
| | Speed | 22 | 37 | 37 | 24 | 18 | 13 | 9 | 13 | 37 | 18 | 30 | 36 | 37 |
| | | WNW | W | W | W | W | W | W | N | W | W | W | W | |
| 1953 | Direction | 270 | 230 | 50 | 270 | 130 | 270 | 50 | 50 | 270 | 50 | 300 | 270 | |
| | Speed | 12 | 16 | 18 | 18 | 37 | 12 | 13 | 28 | 44 | 18 | 20 | 18 | 44 |
| | | W | SW | NE | W | SE | W | NE | NE | W | NE | WNW | W | |
| 1954 | Direction | 310 | 230 | 270 | 230 | 270 | 270 | 90 | 270 | 230 | 270 | 50 | 270 | |
| | Speed | 12 | 14 | 18 | 12 | 18 | 9 | 18 | 18 | 11 | 18 | 10 | 13 | 18 |
| | | NW | SW | W | SW | W | W | E | W | SW | W | NE | W | |
| 1955 | Direction | 90 | 310 | 270 | 270 | 270 | 300 | 270 | 270 | 270 | 360 | 50 | 270 | |
| | Speed | 7 | 18 | 15 | 24 | 15 | 20 | 10 | 10 | 12 | 22 | 11 | 15 | 24 |
| | | E | NW | W | W | W | WNW | W | W | W | N | NE | W | |
| 1956 | Direction | 270 | 40 | 270 | 90 | 290 | 270 | 270 | 270 | 360 | 270 | 90 | 270 | |
| | Speed | 12 | 9 | 20 | 40 | 17 | 22 | 8 | 14 | 15 | 10 | 15 | 22 | 40 |
| | | W | NE | W | E | WNW | W | W | W | N | W | E | W | |
| 1957 | Direction | 100 | 270 | 360 | 270 | 230 | 270 | 70 | 310 | 270 | 90 | 360 | 310 | |
| | Speed | 28 | 40 | 12 | 20 | 15 | 25 | 18 | 10 | 17 | 17 | 18 | 15 | 40 |
| | | E | W | N | W | SW | W | ENE | NW | W | E | N | NW | |
| 1958 | Direction | 270 | 230 | 270 | 270 | 270 | 270 | 270 | 270 | 310 | 270 | 310 | 270 | |
| | Speed | 18 | 20 | 17 | 20 | 15 | 15 | 8 | 15 | 10 | 26 | 18 | 12 | 26 |
| | | W | SW | W | W | W | W | W | W | NW | W | NW | W | |
| 1959 | Direction | 270 | 270 | 270 | 270 | 270 | 20 | 290 | 270 | 360 | 270 | 210 | 310 | |
| | Speed | 10 | 18 | 12 | 10 | 20 | 30 | 10 | 8 | 12 | 12 | 15 | 6 | 30 |
| | | W | W | W | W | W | NNE | WNW | W | N | W | SSW | NW | |
| 1960 | Direction | 270 | 270 | 90 | 270 | 270 | 360 | 270 | 180 | 90 | 70 | 270 | 50 | |
| | Speed | 12 | 9 | 7 | 18 | 10 | 8 | 18 | 9 | 7 | 8 | 18 | 8 | 18 |
| | | W | W | E | W | W | N | W | S | E | ENE | W | NE | |
| 1961 | Direction | 310 | 270 | 310 | 270 | 270 | 270 | 270 | 270 | 90 | 270 | 50 | 290 | |
| | Speed | 10 | 20 | 20 | 18 | 18 | 18 | 20 | 15 | 8 | 12 | 9 | 10 | 20 |
| | | NW | W | NW | W | W | W | W | W | E | W | NE | WNW | |
| 1962 | Direction | 270 | 270 | 80 | 290 | 270 | 360 | 290 | 270 | 20 | 270 | 90 | 70 | |
| | Speed | 22 | 13 | 14 | 18 | 12 | 26 | 10 | 12 | 14 | 10 | 12 | 15 | 26 |
| | | W | W | E | WNW | W | N | WNW | W | NNE | W | E | ENE | |
| 1963 | Direction | 270 | 360 | 70 | 70 | 270 | 270 | 250 | 290 | 270 | 270 | 360 | 50 | |
| | Speed | 14 | 40 | 14 | 12 | 18 | 14 | 12 | 10 | 12 | 15 | 14 | 12 | 40 |
| | | W | N | ENE | ENE | W | W | WSW | WNW | W | W | N | NE | |
| 1964 | Direction | 270 | 70 | 270 | 270 | 290 | 170 | 270 | 290 | 270 | 280 | 270 | 20 | |
| | Speed | 18 | 10 | 12 | 18 | 15 | 20 | 12 | 8 | 12 | 22 | 28 | 12 | 28 |
| | | W | ENE | W | W | WNW | S | W | WNW | W | W | W | NNE | |
| 1965 | Direction | 40 | 290 | 270 | 270 | 230 | 270 | 270 | 270 | 60 | 310 | 270 | 290 | |
| | Speed | 19 | 16 | 18 | 18 | 12 | 14 | 12 | 13 | 14 | 15 | 28 | 11 | 28 |
| | | NE | WNW | W | W | SW | W | W | W | E | NW | W | WNW | |
| 1966 | Direction | 270 | 290 | 310 | 270 | 270 | 350 | 280 | 240 | 330 | 40 | 230 | 300 | |
| | Speed | 8 | 15 | 17 | 15 | 18 | 12 | 14 | 12 | 15 | 15 | 10 | 12 | 18 |
| | | W | WNW | NW | W | W | N | W | WSW | NNW | NE | SW | WNW | |
| 1967 | Direction | 10 | 290 | 270 | 270 | 310 | 270 | 20 | 280 | 270 | 330 | 270 | 290 | |
| | Speed | 15 | 25 | 20 | 25 | 12 | 14 | 40 | 14 | 12 | 15 | 20 | 24 | 40 |
| | | N | WNW | W | W | NW | W | NNE | W | W | NNW | W | WNW | |
| 1968 | Direction | 330 | 300 | 270 | 270 | 280 | 350 | 260 | 290 | 280 | 30 | 300 | 30 | |
| | Speed | 25 | 28 | 28 | 17 | 12 | 10 | 12 | 15 | 12 | 18 | 18 | 15 | 28 |
| | | NNW | WNW | W | W | W | N | W | WNW | W | NNE | WNW | NNE | |
| 1969 | Direction | 90 | 270 | 90 | 270 | 280 | 150 | 280 | 310 | 300 | 310 | 270 | 330 | |
| | Speed | 18 | 15 | 15 | 18 | 12 | 20 | 15 | 14 | 15 | 15 | 20 | 12 | 20 |
| | | E | W | E | W | W | SSE | W | NW | WNW | NW | W | NNW | |
| 1970 | Direction | 90 | 350 | 260 | 280 | 290 | 290 | 280 | 290 | 280 | 340 | 290 | 60 | |
| | Speed | 10 | 10 | 14 | 13 | 20 | 12 | 15 | 10 | 12 | 15 | 12 | 10 | 20 |
| | | E | N | W | W | WNW | WNW | W | WNW | W | NNW | WNW | ENE | |
| 1971 | Direction | 90 | 320 | 280 | 270 | 270 | 280 | 280 | 330 | 90 | 310 | 300 | 310 | |
| | Speed | 10 | 28 | 11 | 26 | 12 | 15 | 12 | 15 | 12 | 18 | 12 | 13 | 28 |
| | | E | NW | W | W | W | W | W | NNW | E | NW | WNW | NW | |
| 1972 | Direction | 280 | 280 | 10 | 310 | 310 | 50 | 330 | 360 | 300 | 50 | 280 | 270 | |
| | Speed | 15 | 12 | 12 | 12 | 12 | 14 | 6 | 15 | 12 | 11 | 20 | 12 | 20 |
| | | W | W | N | NW | NW | NE | NNW | N | WNW | NE | W | W | |
| 1973 | Direction | 280 | 320 | 280 | 310 | 340 | 300 | 310 | 320 | 310 | 310 | 310 | 340 | |
| | Speed | 10 | 10 | 20 | 16 | 12 | 10 | 9 | 9 | 12 | 14 | 22 | 12 | 22 |
| | | W | NW | W | NW | NNW | WNW | NW | NW | NW | NW | NW | NNW | |
| 1974 | Direction | 70 | 70 | 310 | 310 | 300 | 280 | 280 | 280 | 270 | 340 | 290 | 310 | |
| | Speed | 9 | 9 | 12 | 11 | 20 | 12 | 12 | 9 | 14 | 7 | 15 | 20 | 20 |
| | | ENE | ENE | NW | NW | WNW | W | W | W | W | NNW | WNW | NW | |
| 1975 | Direction | 30 | 310 | 180 | 280 | 90 | 310 | 300 | 300 | 310 | 300 | 360 | 280 | |
| | Speed | 20 | 12 | 12 | 12 | 10 | 12 | 12 | 12 | 11 | 8 | 12 | 12 | 20 |
| | | NNE | NW | S | W | E | NW | WNW | WNW | NW | WNW | N | W | |
| 1982 | Direction | 350 | 290 | 270 | 270 | 240 | 360 | 300 | 270 | 60 | 110 | 270 | 60 | |
| | Speed | 15 | 11 | 9 | 11 | 9 | 8 | 7 | 7 | 8 | 8 | 10 | 6 | 15 |
| | | N | WNW | W | W | WSW | N | WNW | W | ENE | ESE | W | ENE | |
| 1983 | Direction | 250 | 340 | 330 | 260 | 300 | 270 | 150 | 270 | 270 | 300 | 280 | 210 | |
| | Speed | 11 | 8 | 10 | 7 | 8 | 7 | 10 | 8 | 7 | 7 | 10 | 7 | 11 |
| | | WSW | NNW | NNW | W | WNW | W | SSE | W | W | WNW | W | SSW | |
| Speed | Max | 30 | 40 | 37 | 40 | 37 | 30 | 40 | 30 | 44 | 37 | 37 | 36 | 44 |
| | Mean | 15.3 | 18 | 16.7 | 17.3 | 15.6 | 15.6 | 13.3 | 13.1 | 14.5 | 15.2 | 17.2 | 14 | 15.5 |
| | Min | 7 | 6 | 7 | 7 | 8 | 7 | 6 | 7 | 7 | 7 | 9 | 6 | 6 |

# APPENDIX A. 2 HYDROLOGY

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## A. 2. 1 Hydrological Observation Network and Data

### 1. Hydrological Observation Network

The hydrological observation network for the three rivers, that the Haraz, the Babol and the Talar rivers, is shown in the Figure A. 2. 1-1.

### 2. Observation Station and Catchment Area

In connection with the study of floods, catchment area of the Babol river and the tributaries were checked on the map of scale 1 : 50,000. Revision of the catchment area was made on some stations. The catchment areas of the hydrological observation stations concerning the Haraz and the Babol river systems are as follows;

| River | Catchment Area (sq.km) | Annual Runoff (MCM) | Runoff Depth (MCM) |
|---|---|---|---|
| Haraz River | | | - |
| Polour | 780 | 416 | 533 |
| Razan | 276 | 171 | 620 |
| Karehsang | 4,061 | 1,086 | 267 |
| Sorkhrud | - | 184 | - |
| Babol River | | | |
| Gharan Talar | 393 | 225 | 573 |
| Babol | 1,643 | 484 | 295 |
| Miandasht | - | 399 | - |
| Kela Rud River | | | |
| Diva | 130 (*) | 61 | 469 |
| Sajjad Rud River | | | |
| Ghalugah | 256 (*) | 72 | 281 |

Note: * : catchment area is modified.
-- : catchment area is not defined due to flood plain.

### 3. Data Collected

For this Study, collected hydrological data are listed in the Table A. 2. 1-1.

## TABLE A. 2. 1 - 1 LIST OF HYDROLOGICAL DATA FOR THE STUDY

Hydrological Year in Iranian Calendar (1st starting from year 1325-26)

| River Station | 25 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 35 | 6 | 7 | 8 | 9 | 40 | 1 | 2 | 3 | 4 | 45 | 6 | 7 | 8 | 9 | 50 | 1 | 2 | 3 | 4 | 55 | 6 | 7 | 8 | 9 | 60 | 1 | 2 | 3 | 4 | 65 | 6 | 7 | 8 | 9 | 70 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Babol River | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gharan Talar | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | | | | | | | * | * | * | * | | | | | | | | | | | |
| D | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | | | | * | * | * | * | | | | | | | | | | | |
| Babol | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | * | * | * | * | * | * | * | * | * | |
| Miandasht | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | | | | | | | | | | | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | | * | * | | | | | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | * | * | | | * | * | | | * | * | | | | | |
| Haraz River | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Polour | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | * | * | * | * | * | = | = | = | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | | | | | | | |
| D | * | * | * | * | * | * | * | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | * | | * | | * | | * | * | * | | | | | | |
| Razan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | | | | | | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | | | | | | | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Karehsang | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | * | * | * | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | | | |
| Sorkhrud | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | | | | | | | | | | | | | | | | | * | * | * | * | * | * | = | = | = | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| Kela Rud River | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Diva | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | = | = | = | * | * | * | * | * | * | * | | | | | | | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | * | * | * | * | * | | | | | | | |
| Sajjad Rud River | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Galugah(Bandpay) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | = | * | = | = | = | * | * | * | * | * | | | | | | | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | | | | * | * | * | * | * | | | | | | | |

(Note) M : Monthly Discharge Data D : Daily Discharge Data
* : collected = : interpolated by NWDP-1 study

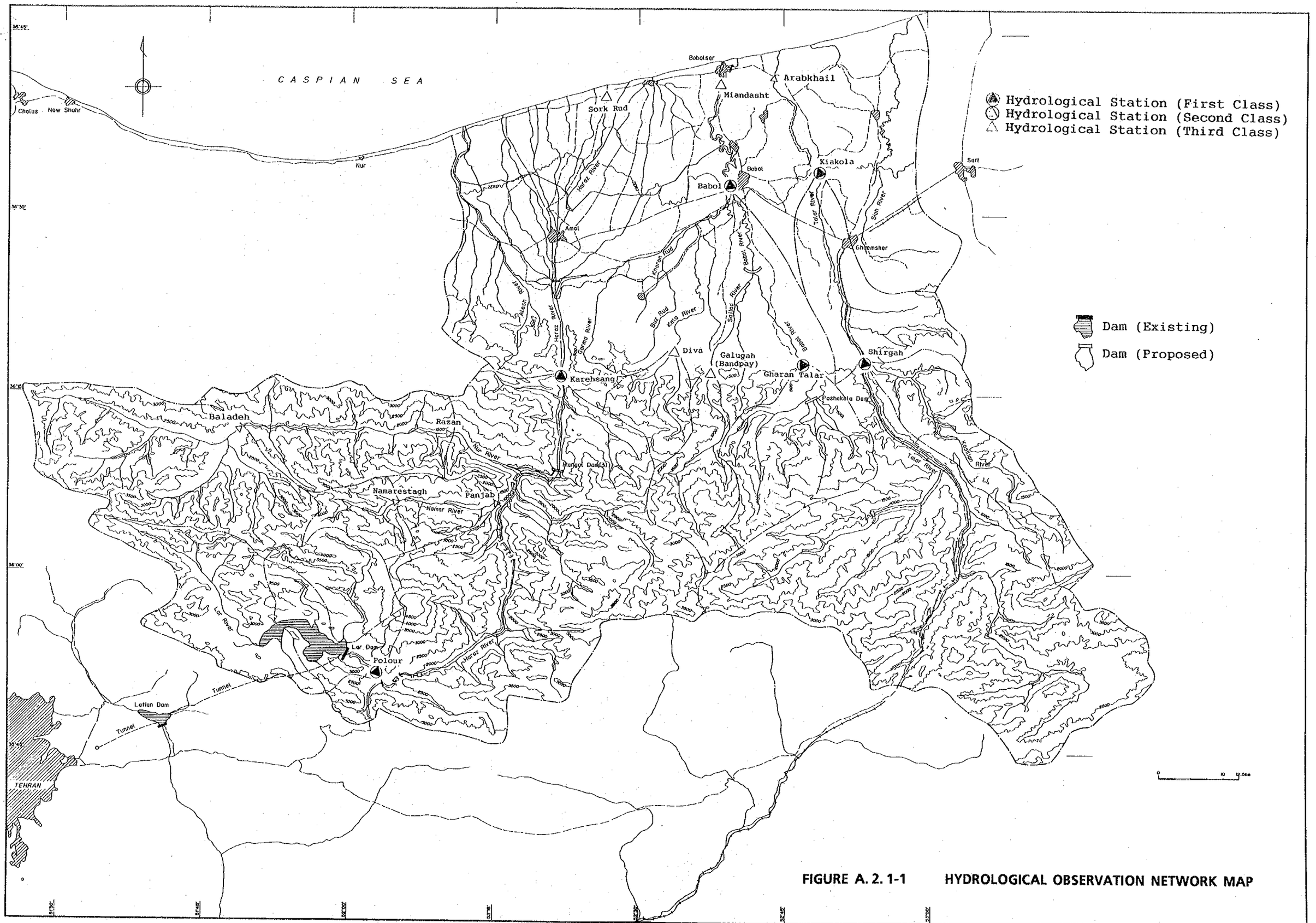



**FIGURE A. 2. 1-1 HYDROLOGICAL OBSERVATION NETWORK MAP**

## A. 2. 2 Annual and Monthly Runoff

### 1. Mean Runoff

Annual and monthly mean runoff of the hydrological station is summarized as below;

**Mean Annual And Monthly Runoff**

| River Station | Meh Oct | Aba Nov | Aza Dec | Dey Jan | Bah Feb | Esf Mar | Far Apr | Ord May | Kho Jun | Tir Jul | Mor Aug | Sha Sep | Annual (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Haraz River | | | | | | | | | | | | | |
| Polour | 13.5 | 12.0 | 10.6 | 13.0 | 11.0 | 9.7 | 37.0 | 111.4 | 106.1 | 49.2 | 25.2 | 17.1 | 415.6 |
| Razan | 7.1 | 9.0 | 6.3 | 5.8 | 5.8 | 6.8 | 15.9 | 36.0 | 36.2 | 21.5 | 11.6 | 9.4 | 171.3 |
| Residual Basin | 39.0 | 42.0 | 37.3 | 30.5 | 31.5 | 37.5 | 54.6 | 99.6 | 110.5 | 76.0 | 61.7 | 49.6 | 669.6 |
| Karehsang | 52.5 | 54.0 | 47.9 | 43.4 | 42.5 | 47.2 | 91.6 | 210.9 | 216.6 | 125.1 | 86.9 | 66.7 | 1,085.2 |
| Sorkrud | 9.2 | 13.6 | 15.7 | 14.3 | 11.1 | 12.7 | 19.3 | 41.2 | 27.0 | 4.3 | 5.0 | 10.3 | 183.7 |
| Babol River | | | | | | | | | | | | | |
| Gharan Talar | 22.3 | 20.6 | 15.8 | 14.4 | 17.3 | 22.6 | 30.1 | 19.0 | 15.0 | 12.6 | 13.6 | 21.9 | 225.2 |
| Babol | 53.7 | 55.6 | 38.0 | 41.1 | 46.1 | 55.5 | 61.6 | 31.2 | 23.0 | 16.5 | 22.1 | 38.5 | 482.9 |
| Kela Rud River | | | | | | | | | | | | | |
| Diva | 4.3 | 4.7 | 5.2 | 5.4 | 5..9 | 7.0 | 7.0 | 4.9 | 4.3 | 4.5 | 4.3 | 3.9 | 61.4 |
| Sajjad Rud River | | | | | | | | | | | | | |
| Ghalugah | 6.6 | 6.7 | 6.2 | 6.1 | 6.2 | 8.5 | 10.5 | 5.6 | 4.5 | 3.9 | 2.8 | 4.6 | 72.2 |

Drought of the Haraz river has been analyzed for annual and seasonal runoffs. Seasonal runoff is selected for the period of irrigation, that is from April (Far) to August (Mor).

**Probable Drought of the Haraz River**

(Unit: MCM)

| Annual | 1/2 | 1/5 | 1/10 | 1/20 | 1/50 | 1/100-yr |
|---|---|---|---|---|---|---|
| Polour | 416 | 310 | 274 | 248 | 222 | 207 |
| Residual | 670 | 551 | 510 | 482 | 454 | 439 |
| Karehsang | 1,086 | 863 | 784 | 724 | 662 | 623 |
| Irrigation Period (Apr. - Aug.) (Far - Mor) | | | | | | |
| Polour | 328 | 232 | 199 | 174 | 149 | 135 |
| Residual | 402 | 271 | 227 | 195 | 164 | 146 |
| Karehsang | 730 | 530 | 454 | 397 | 339 | 303 |

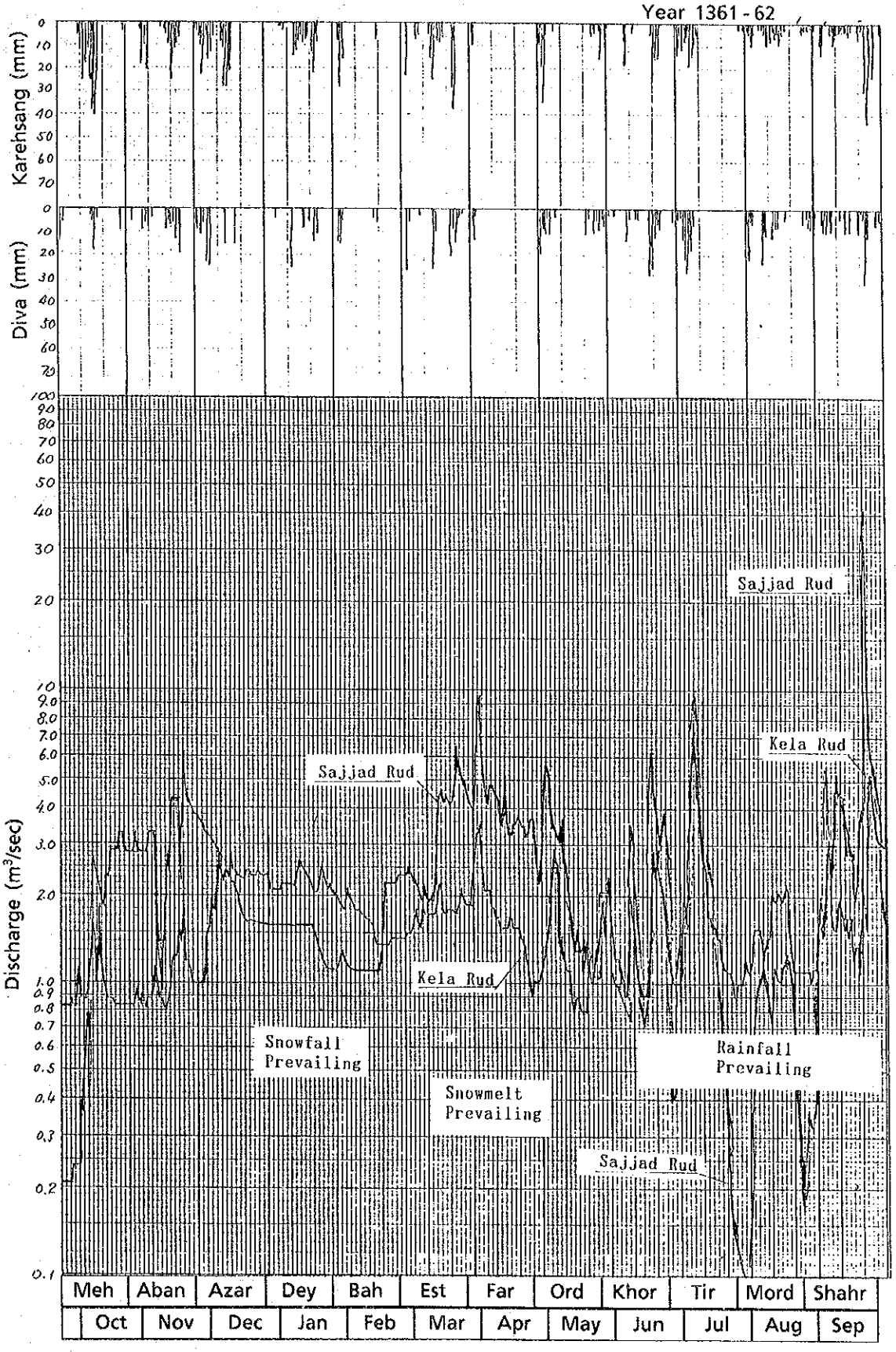
From above result, the year 1969 - 70 (or 1348 - 49) is selected as a representative drought year corresponding to 1/10-year drought, taking into

consideration the runoff of 225 MCM from the residual basis, which is closest to the 1/10-year drought of the residual basin.

## 2. Runoff Analysis of Tributaries

Rainfall-runoff analysis has been analyzed as shown in Figure A.2.2-1. However, relation between rainfall and runoff seems low. It is recommended to increase rainfall observation intensity in future.

FIGURE A. 2. 2-1 RAINFALL AND RUNOFF RELATION OF THE KELA RUD AND THE SAJJAD RUD RIVERS



## TABLE A. 2. 2-1 MONTHLY DISCHARGE OF THE LAR RIVER AT POLOUR

(Unit : cms)

| Year | Meh OCT | Aba NOV | Aza DEC | Dey JAN | Bah FEB | Esf MAR | Far APR | Ord MAY | Kho JUN | Tir JUL | Mor AUG | Sha SEP | Averag (cms) | Total (MCM) | Far - Mor (cms) | Far - Mor (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1329-30 | 5.26 | 4.15 | 3.45 | 4.08 | 4.20 | 3.49 | 6.51 | 18.85 | 24.26 | 8.70 | 6.60 | 5.64 | 8.01 | 252.6 | 13.00 | 174.1 |
| 1330-31 | 5.53 | 5.83 | 4.75 | 8.48 | 4.81 | 3.69 | 32.85 | 53.61 | 61.97 | 34.48 | 12.74 | 9.53 | 20.14 | 635.1 | 39.10 | 523.6 |
| 1331-32 | 7.49 | 6.15 | 5.60 | 5.89 | 5.40 | 4.80 | 7.62 | 44.45 | 43.42 | 25.16 | 10.33 | 7.14 | 14.62 | 461.1 | 26.20 | 350.9 |
| 1332-33 | 6.74 | 6.60 | 6.37 | 7.15 | 5.91 | 5.45 | 9.76 | 77.90 | 62.97 | 33.29 | 19.36 | 9.04 | 21.16 | 667.3 | 40.70 | 545.1 |
| 1333-34 | 3.88 | 3.43 | 3.03 | 4.87 | 3.33 | 2.83 | 9.70 | 31.02 | 31.40 | 14.30 | 7.19 | 4.95 | 10.12 | 319.1 | 18.70 | 250.4 |
| 1334-35 | 7.22 | 6.38 | 5.63 | 9.06 | 6.19 | 5.26 | 18.05 | 57.69 | 58.40 | 26.59 | 13.37 | 9.20 | 18.82 | 593.5 | 34.80 | 466.0 |
| 1335-36 | 6.72 | 5.94 | 5.24 | 8.43 | 5.76 | 4.90 | 16.80 | 53.70 | 54.36 | 24.75 | 12.44 | 8.56 | 17.52 | 552.5 | 32.40 | 433.9 |
| 1336-37 | 6.00 | 5.08 | 5.13 | 5.38 | 6.19 | 5.18 | 23.48 | 34.03 | 21.97 | 12.60 | 6.67 | 4.77 | 11.49 | 362.4 | 19.80 | 265.2 |
| 1337-38 | 3.89 | 3.40 | 3.66 | 7.58 | 2.07 | 3.68 | 21.23 | 40.07 | 35.26 | 17.71 | 9.01 | 6.17 | 12.98 | 409.3 | 24.70 | 330.8 |
| 1338-39 | 4.93 | 3.84 | 3.76 | 5.24 | 2.55 | 3.93 | 4.99 | 21.84 | 17.42 | 8.11 | 5.86 | 4.63 | 7.32 | 230.8 | 11.60 | 155.4 |
| 1339-40 | 4.16 | 3.74 | 3.86 | 4.10 | 3.46 | 2.84 | 4.10 | 24.68 | 18.42 | 10.73 | 6.22 | 5.16 | 7.70 | 242.8 | 12.80 | 171.4 |
| 1340-41 | 4.31 | 3.82 | 3.72 | 4.03 | 3.47 | 4.23 | 8.28 | 29.65 | 32.48 | 15.07 | 8.82 | 6.36 | 10.48 | 330.5 | 18.90 | 253.1 |
| 1341-42 | 5.15 | 4.34 | 3.35 | 3.68 | 3.09 | 2.83 | 13.17 | 36.16 | 49.71 | 21.32 | 11.90 | 7.38 | 13.70 | 432.0 | 26.50 | 354.9 |
| 1342-43 | 5.39 | 4.18 | 4.68 | 4.20 | 11.40 | 4.00 | 17.66 | 41.19 | 22.32 | 8.46 | 5.44 | 5.32 | 11.30 | 356.4 | 19.00 | 254.5 |
| 1343-44 | 3.95 | 3.35 | 3.30 | 2.90 | 2.90 | 3.31 | 8.74 | 47.52 | 32.00 | 12.81 | 7.07 | 5.14 | 11.23 | 354.2 | 21.60 | 289.3 |
| 1344-45 | 4.42 | 4.36 | 3.80 | 3.71 | 3.39 | 4.49 | 11.13 | 35.03 | 32.29 | 13.94 | 7.63 | 4.89 | 10.88 | 343.1 | 20.00 | 267.8 |
| 1345-46 | 4.77 | 4.71 | 3.98 | 3.38 | 3.03 | 2.88 | 4.69 | 30.90 | 26.23 | 10.45 | 6.26 | 4.49 | 8.91 | 281.0 | 15.70 | 210.3 |
| 1346-47 | 4.04 | 3.31 | 3.27 | 3.20 | 8.19 | 3.01 | 8.40 | 48.16 | 68.65 | 25.52 | 10.98 | 8.69 | 16.52 | 521.0 | 32.30 | 432.6 |
| 1347-48 | 6.65 | 5.78 | 4.38 | 7.01 | 6.02 | 8.26 | 27.08 | 86.58 | 78.81 | 34.55 | 17.61 | 10.02 | 24.69 | 778.6 | 48.90 | 654.9 |
| 1348-49 | 7.30 | 9.11 | 6.35 | 5.47 | 4.75 | 4.46 | 14.88 | 19.75 | 16.25 | 8.70 | 6.13 | 4.67 | 9.04 | 285.1 | 13.10 | 175.4 |
| 1349-50 | 3.87 | 3.32 | 3.10 | 2.64 | 2.80 | 3.24 | 10.82 | 52.31 | 45.07 | 15.34 | 7.81 | 5.39 | 13.16 | 415.0 | 26.30 | 352.2 |
| 1350-51 | 4.61 | 4.07 | 3.47 | 10.08 | 5.70 | 4.34 | 6.92 | 52.01 | 58.40 | 32.85 | 13.80 | 7.50 | 17.20 | 542.4 | 32.80 | 439.3 |
| 1351-52 | 7.15 | 5.24 | 4.31 | 4.29 | 3.69 | 5.19 | 16.42 | 50.75 | 40.70 | 15.68 | 7.90 | 5.66 | 14.09 | 444.3 | 26.30 | 352.2 |
| 1352-53 | 4.75 | 4.05 | 3.94 | 3.49 | 3.15 | 3.17 | 11.00 | 31.48 | 25.45 | 15.20 | 8.88 | 6.94 | 10.25 | 323.2 | 18.40 | 246.4 |
| 1353-54 | 5.57 | 3.85 | 3.09 | 2.78 | 2.19 | 2.15 | 18.79 | 37.98 | 38.29 | 13.42 | 6.89 | 4.99 | 11.83 | 373.1 | 23.10 | 309.4 |
| 1354-55 | 3.90 | 3.55 | 2.76 | 2.82 | 2.34 | 2.20 | 5.62 | 54.32 | 51.11 | 23.43 | 11.01 | 6.16 | 14.32 | 451.6 | 29.10 | 389.7 |
| 1355-56 | 4.79 | 4.37 | 3.43 | 2.93 | 2.68 | 3.93 | 9.88 | 27.22 | 32.79 | 13.31 | 7.36 | 5.67 | 10.00 | 315.4 | 18.10 | 242.4 |
| 1356-57 | 5.95 | 5.60 | 5.06 | 3.78 | 3.21 | 4.15 | 26.67 | 39.69 | 32.71 | 18.26 | 9.65 | 6.11 | 13.57 | 427.9 | 25.40 | 340.2 |
| 1357-58 | 4.39 | 4.23 | 3.39 | 2.78 | 2.95 | 2.87 | 21.98 | 46.85 | 42.72 | 21.82 | 10.31 | 6.63 | 14.45 | 455.7 | 28.70 | 384.4 |
| 1358-59 | 4.72 | 4.16 | 3.03 | 3.00 | 2.55 | 2.65 | 21.79 | 29.29 | 32.90 | 14.98 | 7.53 | 5.18 | 11.13 | 351.0 | 21.30 | 285.3 |
| 1359-60 | 4.93 | 4.36 | 4.13 | 6.18 | 4.22 | 3.59 | 12.31 | 39.37 | 39.85 | 18.14 | 9.12 | 6.27 | 12.86 | 405.6 | 23.80 | 318.7 |
| 1360-61 | 3.88 | 3.43 | 3.02 | 4.86 | 3.32 | 2.82 | 9.69 | 30.98 | 31.36 | 14.28 | 7.18 | 4.94 | 10.11 | 318.8 | 18.70 | 250.4 |
| 1361-62 | 5.89 | 5.21 | 4.59 | 7.39 | 5.05 | 4.29 | 14.72 | 47.06 | 47.65 | 21.69 | 10.90 | 7.50 | 15.35 | 484.1 | 28.40 | 380.3 |
| Mean | 5.20 | 4.63 | 4.08 | 5.00 | 4.25 | 3.88 | 13.81 | 41.58 | 39.62 | 18.35 | 9.39 | 6.38 | 13.18 | 415.6 | 24.60 | 329.4 |
| (%) | 39.5 | 35.1 | 31 | 37.9 | 32.2 | 29.4 | 104.8 | 315.5 | 300.6 | 139.2 | 71.2 | 48.4 | 100 | | 186.6 | |
| S.D. | 1.11 | 1.24 | 0.97 | 2.06 | 1.92 | 1.18 | 7.17 | 14.84 | 15.45 | 7.68 | 3.25 | 1.57 | 3.99 | 126.0 | 8.44 | 113.0 |
| Max | 7.49 | 9.11 | 6.37 | 10.08 | 11.4 | 8.26 | 32.85 | 86.58 | 78.81 | 34.55 | 19.36 | 10.02 | 24.69 | 778.6 | 48.9 | 654.9 |
| Min | 3.87 | 3.31 | 2.76 | 2.64 | 2.07 | 2.15 | 4.1 | 18.85 | 16.25 | 8.11 | 5.44 | 4.49 | 7.32 | 230.8 | 11.6 | 155.4 |
| MCM | 13.48 | 12.00 | 10.58 | 12.96 | 11.02 | 9.72 | 36.99 | 111.37 | 106.12 | 43.15 | 25.15 | 17.09 | | 415.6 | | 328.8 |
| (%) | 3.2 | 2.9 | 2.5 | 3.1 | 2.7 | 2.3 | 8.9 | 26.8 | 25.5 | 11.8 | 6.1 | 4.1 | | 100 | | 79.1 |

(Data Source) HWDP-1 Study Report (A-2, Hydrology)

(Note) 1. Conversion from cms to MCM is computed under the following conditions.
Number of days in a year = 365 days
Number of days in a month are as below;
30days/month for Mehr-Bahman, 29days for Esfand, 31 days for Farvardin-Sharivar

2. [ ] interpolated with the data of Karehsang by the HWDP-1 Study.

## TABLE A. 2. 2-2 MONTHLY DISCHARGE OF THE NOUR RIVER AT RAZAN

(Unit : cms)

| Year | MEHR OCT | ABAN NOV | AZAR DEC | DEY JAN | BAHMAN FEB | ESFAND MAR | FARVARD APR | ORDIBEH MAY | KHORDAD JUN | TIR JUL | MORDAD AUG | SHARIVA SEP | Average (cms) | Total (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1342-43 | 2.661 | 2.910 | 2.597 | 2.383 | 2.443 | 2.532 | 6.026 | 13.264 | 8.501 | 4.608 | 3.315 | 3.094 | 4.565 | 143.96 |
| 1343-44 | 2.314 | 2.343 | 2.244 | 1.972 | 2.041 | 2.549 | 5.800 | 15.778 | 12.788 | 6.521 | 3.940 | 2.949 | 5.157 | 162.63 |
| 1344-45 | 2.925 | 3.123 | 2.934 | 2.353 | 2.408 | 2.559 | 5.295 | 13.389 | 11.630 | 6.088 | 3.892 | 2.656 | 4.981 | 157.08 |
| 1345-46 | 2.815 | 2.597 | 2.204 | 2.165 | 2.055 | 2.256 | 2.969 | 10.462 | 9.260 | 4.637 | 3.031 | 2.363 | 3.931 | 123.97 |
| 1346-47 | 2.527 | 2.244 | 2.130 | 1.787 | 1.802 | 2.880 | 6.343 | 14.360 | 20.176 | 10.130 | 5.247 | 3.584 | 6.173 | 194.67 |
| 1347-48 | 2.765 | 2.934 | 2.800 | 2.596 | 2.621 | 5.585 | 11.519 | 24.040 | 21.709 | 14.100 | 7.731 | 4.910 | 8.706 | 274.55 |
| 1348-49 | 5.128 | 5.970 | 4.475 | 3.532 | 3.188 | 2.730 | 5.355 | 7.578 | 7.180 | 3.461 | 1.855 | 1.295 | 4.319 | 136.20 |
| 1349-50 | 1.338 | 1.355 | 1.283 | 1.165 | 1.216 | 3.048 | 8.449 | 16.371 | 15.639 | 7.620 | 3.626 | 1.348 | 5.271 | 166.23 |
| 1350-51 | 2.092 | 3.023 | 2.820 | 2.426 | 2.344 | 2.525 | 6.830 | 14.461 | 18.655 | 15.687 | 10.136 | 6.599 | 7.391 | 233.08 |
| 1351-52 | 3.492 | 3.162 | 2.905 | 2.517 | 2.745 | 3.344 | 5.896 | 13.362 | 13.421 | 6.090 | 2.246 | 1.468 | 5.094 | 160.64 |
| 1352-53 | 1.657 | 1.359 | 1.110 | 1.397 | 1.587 | 2.762 | 5.645 | 8.158 | 8.696 | 7.356 | 4.743 | 3.175 | 4.012 | 126.52 |
| 1353-54 | 2.037 | 1.480 | 1.272 | 1.352 | 1.251 | 1.240 | 5.133 | 13.614 | 17.368 | 7.391 | 1.791 | 1.497 | 4.680 | 147.59 |
| 1354-55 | 1.763 | 1.935 | 1.739 | 1.733 | 1.633 | 1.658 | 6.133 | 17.013 | 15.727 | 10.268 | 4.317 | 3.058 | 5.655 | 178.34 |
| 1355-56 | 4.915 | 2.882 | 2.895 | 3.044 | 2.851 | 3.938 | 5.994 | 15.627 | 18.950 | 9.497 | 4.520 | 2.205 | 6.500 | 204.98 |
| 1356-57 | 3.220 | 4.587 | 2.755 | 2.847 | 2.748 | 3.435 | 8.576 | 11.886 | 14.229 | 10.877 | 4.960 | 1.989 | 6.061 | 191.14 |
| 1357-58 | 2.183 | 2.956 | 2.139 | 2.449 | 2.201 | 1.898 | 5.265 | 9.386 | 12.331 | 8.261 | 3.083 | 16.390 | 5.778 | 182.22 |
| 1358-59 | 1.478 | 14.230 | 2.501 | 1.935 | 2.256 | 2.146 | 6.695 | 8.507 | 7.615 | 4.894 | 4.728 | 2.891 | 5.012 | 158.06 |
| 1359-60 | 3.292 | 2.878 | 2.764 | 2.727 | 2.853 | 2.892 | 3.537 | 13.091 | 10.965 | 8.992 | 4.637 | 2.917 | 5.155 | 162.57 |
| 1360-61 | 3.168 | 4.751 | 2.285 | 1.794 | 1.660 | 1.692 | 3.074 | 9.351 | 7.757 | 5.313 | 3.217 | 2.781 | 3.932 | 124.00 |
| 1361-62 | 3.040 | 2.819 | 2.657 | 2.520 | 2.428 | 2.550 | 4.050 | 19.340 | 17.860 | 8.600 | 5.710 | 3.120 | 6.293 | 198.46 |
| Mean | 2.741 | 3.468 | 2.425 | 2.235 | 2.217 | 2.711 | 5.929 | 13.452 | 13.523 | 8.020 | 4.336 | 3.514 | 5.433 | 171.34 |
| (%) | 50.5 | 63.8 | 44.6 | 41.1 | 40.8 | 49.9 | 109.1 | 247.6 | 248.9 | 147.6 | 79.8 | 64.7 | 100 | |
| S.D(cms) | 0.974 | 2.705 | 0.729 | 0.583 | 0.540 | 0.909 | 1.927 | 3.949 | 4.459 | 3.071 | 1.899 | 3.190 | 1.168 | 36.85 |
| Max | 5.128 | 14.23 | 4.475 | 3.532 | 3.188 | 5.585 | 11.519 | 24.04 | 21.709 | 15.687 | 10.136 | 16.39 | 8.706 | 274.55 |
| Min | 1.338 | 1.355 | 1.11 | 1.165 | 1.216 | 1.24 | 2.969 | 7.578 | 7.18 | 3.461 | 1.791 | 1.295 | 3.931 | 123.97 |
| MCM | 7.10 | 8.99 | 6.29 | 5.79 | 5.75 | 6.79 | 15.88 | 36.03 | 36.22 | 21.48 | 11.61 | 9.41 | | 171.34 |
| (%) | 4.1 | 5.2 | 3.7 | 3.4 | 3.4 | 4 | 9.3 | 21 | 21.1 | 12.5 | 6.8 | 5.5 | | 100 |

(Data Source) HWDP-1 Study Report (A-2, Hydrology)

(Note) 1. Conversion from cms to MCM is computed under the following condition.
Number of days in an Year = 365 days
Number onth Esfand
30days/month for Mehr-Bahman, 29days for Esfand, 31days for Farvardin-Sharivar

2. [ ] interpolated with the data of Karehsang by the HWDP-1 Study.

## TABLE A. 2. 2-3 MONTHLY RUNOFF OF THE RESIDUAL BASIN OF THE HARAZ RIVER BELOW THE LAR DAM

(Unit : MCM)

| Year | Meh | Aba | Aza | Dey | Bah | Esf | Far | Ord | Kho | Tir | Mor | Sha | Annual | Far-Mor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | (MCM) | (MCM) |
| 1329-30 | 27.58 | 25.45 | 24.76 | 20.96 | 19.95 | 23.76 | 29.73 | 30.37 | 36.02 | 32.85 | 23.11 | 25.07 | 319.71 | 152.18 |
| 1330-31 | 21.44 | 29.55 | 24.76 | 12.83 | 23.48 | 32.49 | 28.04 | 33.53 | 65.41 | 74.84 | 64.20 | 47.56 | 458.13 | 266.02 |
| 1331-32 | 34.06 | 37.12 | 31.70 | 16.79 | 21.33 | 31.52 | 78.88 | 84.70 | 106.52 | 112.30 | 110.40 | 50.01 | 715.33 | 492.80 |
| 1332-33 | 49.53 | 51.63 | 45.34 | 37.09 | 39.37 | 48.50 | 97.66 | 74.81 | 125.91 | 78.53 | 64.87 | 64.71 | 777.95 | 441.78 |
| 1333-34 | 48.70 | 51.40 | 46.37 | 36.16 | 32.84 | 33.65 | 33.80 | 32.95 | 73.39 | 45.05 | 43.28 | 48.34 | 525.93 | 228.47 |
| 1334-35 | 27.17 | 29.26 | 34.22 | 24.58 | 32.61 | 37.63 | 48.58 | 112.62 | 108.82 | 86.38 | 186.68 | 173.75 | 902.30 | 543.08 |
| 1335-36 | 36.57 | 31.26 | 28.41 | 11.85 | 16.25 | 19.69 | 11.76 | 26.81 | 162.92 | 223.16 | 176.80 | 109.60 | 855.08 | 601.45 |
| 1336-37 | 62.55 | 68.92 | 50.02 | 43.27 | 31.06 | 36.96 | 66.96 | 100.65 | 81.29 | 53.53 | 48.83 | 38.30 | 692.34 | 361.26 |
| 1337-38 | 37.61 | 36.21 | 35.01 | 20.19 | 33.33 | 28.29 | 48.72 | 186.88 | 167.88 | 96.35 | 65.65 | 49.65 | 805.77 | 565.48 |
| 1338-39 | 42.09 | 48.19 | 47.01 | 43.70 | 48.26 | 45.45 | 75.45 | 98.91 | 76.12 | 55.69 | 50.99 | 52.66 | 684.52 | 357.16 |
| 1339-40 | 46.32 | 44.66 | 38.72 | 38.10 | 38.72 | 38.85 | 48.56 | 88.39 | 65.56 | 40.12 | 43.55 | 42.94 | 572.49 | 286.18 |
| 1340-41 | 31.00 | 32.17 | 28.54 | 25.58 | 30.49 | 23.70 | 32.43 | 76.55 | 115.44 | 54.35 | 33.32 | 34.56 | 518.13 | 312.09 |
| 1341-42 | 31.93 | 31.96 | 26.83 | 23.82 | 25.17 | 27.81 | 39.56 | 69.21 | 103.60 | 63.94 | 43.98 | 39.24 | 527.05 | 320.29 |
| 1342-43 | 30.25 | 37.72 | 33.05 | 26.51 | 10.89 | 30.57 | 56.90 | 126.00 | 90.91 | 58.04 | 42.88 | 39.24 | 586.96 | 376.73 |
| 1343-44 | 27.94 | 30.02 | 26.26 | 24.70 | 25.92 | 32.58 | 60.75 | 154.19 | 142.03 | 80.78 | 49.76 | 37.12 | 692.05 | 487.51 |
| 1344-45 | 37.35 | 40.98 | 35.25 | 29.28 | 31.05 | 29.79 | 63.24 | 144.75 | 120.44 | 69.98 | 47.38 | 32.51 | 681.98 | 445.79 |
| 1345-46 | 34.56 | 30.89 | 25.97 | 26.83 | 25.85 | 28.74 | 38.68 | 103.17 | 94.10 | 53.22 | 35.59 | 28.33 | 525.93 | 324.76 |
| 1346-47 | 31.44 | 28.41 | 26.51 | 20.74 | 8.06 | 38.89 | 88.17 | 127.01 | 176.67 | 111.61 | 62.78 | 39.02 | 759.31 | 566.24 |
| 1347-48 | 30.38 | 34.01 | 35.21 | 24.93 | 27.95 | 70.48 | 132.42 | 198.12 | 177.02 | 158.80 | 89.67 | 59.30 | 1038.39 | 756.03 |
| 1348-49 | 54.41 | 59.96 | 46.89 | 39.03 | 34.14 | 33.96 | 53.30 | 63.64 | 47.79 | 31.42 | 29.17 | 29.30 | 523.01 | 225.32 |
| 1349-50 | 36.76 | 36.31 | 33.61 | 34.37 | 32.66 | 42.62 | 74.65 | 111.87 | 80.86 | 59.40 | 53.59 | 49.92 | 646.62 | 380.37 |
| 1350-51 | 38.18 | 41.73 | 37.07 | 17.75 | 27.61 | 35.01 | 69.59 | 125.08 | 194.18 | 129.20 | 118.98 | 106.46 | 940.84 | 637.03 |
| 1351-52 | 33.10 | 38.44 | 42.54 | 37.48 | 40.78 | 47.59 | 70.28 | 249.57 | 266.82 | 73.14 | 62.00 | 39.16 | 1000.92 | 721.81 |
| 1352-53 | 39.32 | 35.66 | 31.31 | 22.62 | 26.83 | 43.93 | 65.92 | 63.77 | 64.79 | 63.91 | 29.60 | 29.46 | 517.12 | 287.99 |
| 1353-54 | 20.97 | 22.58 | 20.42 | 16.14 | 20.27 | 29.71 | 40.36 | 158.64 | 249.46 | 50.84 | 29.12 | 23.78 | 682.29 | 528.42 |
| 1354-55 | 27.60 | 41.11 | 43.65 | 39.61 | 31.64 | 34.15 | 56.22 | 87.40 | 134.62 | 100.66 | 59.94 | 59.67 | 716.27 | 438.84 |
| 1355-56 | 55.78 | 57.51 | 62.60 | 47.10 | 52.39 | 49.46 | 36.83 | 91.33 | 114.56 | 80.54 | 74.73 | 52.49 | 775.32 | 397.99 |
| 1356-57 | 45.78 | 64.15 | 33.46 | 28.90 | 23.25 | 35.80 | 60.99 | 52.14 | 62.70 | 53.97 | 24.69 | 19.90 | 505.73 | 254.49 |
| 1357-58 | 59.69 | 68.23 | 71.95 | 75.19 | 76.02 | 73.99 | 36.11 | 29.71 | 62.73 | 33.96 | 38.95 | 43.44 | 669.97 | 201.46 |
| 1358-59 | 45.62 | 43.86 | 37.20 | 37.87 | 37.27 | 37.46 | 50.41 | 63.37 | 35.46 | 43.45 | 63.40 | 44.25 | 539.62 | 256.09 |
| 1359-60 | 48.83 | 42.10 | 43.84 | 38.02 | 44.79 | 45.37 | 34.10 | 94.04 | 63.29 | 94.09 | 57.88 | 41.68 | 648.03 | 343.40 |
| 1360-61 | 49.89 | 72.29 | 40.28 | 28.92 | 31.13 | 31.74 | 34.72 | 64.65 | 41.57 | 53.43 | 43.42 | 43.36 | 535.40 | 237.79 |
| 1361-62 | 42.97 | 41.79 | 41.21 | 32.12 | 36.94 | 39.19 | 34.76 | 160.03 | 137.96 | 79.15 | 68.01 | 41.22 | 755.35 | 479.91 |
| Average (MCM) | 39.01 | 41.99 | 37.28 | 30.45 | 31.46 | 37.49 | 54.56 | 99.55 | 110.51 | 75.96 | 61.73 | 49.58 | 669.57 | 402.31 |

(Note) Runoff of Residual Basin = Karehsang Runoff - Lar Runoff

## TABLE A.2.2-4 MONTHLY DISCHARGE OF THE HARAZ RIVER AT KAREHSANG

(Unit : mm)

| Year | Meh OCT | Aba NOV | Aza DEC | Dey JAN | Bah FEB | Esf MAR | Far APR | Ord MAY | Kho JUN | Tir JUL | Mor AUG | Sha SEP | Averag (cms) | Total (MCM) | Far -Mor (cms) | Far -Mor (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1329-30 | 15.90 | 13.97 | 13.00 | 12.17 | 11.90 | 12.97 | 17.61 | 30.19 | 37.71 | 21.00 | 15.23 | 15.00 | 18.15 | 572 | 24.35 | 326 |
| 1330-31 | 13.80 | 17.23 | 14.30 | 13.43 | 13.87 | 16.66 | 43.32 | 66.13 | 86.39 | 62.42 | 36.71 | 27.29 | 34.66 | 1,093 | 58.99 | 790 |
| 1331-32 | 20.63 | 20.47 | 17.83 | 12.37 | 13.63 | 17.38 | 37.07 | 76.07 | 83.19 | 67.09 | 51.55 | 25.81 | 37.30 | 1,176 | 62.99 | 844 |
| 1332-33 | 25.85 | 26.52 | 23.86 | 21.46 | 21.10 | 24.81 | 46.22 | 105.83 | 109.90 | 62.61 | 43.58 | 33.20 | 45.83 | 1,445 | 73.64 | 986 |
| 1333-34 | 22.67 | 23.26 | 20.92 | 18.82 | 16.00 | 16.26 | 22.32 | 43.32 | 58.80 | 31.12 | 23.35 | 23.00 | 26.80 | 845 | 35.78 | 479 |
| 1334-35 | 17.70 | 17.67 | 16.83 | 16.54 | 18.77 | 20.28 | 36.19 | 99.74 | 99.03 | 58.84 | 83.07 | 74.07 | 47.43 | 1,496 | 75.37 | 1,009 |
| 1335-36 | 20.83 | 18.00 | 16.20 | 13.00 | 12.03 | 12.76 | 21.19 | 63.71 | 115.19 | 108.07 | 78.45 | 49.48 | 44.63 | 1,407 | 77.32 | 1,035 |
| 1336-37 | 30.13 | 31.67 | 24.43 | 22.07 | 18.17 | 19.93 | 48.48 | 71.61 | 52.32 | 36.32 | 24.90 | 19.07 | 33.44 | 1,055 | 46.73 | 626 |
| 1337-38 | 18.40 | 17.37 | 17.17 | 15.37 | 14.93 | 14.97 | 39.42 | 109.84 | 97.94 | 53.68 | 33.52 | 24.71 | 38.53 | 1,215 | 66.88 | 896 |
| 1338-39 | 21.17 | 22.43 | 21.90 | 22.10 | 21.17 | 22.07 | 33.16 | 58.77 | 45.84 | 28.90 | 24.90 | 24.29 | 29.03 | 915 | 38.31 | 513 |
| 1339-40 | 22.03 | 20.97 | 18.80 | 18.80 | 18.40 | 17.55 | 22.23 | 57.68 | 42.90 | 25.71 | 22.48 | 21.19 | 25.85 | 815 | 34.20 | 458 |
| 1340-41 | 16.27 | 16.23 | 14.73 | 13.90 | 15.23 | 13.69 | 20.39 | 58.23 | 75.58 | 35.36 | 21.26 | 19.26 | 26.90 | 848 | 42.16 | 565 |
| 1341-42 | 17.47 | 16.67 | 13.70 | 12.87 | 12.80 | 13.93 | 27.94 | 62.00 | 88.39 | 45.19 | 28.32 | 22.03 | 30.41 | 959 | 50.37 | 675 |
| 1342-43 | 17.06 | 18.73 | 17.43 | 15.20 | 15.60 | 16.20 | 39.65 | 88.23 | 56.26 | 30.13 | 21.45 | 19.97 | 29.91 | 943 | 47.14 | 631 |
| 1343-44 | 14.73 | 14.93 | 13.43 | 12.43 | 12.90 | 16.31 | 31.42 | 105.09 | 85.03 | 42.97 | 25.65 | 19.00 | 33.18 | 1,046 | 58.03 | 777 |
| 1344-45 | 18.83 | 20.17 | 17.40 | 15.00 | 15.37 | 16.38 | 34.74 | 89.07 | 77.26 | 40.07 | 25.32 | 17.03 | 32.51 | 1,025 | 53.29 | 714 |
| 1345-46 | 18.10 | 16.63 | 14.00 | 13.73 | 13.00 | 14.35 | 19.13 | 69.42 | 61.36 | 30.32 | 19.55 | 15.07 | 25.59 | 807 | 39.96 | 535 |
| 1346-47 | 16.17 | 14.27 | 13.50 | 11.20 | 11.30 | 18.53 | 41.32 | 95.58 | 134.61 | 67.19 | 34.42 | 23.26 | 40.60 | 1,280 | 74.62 | 999 |
| 1347-48 | 17.77 | 18.90 | 18.00 | 16.63 | 16.80 | 36.39 | 76.52 | 160.55 | 144.90 | 93.84 | 51.09 | 32.16 | 57.61 | 1,817 | 105.38 | 1,411 |
| 1348-49 | 28.29 | 32.24 | 24.44 | 20.53 | 17.92 | 18.01 | 34.78 | 43.51 | 34.09 | 20.43 | 17.02 | 15.61 | 25.63 | 808 | 29.97 | 401 |
| 1349-50 | 18.05 | 17.33 | 16.07 | 15.90 | 15.40 | 20.25 | 38.69 | 94.08 | 75.26 | 37.52 | 27.82 | 24.03 | 33.67 | 1,062 | 54.67 | 732 |
| 1350-51 | 19.34 | 20.17 | 17.77 | 16.93 | 16.35 | 18.31 | 32.90 | 98.71 | 130.90 | 81.09 | 58.22 | 47.25 | 47.04 | 1,483 | 80.36 | 1,076 |
| 1351-52 | 19.92 | 20.07 | 20.72 | 18.75 | 19.42 | 24.18 | 42.66 | 143.93 | 140.32 | 42.99 | 31.05 | 20.29 | 45.82 | 1,445 | 80.19 | 1,074 |
| 1352-53 | 19.92 | 17.81 | 16.02 | 12.22 | 13.50 | 20.70 | 35.61 | 55.29 | 49.64 | 39.06 | 19.93 | 17.94 | 26.65 | 840 | 39.91 | 534 |
| 1353-54 | 13.66 | 12.56 | 10.97 | 9.01 | 10.01 | 14.01 | 33.86 | 97.21 | 131.43 | 32.40 | 17.76 | 13.87 | 33.47 | 1,056 | 62.53 | 837 |
| 1354-55 | 14.55 | 19.41 | 19.60 | 18.10 | 14.55 | 15.83 | 26.61 | 86.95 | 101.37 | 61.01 | 33.39 | 28.44 | 37.03 | 1,168 | 61.87 | 829 |
| 1355-56 | 26.31 | 26.56 | 27.58 | 21.10 | 23.09 | 23.67 | 23.63 | 61.32 | 75.56 | 43.38 | 35.26 | 25.27 | 34.58 | 1,091 | 47.83 | 641 |
| 1356-57 | 23.61 | 30.35 | 17.97 | 14.93 | 12.18 | 18.44 | 49.44 | 59.16 | 56.12 | 38.41 | 18.87 | 13.54 | 29.61 | 934 | 44.40 | 595 |
| 1357-58 | 27.42 | 30.55 | 31.15 | 31.79 | 32.28 | 32.40 | 35.46 | 57.94 | 66.14 | 34.50 | 24.85 | 22.85 | 35.70 | 1,126 | 43.78 | 586 |
| 1358-59 | 22.32 | 21.08 | 17.38 | 17.61 | 16.93 | 17.60 | 40.61 | 52.95 | 46.14 | 31.20 | 31.20 | 21.70 | 28.24 | 891 | 40.42 | 541 |
| 1359-60 | 23.77 | 20.60 | 21.04 | 20.85 | 21.50 | 21.70 | 25.04 | 74.48 | 63.48 | 53.27 | 30.73 | 21.83 | 33.41 | 1,054 | 49.40 | 662 |
| 1360-61 | 23.13 | 31.32 | 18.56 | 16.02 | 15.33 | 15.49 | 22.65 | 55.12 | 46.88 | 34.23 | 23.39 | 21.13 | 27.08 | 854 | 36.45 | 488 |
| 1361-62 | 22.47 | 21.33 | 20.49 | 19.78 | 19.30 | 19.93 | 27.70 | 106.81 | 99.16 | 51.24 | 36.29 | 22.89 | 39.30 | 1,239 | 64.24 | 860 |
| Mean | 20.25 | 20.83 | 18.46 | 16.75 | 16.39 | 18.85 | 34.18 | 78.74 | 80.88 | 46.71 | 32.44 | 24.89 | 34.41 | 1,085 | 54.59 | 731 |
| (%) | 58.8 | 60.5 | 53.6 | 48.7 | 47.6 | 54.8 | 99.3 | 228.8 | 235 | 135.7 | 94.3 | 72.3 | 100 | | 158.6 | |
| S.D. | 4.19 | 5.34 | 4.31 | 4.34 | 4.25 | 5.06 | 11.46 | 28.03 | 31.46 | 19.96 | 15.87 | 11.71 | 8.14 | 257 | 17.56 | 235 |
| Max | 30.13 | 32.24 | 31.15 | 31.79 | 32.28 | 36.39 | 76.52 | 160.55 | 144.9 | 108.07 | 83.07 | 74.07 | 57.61 | | 105.38 | |
| Min | 13.66 | 12.56 | 10.97 | 9.01 | 10.01 | 12.76 | 17.61 | 30.19 | 34.09 | 20.43 | 15.23 | 13.54 | 18.15 | | 24.35 | |
| MCM | 52.49 | 53.99 | 47.85 | 43.42 | 42.48 | 47.23 | 91.55 | 210.90 | 216.63 | 125.11 | 86.89 | 66.67 | | 1,085 | | 731 |
| (%) | 4.8 | 5 | 4.4 | 4 | 3.9 | 4.4 | 8.4 | 19.4 | 20 | 11.5 | 8 | 6.1 | | 100 | | 67 |

(Data Source) HWDP-1 Study Report (A-2, Hydrology)

(Note) 1. Conversion from cms to MCM is computed under the following conditions.
Number of days in a year = 365 days
Number of days in a month are as below;
30days/month for Mehr-Bahman, 29days for Esfand, 31days for Farvardin-Sharivar

2. [ ] interpolated by the data of Shirgah(Tatar) and Razan by the HWDP-1 Study.

## TABLE A.2.2-5 MONTHLY DISCHARGE OF THE HARAZ RIVER AT SORKH RUD

(Unit : cms)

| Year | MEHR OCT | ABAN NOV | AZAR DEC | DEY JAN | BAHMAN FEB | ESFAND MAR | FARVARD APR | ORDIBEH MAY | KHORDAD JUN | TIR JUL | MORDAD AUG | SHARIVA SEP | Average (cms) | Total (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1342-43 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1343-44 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1344-45 | 2.13 | 2.83 | 1.67 | 2.42 | 2.03 | 2.12 | 0.99 | 7.09 | 6.07 | 0.18 | 0.30 | 1.42 | 2.442 | 77.01 |
| 1345-46 | 3.83 | 4.18 | 1.59 | 2.26 | 2.32 | 2.23 | 0.67 | 7.79 | 1.96 | 0.11 | 0.17 | 0.20 | 2.268 | 71.52 |
| 1346-47 | 1.03 | 0.77 | 0.53 | 0.89 | 1.03 | 0.50 | 1.06 | 10.27 | 40.22 | 8.40 | 1.41 | 4.10 | 5.949 | 187.61 |
| 1347-48 | 3.74 | 4.17 | 5.98 | 4.19 | 4.39 | 15.84 | 44.42 | 74.65 | 14.46 | 3.11 | 11.43 | 17.96 | 17.207 | 542.64 |
| 1348-49 | 1.67 | 2.58 | 2.97 | 2.72 | 2.10 | 6.53 | 4.33 | 0.33 | 0.11 | 0.03 | 0.47 | 0.79 | 2.023 | 63.80 |
| 1349-50 | 1.02 | 0.70 | 0.93 | 1.04 | 1.01 | 0.80 | 0.49 | 8.45 | 6.16 | 0.49 | 0.60 | 0.80 | 1.893 | 59.70 |
| 1350-51 | 5.35 | 8.20 | 9.45 | 8.64 | 6.68 | 7.66 | 10.87 | 23.79 | 15.59 | 2.32 | 2.85 | 5.79 | 8.957 | 282.47 |
| 1351-52 | 13.30 | 10.90 | 11.21 | 11.52 | 11.07 | 11.23 | 8.20 | 19.20 | 7.88 | 0.00 | 0.03 | 4.04 | 9.001 | 283.86 |
| 1352-53 | 1.84 | 2.83 | 3.26 | 2.98 | 2.30 | 2.64 | 3.75 | 8.18 | 5.37 | 0.80 | 0.98 | 2.00 | 3.086 | 97.32 |
| 1353-54 | 2.99 | 4.59 | 5.29 | 4.84 | 3.74 | 4.29 | 6.09 | 13.32 | 8.73 | 1.30 | 1.60 | 3.24 | 5.015 | 158.15 |
| 1354-55 | 0.24 | 0.00 | 1.45 | 2.91 | 0.05 | 0.12 | 3.68 | 38.58 | 40.82 | 0.83 | 0.73 | 0.23 | 7.600 | 239.67 |
| 1355-56 | 2.53 | 5.08 | 3.02 | 4.21 | 3.23 | 3.05 | 2.05 | 0.13 | 0.15 | 0.00 | 1.75 | 4.06 | 2.419 | 76.29 |
| 1356-57 | 3.81 | 8.78 | 16.48 | 7.41 | 5.54 | 11.80 | 9.07 | 17.20 | 2.22 | 0.13 | 0.09 | 0.28 | 6.853 | 216.12 |
| 1357-58 | 2.09 | 7.19 | 5.36 | 6.58 | 7.10 | 8.92 | 3.66 | 18.65 | 13.01 | 1.39 | 4.35 | 3.73 | 6.840 | 215.71 |
| 1358-59 | 3.41 | 1.98 | 1.01 | 1.90 | 1.61 | 1.19 | 21.99 | 9.43 | 6.18 | 0.92 | 0.13 | 1.84 | 4.348 | 137.12 |
| 1359-60 | 1.05 | 4.70 | 3.68 | 3.41 | 0.91 | 3.70 | 4.92 | 19.06 | 11.94 | 6.09 | 2.55 | 7.66 | 5.861 | 184.83 |
| 1360-61 | 6.66 | 4.60 | 4.75 | 11.24 | 7.79 | 4.67 | 2.15 | 0.58 | 0.56 | 0.84 | 3.36 | 4.49 | 4.269 | 134.63 |
| 1361-62 | 7.05 | 20.33 | 30.65 | 20.38 | 14.06 | 3.95 | 1.04 | 0.02 | 0.09 | 2.00 | 0.87 | 6.43 | 8.802 | 277.58 |
| Mean | 3.541 | 5.245 | 6.071 | 5.530 | 4.276 | 5.069 | 7.191 | 15.374 | 10.084 | 1.608 | 1.871 | 3.837 | 5.824 | 183.67 |
| (%) | 60.8 | 90.1 | 104.2 | 95 | 73.4 | 87 | 123.5 | 264 | 173.1 | 27.6 | 32.1 | 65.9 | 100 | |
| S.D(cms) | 3.003 | 4.629 | 7.185 | 4.763 | 3.697 | 4.296 | 10.348 | 17.273 | 11.801 | 2.198 | 2.615 | 4.056 | 3.892 | 122.75 |
| Max | 13.3 | 20.33 | 30.65 | 20.38 | 14.06 | 15.84 | 44.42 | 74.65 | 40.82 | 8.4 | 11.43 | 17.96 | 17.207 | 542.64 |
| Min | 0.24 | 0 | 0.53 | 0.89 | 0.05 | 0.12 | 0.49 | 0.02 | 0.09 | 0 | 0.03 | 0.2 | 0 | 0 |
| MCM | 9.18 | 13.60 | 15.74 | 14.33 | 11.08 | 12.70 | 19.26 | 41.18 | 27.01 | 4.31 | 5.01 | 10.28 | | 183.68 |
| (%) | 5 | 7.4 | 8.6 | 7.8 | 6 | 6.9 | 10.5 | 22.4 | 14.7 | 2.3 | 2.7 | 5.6 | | 100 |

(Data Source) HWDP-1 Study Report (A-2, Hydrology)

(Note) 1. Conversion from cms to MCM is computed under the following condition.

*Number of days in an Year = 365 days*

Number onth Esfand

30days/month for Mehr-Bahman, 29days for Esfand, 31days for Farvardin-Sharivar

2. [ ] interpolated with the data of Karehsang by the HWDP-1 Study.

## TABLE A.2.2-6 MONTHLY DISCHARGE OF THE BABOL RIVER AT GHARAN TALAR

(Unit : cms)

| Year | Meh OCT | Aba NOV | Aza DEC | Dey JAN | Bah FEB | Esf MAR | Far APR | Ord MAY | Kho JUN | Tir JUL | Mor AUG | Sha SEP | Averag (cms) | Total (MCM) | Far -Mor (cms) | Far -Mor (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1329-30 | 4.46 | 6.25 | 7.06 | 5.26 | 6.97 | 11.14 | 6.68 | 5.58 | 1.87 | 1.99 | 1.21 | 3.63 | 5.13 | 162 | 3.47 | 46 |
| 1330-31 | 15.59 | 14.00 | 6.76 | 4.35 | 7.03 | 11.87 | 8.65 | 13.24 | 4.34 | 9.67 | 1.01 | 6.79 | 8.58 | 271 | 7.38 | 99 |
| 1331-32 | 3.12 | 4.69 | 3.70 | 5.22 | 5.15 | 8.40 | 16.71 | 4.81 | 5.09 | 2.99 | 16.59 | 10.83 | 7.32 | 231 | 9.24 | 124 |
| 1332-33 | 8.15 | 8.04 | 5.42 | 7.29 | 4.35 | 8.32 | 13.70 | 5.53 | 1.74 | 3.50 | 12.32 | 7.18 | 7.13 | 225 | 7.36 | 99 |
| 1333-34 | 5.00 | 4.58 | 5.99 | 3.94 | 2.70 | 6.96 | 7.76 | 5.47 | 5.94 | 2.48 | 2.39 | 6.25 | 4.95 | 156 | 4.81 | 64 |
| 1334-35 | 7.41 | 3.87 | 3.88 | 3.89 | 6.09 | 8.91 | 13.57 | 4.75 | 5.50 | 1.43 | 3.75 | 4.67 | 5.63 | 178 | 5.80 | 78 |
| 1335-36 | 11.91 | 4.41 | 5.86 | 4.85 | 7.91 | 8.33 | 11.63 | 3.23 | 18.17 | 8.49 | 9.44 | 3.55 | 8.16 | 257 | 10.19 | 136 |
| 1336-37 | 12.06 | 15.95 | 8.99 | 6.99 | 3.95 | 4.43 | 9.63 | 4.03 | 6.06 | 7.47 | 5.95 | 5.91 | 7.61 | 240 | 6.63 | 89 |
| 1337-38 | 8.63 | 10.85 | 8.70 | 4.93 | 14.90 | 13.29 | 16.58 | 14.29 | 5.96 | 3.62 | 4.27 | 10.58 | 9.70 | 306 | 8.94 | 120 |
| 1338-39 | 10.83 | 20.47 | 12.19 | 5.19 | 3.68 | 7.73 | 18.34 | 7.06 | 5.03 | 9.06 | 4.07 | 12.01 | 9.64 | 304 | 8.71 | 117 |
| 1339-40 | 5.31 | 11.00 | 6.66 | 8.40 | 7.21 | 9.00 | 13.24 | 4.31 | 5.77 | 1.09 | 3.48 | 14.18 | 7.46 | 235 | 5.58 | 75 |
| 1340-41 | 11.95 | 11.40 | 6.50 | 5.14 | 10.91 | 5.83 | 10.92 | 7.79 | 13.35 | 2.54 | 2.54 | 10.15 | 8.25 | 260 | 7.43 | 100 |
| 1341-42 | 7.08 | 9.76 | 3.78 | 3.15 | 3.90 | 7.19 | 6.64 | 20.01 | 4.92 | 4.27 | 5.56 | 10.47 | 7.25 | 229 | 8.28 | 111 |
| 1342-43 | 32.89 | 8.32 | 7.14 | 7.70 | 9.94 | 12.76 | 16.00 | 6.16 | 1.30 | 2.33 | 8.48 | 21.67 | 11.21 | 354 | 6.85 | 92 |
| 1343-44 | 6.46 | 6.93 | 3.81 | 5.16 | 5.63 | 8.56 | 7.45 | 5.63 | 1.15 | 4.50 | 7.21 | 7.74 | 5.84 | 184 | 5.19 | 70 |
| 1344-45 | 6.03 | 6.27 | 3.76 | 7.97 | 4.15 | 12.32 | 10.57 | 11.59 | 2.19 | 2.07 | 2.16 | 4.47 | 6.10 | 192 | 5.72 | 77 |
| 1345-46 | 28.84 | 3.90 | 1.26 | 1.67 | 5.54 | 7.35 | 16.64 | 5.97 | 4.01 | 1.22 | 4.07 | 3.74 | 7.00 | 221 | 6.38 | 85 |
| 1346-47 | 12.52 | 4.64 | 5.36 | 9.50 | 9.75 | 12.49 | 13.73 | 8.67 | 14.08 | 8.95 | 3.96 | 7.08 | 9.22 | 291 | 9.88 | 132 |
| 1347-48 | 1.74 | 12.29 | 9.45 | 3.22 | 7.36 | 6.32 | 10.77 | 2.62 | 2.12 | 6.22 | 8.72 | 14.56 | 7.28 | 230 | 6.09 | 82 |
| 1348-49 | 10.18 | 13.95 | 10.43 | 9.80 | 7.83 | 10.48 | 7.80 | 4.76 | 4.96 | 2.38 | 8.27 | 18.49 | 9.09 | 287 | 5.63 | 75 |
| 1349-50 | 4.96 | 7.24 | 4.95 | 5.58 | 9.46 | 9.96 | 8.94 | 3.57 | 1.93 | 1.93 | 0.38 | 1.82 | 5.01 | 158 | 3.35 | 45 |
| 1350-51 | 1.07 | 3.40 | 2.59 | 4.20 | 4.70 | 10.22 | 13.97 | 15.79 | 9.01 | 3.95 | 4.53 | 2.69 | 6.37 | 201 | 9.45 | 127 |
| 1351-52 | 1.46 | 1.76 | 5.43 | 5.33 | 7.29 | 6.71 | 9.36 | 6.96 | 4.12 | 5.81 | 1.59 | 18.93 | 6.25 | 197 | 5.57 | 75 |
| 1352-53 | 6.59 | 5.36 | 5.09 | 4.47 | 8.12 | 13.75 | 15.51 | 6.23 | 3.09 | 9.30 | 5.50 | 7.84 | 7.56 | 238 | 7.93 | 106 |
| 1353-54 | 6.30 | 5.78 | 4.48 | 4.06 | 4.90 | 6.56 | 8.13 | 5.16 | 4.06 | 3.43 | 3.65 | 5.99 | 5.20 | 164 | 4.89 | 65 |
| 1354-55 | 8.74 | 8.01 | 6.21 | 5.63 | 6.79 | 9.10 | 11.26 | 7.15 | 5.63 | 4.77 | 5.05 | 8.30 | 7.21 | 227 | 6.77 | 91 |
| 1355-56 | 8.64 | 7.93 | 6.14 | 5.57 | 6.71 | 9.00 | 11.14 | 7.07 | 5.57 | 4.71 | 5.00 | 8.21 | 7.13 | 225 | 6.70 | 90 |
| 1356-57 | 8.82 | 7.52 | 4.56 | 3.85 | 8.07 | 8.09 | 6.33 | 5.74 | 8.24 | 6.77 | 4.75 | 5.64 | 6.52 | 206 | 6.37 | 85 |
| 1357-58 | 4.13 | 6.94 | 6.50 | 6.39 | 7.66 | 8.10 | 9.31 | 10.06 | 7.88 | 4.94 | 6.28 | 4.35 | 6.88 | 217 | 7.69 | 103 |
| 1358-59 | 3.49 | 5.48 | 6.43 | 5.55 | 6.65 | 9.96 | 10.34 | 4.58 | 3.68 | 3.37 | 3.95 | 6.82 | 5.84 | 184 | 5.18 | 69 |
| 1359-60 | 5.56 | 8.61 | 5.50 | 6.73 | 4.48 | 6.75 | 13.93 | 6.53 | 6.68 | 8.59 | 4.85 | 4.28 | 6.88 | 217 | 8.12 | 109 |
| 1360-61 | 6.52 | 4.92 | 8.50 | 8.55 | 6.51 | 8.24 | 7.88 | 4.14 | 4.31 | 4.22 | 3.41 | 1.81 | 5.72 | 180 | 4.79 | 64 |
| 1361-62 | 7.95 | 7.69 | 8.17 | 3.89 | 4.64 | 6.99 | 7.18 | 5.21 | 6.55 | 6.96 | 3.11 | 9.50 | 6.48 | 204 | 5.80 | 78 |
| Mean | 8.62 | 7.95 | 6.10 | 5.56 | 6.69 | 9.00 | 11.22 | 7.08 | 5.58 | 4.70 | 5.08 | 8.19 | 7.14 | 225 | 6.73 | 90 |
| (%) | 120.7 | 111.3 | 85.4 | 77.9 | 93.7 | 126.1 | 157.1 | 99.2 | 78.2 | 65.8 | 71.1 | 114.7 | 100 | | 94.3 | |
| S.D. | 6.58 | 3.96 | 2.25 | 1.86 | 2.43 | 2.23 | 3.40 | 3.82 | 3.66 | 2.59 | 3.27 | 4.86 | 1.46 | 46 | 1.72 | 23 |
| Max | 32.89 | 20.47 | 12.19 | 9.8 | 14.9 | 13.75 | 18.34 | 20.01 | 18.17 | 9.67 | 16.59 | 21.87 | 11.21 | | 10.19 | |
| Min | 1.07 | 1.76 | 1.26 | 1.67 | 2.7 | 4.43 | 6.33 | 2.62 | 1.15 | 1.09 | 0.38 | 1.81 | 4.95 | | 3.35 | |
| MCM | 22.34 | 20.61 | 15.81 | 14.41 | 17.34 | 22.55 | 30.05 | 18.96 | 14.95 | 12.59 | 13.61 | 21.94 | | 225 | | 90 |
| (%) | 9.9 | 9.2 | 7 | 6.4 | 7.7 | 10 | 13.3 | 8.4 | 6.6 | 5.6 | 6 | 9.7 | | 100 | | 40 |

(Data Source) HWDP-1 Study Report (A-2, Hydrology)

(Note) 1. Conversion from cms to MCM is computed under the following conditions.
Number of days in a year = 365 days
Number of days in a month are as below;
30days/month for Mehr-Bahman, 29days for Esfand, 31days for Farvardin-Sharivar

2. [ ] interpolated by the data of Shirgah(Talar) and Razan by the HWDP-1 Study.

## TABLE A.2.2-7 MONTHLY DISCHARGE OF THE KELA RUD AT DIVA

(Unit : cms)

| Year | MEHR OCT | ABAN NOV | AZAR DEC | DEY JAN | BAHMAN FEB | ESFAND MAR | FARVARD APR | ORDIBEH MAY | KHORDAD JUN | TIR JUL | MORDAD AUG | SHARIVA SEP | Average (cms) | Total (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1345-46 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1346-47 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1347-48 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1348-49 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1349-50 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1350-51 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1351-52 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1352-53 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1353-54 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1354-55 | 1.61 | 1.57 | 2.67 | 2.08 | 1.94 | 3.69 | 4.31 | 2.47 | 2.64 | 1.86 | 0.72 | 1.27 | 2.231 | 70.36 |
| 1355-56 | 1.64 | 1.79 | 2.68 | 3.28 | 3.35 | 2.91 | 2.57 | 1.30 | 0.90 | 1.72 | 2.68 | 1.83 | 2.213 | 69.79 |
| 1356-57 | 1.69 | 1.56 | 1.43 | 1.53 | 1.61 | 1.99 | 1.97 | 1.64 | 1.79 | 1.69 | 1.44 | 1.48 | 1.651 | 52.07 |
| 1357-58 | 0.76 | 0.63 | 0.62 | 0.83 | 0.94 | 0.94 | 0.78 | 0.82 | 0.78 | 0.86 | 0.99 | 1.09 | 0.837 | 26.40 |
| 1358-59 | 0.90 | 1.24 | 2.01 | 1.19 | 2.39 | 4.94 | 3.41 | 1.11 | 1.01 | 1.05 | 0.96 | 1.63 | 1.807 | 56.99 |
| 1359-60 | 2.32 | 1.27 | 1.54 | 1.87 | 1.62 | 1.79 | 2.68 | 1.97 | 2.11 | 2.37 | 2.12 | 1.76 | 1.956 | 61.68 |
| 1360-61 | 1.90 | 1.18 | 1.67 | 2.16 | 2.19 | 2.65 | 3.37 | 4.11 | 3.51 | 3.60 | 3.32 | 0.91 | 2.557 | 80.64 |
| 1361-62 | 0.98 | 1.04 | 2.15 | 2.23 | 1.63 | 1.79 | 1.70 | 1.39 | 1.38 | 2.09 | 1.49 | 2.31 | 1.682 | 53.04 |
| 1362-63 | 2.75 | 1.35 | 3.21 | 2.65 | 2.62 | 3.28 | 2.53 | 2.03 | 1.72 | 1.35 | 1.99 | 1.39 | 2.230 | 70.33 |
| 1363-64 | 0.89 | 1.33 | 2.56 | 2.93 | 3.78 | 4.09 | 2.96 | 1.63 | 1.10 | 1.16 | 1.17 | 1.32 | 2.063 | 65.06 |
| 1364-65 | 2.62 | 7.04 | 1.43 | 2.29 | 3.13 | 2.68 | 2.45 | 1.58 | 0.84 | 0.84 | 0.75 | 0.92 | 2.197 | 69.28 |
| Mean | 1.642 | 1.818 | 1.997 | 2.095 | 2.291 | 2.795 | 2.612 | 1.823 | 1.616 | 1.690 | 1.603 | 1.446 | 1.947 | 61.40 |
| (%) | 84.3 | 93.4 | 102.6 | 107.6 | 117.7 | 143.6 | 134.2 | 93.6 | 83 | 86.8 | 82.3 | 74.3 | 100 | |
| S.D(cms) | 0.677 | 1.676 | 0.713 | 0.691 | 0.824 | 1.107 | 0.897 | 0.843 | 0.822 | 0.770 | 0.800 | 0.401 | 1.021 | 32.21 |
| Max | 2.75 | 7.04 | 3.21 | 3.28 | 3.78 | 4.94 | 4.31 | 4.11 | 3.51 | 3.6 | 3.32 | 2.31 | 2.557 | 80.64 |
| Min | 0.76 | 0.63 | 0.62 | 0.83 | 0.94 | 0.94 | 0.78 | 0.82 | 0.78 | 0.84 | 0.72 | 0.91 | 0 | 0 |
| MCM | 4.26 | 4.71 | 5.18 | 5.43 | 5.94 | 7.00 | 7.00 | 4.88 | 4.33 | 4.53 | 4.29 | 3.87 | | 61.42 |
| (%) | 6.9 | 7.7 | 8.4 | 8.8 | 9.7 | 11.4 | 11.4 | 7.9 | 7 | 7.4 | 7 | 6.3 | | 100 |

(Data Source) 1354-55 to 1356-57 : HWDP-1 Study Report (A-2, Hydrology)
1357-58 to 1364-65 : MOE

(Note) 1. Conversion from cms to MCM is computed under the following condition.
Number of days in an Year = 365 days
Number onth Esfand
30days/month for Mehr-Bahman, 29days for Esfand, 31days for Farvardin-Sharivar
2. [ ] interpolated with the data of Karehsang by the HWDP-1 Study.

## TABLE A.2.2.-8 MONTHLY DISCHARGE OF THE SAJJAD RUD AT GHALOUGH (BANDPAY)

(Unit : cms)

| Year | MEHR OCT | ABAN NOV | AZAR DEC | DEY JAN | BAHMAN FEB | ESFAND MAR | FARVARDIN APR | ORDIBEHESHT MAY | KHORDAD JUN | TIR JUL | MORDAD AUG | SHARIVAR SEP | Average (cms) | Total (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1345-46 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1346-47 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1347-48 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1348-49 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1349-50 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1350-51 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1351-52 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1352-53 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1353-54 | 2.02 | 1.79 | 1.25 | 1.09 | 1.42 | 2.14 | 2.88 | 1.52 | 1.09 | 0.86 | 0.94 | 1.88 | 1.571 | 49.54 |
| 1354-55 | 2.75 | 3.33 | 3.69 | 2.20 | 1.11 | 2.41 | 5.77 | 3.13 | 1.58 | 0.95 | 0.59 | 0.95 | 2.368 | 74.68 |
| 1355-56 | 3.15 | 2.79 | 1.95 | 3.03 | 2.59 | 3.24 | 2.51 | 0.99 | 0.68 | 1.35 | 1.37 | 2.80 | 2.192 | 69.13 |
| 1356-57 | 3.24 | 2.59 | 1.28 | 1.01 | 2.86 | 2.87 | 2.03 | 1.77 | 2.94 | 2.23 | 1.35 | 1.72 | 2.153 | 67.90 |
| 1357-58 | 1.12 | 2.32 | 2.11 | 2.06 | 2.66 | 2.88 | 3.49 | 3.89 | 2.79 | 1.43 | 2.01 | 1.20 | 2.331 | 73.51 |
| 1358-59 | 0.97 | 1.18 | 1.19 | 0.99 | 2.25 | 3.55 | 3.40 | 0.37 | 0.38 | 0.33 | 0.35 | 1.26 | 1.340 | 42.26 |
| 1359-60 | 5.45 | 5.44 | 2.65 | 5.61 | 1.99 | 3.15 | 6.78 | 2.54 | 1.91 | 3.04 | 1.40 | 1.17 | 3.418 | 107.79 |
| 1360-61 | 2.12 | 2.33 | 3.38 | 2.96 | 3.24 | 5.86 | 5.62 | 2.28 | 2.56 | 2.22 | 1.25 | 0.39 | 2.835 | 89.40 |
| 1361-62 | 1.63 | 3.20 | 2.31 | 1.51 | 1.54 | 3.49 | 4.07 | 2.27 | 1.69 | 1.77 | 0.78 | 4.96 | 2.435 | 76.79 |
| 1362-63 | 3.93 | 1.58 | 3.91 | 3.06 | 2.93 | 4.38 | 2.86 | 2.92 | 1.97 | 1.11 | 1.11 | 1.66 | 2.602 | 82.06 |
| 1363-64 | | | | | | | | | | | | | 0.000 | 0.00 |
| 1364-65 | 1.79 | 1.84 | 2.40 | 2.21 | 3.81 | 3.21 | 3.81 | 1.39 | 0.74 | 0.75 | 0.28 | 1.06 | 1.927 | 60.77 |
| Mean | 2.561 | 2.581 | 2.375 | 2.339 | 2.400 | 3.380 | 3.929 | 2.097 | 1.666 | 1.458 | 1.039 | 1.732 | 2.288 | 72.15 |
| (%) | 111.9 | 112.8 | 103.8 | 102.2 | 104.9 | 147.7 | 171.7 | 91.7 | 72.8 | 63.7 | 45.4 | 75.7 | 100 | |
| S.D(cms) | 1.266 | 1.105 | 0.919 | 1.280 | 0.789 | 0.967 | 1.438 | 0.971 | 0.835 | 0.757 | 0.492 | 1.178 | 1.208 | 38.10 |
| Max | 5.45 | 5.44 | 3.91 | 5.61 | 3.81 | 5.86 | 6.78 | 3.89 | 2.94 | 3.04 | 2.01 | 4.96 | 3.418 | 107.79 |
| Min | 0.97 | 1.18 | 1.19 | 0.99 | 1.11 | 2.14 | 2.03 | 0.37 | 0.38 | 0.33 | 0.28 | 0.39 | 0 | 0 |
| MCM | 6.64 | 6.69 | 6.16 | 6.06 | 6.22 | 8.47 | 10.52 | 5.62 | 4.46 | 3.91 | 2.78 | 4.64 | | 72.17 |
| (%) | 9.2 | 9.3 | 8.5 | 8.4 | 8.6 | 11.7 | 14.6 | 7.8 | 6.2 | 5.4 | 3.9 | 6.4 | | 100 |

(Data Source) 1353-54 : HWDP-1 Study Report (A-2, Hydrology)
1354-55 to 1364-65 : MOE

(Note) 1. Conversion from cms to MCM is computed under the following condition.
Number of days in an Year = 365 days
Number onth Esfand
30days/month for Mehr-Bahman, 29days for Esfand, 31days for Farvardin-Sharivar
2. [ ] interpolated with the data of Karehsang by the HWDP-1 Study.

## A. 2. 3 Floods

### 1. Review of the Catchment Area of the Basin

At the first step of the flood analysis, catchment areas were reviewed at the key stations and sites on the map of scale 1 : 50,000. Details are Table A. 2. 3 - 1. Major revisions are as follows;

| | HWDP - 1 | Revised |
|---|---|---|
| Sajjad Rud (Galough) | 261 sq.km | 256 sq.km |
| Kela Rud (Diva) | 136 | 130 |

### 2. Floods of the Babol River

Floods of the Babol river has been analyzed by the observed records at Babol and Gharan Talar. Table A. 2. 3 - 4 presents revised floods discharges at both stations, verifying the reliability and correlation. Depending on the revised flood discharges, statistic analysis has been given, and the result is as follows;

**Probable Flood Discharge at Gharan Talar and Babol**

| | Drainage Area | Probable Flood Discharge Return Period. (years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (sq.km) | 2 | 5 | 10 | 15 | 20 | 25 | 30 | 50 | 100 |
| Babol River | 393 | | | | | | | | | |
| Gharan Talar | | | | | | | | | | |
| Instantaneous | | | | | | | | | | |
| (cms) | | 115 | 204 | 275 | 318 | 351 | 376 | 398 | 461 | 554 |
| (cms/sq.km) | | 0.293 | 0.519 | 0.700 | 0.809 | 0.893 | 0.957 | 1.013 | 1.173 | 1.410 |
| Daily | | | | | | | | | | |
| (cms) | | 67 | 109 | 141 | 161 | 175 | 186 | 196 | 224 | 264 |
| (cms/sq.km) | | 0.170 | 0.277 | 0.359 | 0.410 | 0.445 | 0.473 | 0.499 | 0.570 | 0.672 |
| Babol | 1643 | | | | | | | | | |
| Instantaneous | | | | | | | | | | |
| (cms) | | 277 | 397 | 471 | 512 | 539 | 560 | 577 | 624 | 685 |
| (cms/sq.km) | | 0.169 | 0.242 | 0.287 | 0.312 | 0.328 | 0.341 | 0.351 | 0.380 | 0.417 |
| Daily | | | | | | | | | | |
| (cms) | | 178 | 268 | 327 | 360 | 383 | 401 | 416 | 456 | 519 |
| (cms/sq.km) | | 0.108 | 0.163 | 0.199 | 0.219 | 0.233 | 0.244 | 0.253 | 0.278 | 0.316 |

## 3. Floods of the Tributaries

Floods of the tributaries has been analyzed by means of comparing the time of concentration. Estimation of the time of concentration is shown in Table A. 2. 3 - 2. Time of concentration is computed by Rziha Formula which is commonly applied for estimating the time of concentration in the mountain ranges.

The result shows that the time of concentration of the Garma Rud and the Alesh rivers is about 3.5 hours and likely similar to that of the Babol river at Gharan Talar. Therefore, specific flood runoff of Gharan Talar is applicable to those tributaries. Tables A2. 3 - 9 to 10 present the flood for the Kari Rud, the Alesh river, and the lower Babol reach of Babol river, respectively.

**TABLE A. 2. 3 - 1 REVIEW OF CATCHMENT AREA**

(Unit : $km^2$)

| River Station/Site | MOE | HWDP-1 Report | Measured on 1 :50,000 Map | Applied C. A. in This Study |
|---|---|---|---|---|
| Kosilian River | | | | |
| Shirgah | 235 | 343 | - | - |
| Talar River | | | | |
| Shirgah | 1,870 | 1,773 | - | - |
| Kia Kola | 2,845 | 2,478 | - | - |
| Babol River | | | | |
| Pasha Kola dam | - | - | 220 | 220 |
| Marzi Darreh dam | - | 360 | - | 360 |
| Gharan Talar dam | - | - | - | - |
| Gharan Talar | 418.8 | 393 | 393 | 393 |
| Reeis Kola Dam | - | 526 | 539 | 526 |
| Babol | 1,430 | 1,643 | 1,625 | 1,643 |
| Sajjad Rud river | | | | |
| Band Pey (Galough) | 247 | 261 | 255.6 | 256 |
| Kela Rud River | | | | |
| Diva | 126 | 136 | 129.8 | 130 |
| Sarbura dam | - | 136 | 147.3 | - |
| Alesh River | | | | |
| Amol-Nur Road (No. 24 + 500) | | | | 162.7 |
| AWMD Junction (No. 10) | | | | 377.9 |
| Kari Rud | | | | |
| Garma Rud Junction (No. 24 + 400) | | | | 116.5 |
| Proposed Floodway (No. 18 + 400) | | | | 151.6 |

**TABLE A.2.3-2 COMPARISON OF THE TIME OF CONCENTRATION OF RIVERS (BABOL, ALESH & GARMA RIVERS)**

| Distance L (km) | Elevation H (m) | Section Distance l (km) | Section Height h (m) | Slope h/l | Flood Velocity w (km/hr) | Section Time t (hr) | Time T (hr) |
|---|---|---|---|---|---|---|---|
| 0.0 | 140 | | | | | | |
| 10.0 | 300 | 10.0 | 160 | 0.01600 | 6.02 | 1.66 | 1.66 |
| 15.5 | 500 | 5.5 | 200 | 0.03636 | 9.86 | 0.56 | 2.22 |
| 22.0 | 900 | 6.5 | 400 | 0.06154 | 13.52 | 0.48 | 2.70 |
| 33.0 | 2500 | 11.0 | 1600 | 0.14545 | 22.64 | 0.49 | 3.19 |
| 34.0 | 3000 | 1.0 | 500 | 0.50000 | 47.50 | 0.02 | 3.21 |

Alesh

| L | H | l | h | h/l | w | t | T |
|---|---|---|---|---|---|---|---|
| 0 | 40 | | | | | | |
| 3.3 | 80 | 3.3 | 40 | 0.012 | 5.1 | 0.65 | 0.65 |
| 3.9 | 100 | 0.6 | 20 | 0.033 | 9.36 | 0.06 | 0.71 |
| 12.1 | 200 | 8.2 | 100 | 0.012 | 5.12 | 1.6 | 2.31 |
| 15.8 | 300 | 3.7 | 100 | 0.027 | 8.25 | 0.45 | 2.76 |
| 18.6 | 400 | 2.8 | 100 | 0.036 | 9.75 | 0.29 | 3.05 |
| 21.1 | 500 | 2.5 | 100 | 0.04 | 10.4 | 0.24 | 3.29 |
| 24.5 | 1000 | 3.4 | 500 | 0.147 | 22.8 | 0.15 | 3.44 |
| 26.6 | 1800 | 2.1 | 800 | 0.381 | 40.4 | 0.05 | 3.49 |

Garma

| L | H | l | h | h/l | w | t | T |
|---|---|---|---|---|---|---|---|
| 5 | 100 | | | | | | |
| 12.7 | 200 | 7.7 | 100 | 0.013 | 5.31 | 1.45 | 1.45 |
| 19.4 | 300 | 6.7 | 100 | 0.015 | 5.78 | 1.16 | 2.61 |
| 24.4 | 400 | 5 | 100 | 0.02 | 6.89 | 0.73 | 3.33 |
| 26.4 | 500 | 2 | 100 | 0.05 | 11.9 | 0.17 | 3.5 |
| 27.3 | 600 | 0.9 | 100 | 0.111 | 19.3 | 0.05 | 3.55 |
| 28.4 | 1000 | 1.1 | 400 | 0.364 | 39.2 | 0.03 | 3.58 |

**TABLE A.2.3-3 TIME OF CONCENTRATION (TP) OF THE SIDE FLOW BASIN AT KR2 (NO.2 + 000)**

| Distance L (km) | Elevation H (m) | Section Distance l (km) | Section Height h (m) | Slope h/l | Flood Velocity w (km/hr) | Section Time t (hr) | Time T (hr) |
|---|---|---|---|---|---|---|---|
| 0.0 | 140 | | | | | | |
| 1.3 | 180 | 1.3 | 40 | 0.03077 | 8.92 | 0.15 | 0.15 |
| 2.3 | 200 | 1.0 | 20 | 0.02000 | 6.89 | 0.15 | 0.29 |
| 4.7 | 300 | 2.4 | 100 | 0.04167 | 10.70 | 0.22 | 0.52 |
| 7.3 | 400 | 2.6 | 100 | 0.03846 | 10.19 | 0.26 | 0.77 |
| 7.7 | 440 | 0.4 | 40 | 0.10000 | 18.09 | 0.02 | 0.79 |

Time of Concentration (Tp) of the Side Flow Basin at DHW1 (No.0+000)

| Distance L (km) | Elevation H (m) | Section Distance l (km) | Section Height h (m) | Slope h/l | Flood Velocity w (km/hr) | Section Time t (hr) | Time T (hr) |
|---|---|---|---|---|---|---|---|
| 0.0 | 100 | | | | | | |
| 4.5 | 220 | 4.5 | 120 | 0.02667 | 8.18 | 0.55 | 0.55 |
| 5.3 | 260 | 0.8 | 40 | 0.05000 | 11.93 | 0.07 | 0.62 |
| 7.0 | 560 | 1.7 | 300 | 0.17647 | 25.43 | 0.07 | 0.68 |

## TABLE A. 2. 3 - 4 REVISION AND INTERPOLATION OF FLOOD DISCHARGES OF THE BABOL RIVER

( Unit : cms )

| Water Year | Babol Station | | | | Gharan Talar Station | | | |
|---|---|---|---|---|---|---|---|---|
| | Recorded | | Revised | | Recorded | | Revised | |
| | Daily Max (Qb1) | Instnt Max (Qbp) | Daily Max (Qb1r) | Instnt Max (Qbpr) | Daily Max (Qg1) | Instnt Max (Qgp) | Daily Max (Qg1r) | Instnt Max (Qgpr) |
| 1328 -29 | 160 | | 160 | *2 249 | 30 | | 30 | *5 40 |
| 1329 -30 | 82 | 102 | 82 | 102 | 57 | | 57 | *5 96 |
| 1330 -31 | 300 | 420 | 300 | 420 | 93 | | 93 | *5 170 |
| 1331 -32 | 305 | 510 | 305 | 510 | 110 | | 110 | *5 205 |
| 1332 -33 | 123 | 175 | 123 | 175 | 65 | | 65 | *5 112 |
| 1333 -34 | 282 | 370 | 282 | 370 | 20 | | 20 | *5 19 |
| 1334 -35 | 70 | 91 | 70 | 91 | 36 | | 36 | *5 52 |
| 1335 -36 | 376 | 374 | *1 260 | 374 | 108 | | 108 | *5 201 |
| 1336 -37 | 240 | 416 | 240 | 416 | 85 | | 85 | *5 154 |
| 1337 -38 | 238 | 288 | 238 | 288 | 85 | | 85 | *5 154 |
| 1338 -39 | 394 | 443 | 394 | 443 | 114 | | 114 | *5 214 |
| 1339 -40 | 190 | 266 | 190 | 266 | 94 | | 94 | *5 172 |
| 1340 -41 | 248 | 311 | 248 | 311 | 117 | | 117 | *5 220 |
| 1341 -42 | 202 | | 202 | *2 302 | 238 | 465 | 238 | 465 |
| 1342 -43 | 700 | 620 | *1 456 | 620 | 570 | | *4 179 | *5 347 |
| 1343 -44 | 315 | 328 | 315 | 328 | 72 | | 72 | *5 127 |
| 1344 -45 | 164 | 267 | 164 | 267 | 56 | | 56 | *5 94 |
| 1345 -46 | 170 | 289 | 170 | 289 | 204 | | 204 | *5 400 |
| 1346 -47 | 256 | 540 | 256 | 540 | 77 | 149 | 77 | 149 |
| 1347 -48 | 335 | 470 | 335 | 470 | 112 | | 112 | *5 210 |
| 1348 -49 | 177 | 243 | 177 | 243 | 77 | 192 | 77 | 192 |
| 1349 -50 | 71 | 168 | 71 | 168 | 46 | 78 | 46 | 78 |
| 1350 -51 | 123 | 224 | 123 | 224 | 72 | 94 | 72 | 94 |
| 1351 -52 | 97 | 190 | 97 | 190 | 40 | 62 | 40 | 62 |
| 1352 -53 | 86 | 128 | 86 | 128 | 40 | 63 | 40 | 63 |
| 1353 -54 | 78 | 83 | 78 | 83 | | | *4 45 | *5 71 |
| 1354 -55 | 135 | 219 | 135 | 219 | | | *4 57 | *5 96 |
| 1355 -56 | 257 | 404 | 257 | 404 | | | *4 83 | *5 150 |
| 1356 -57 | 180 | 450 | 180 | 450 | 39 | 48 | 39 | 48 |
| 1357 -58 | 110 | 134 | 110 | 134 | 36 | 52 | 36 | 52 |
| 1358 -59 | | | *3 39 | *2 97 | 37 | 49 | 37 | 49 |
| 1359 -60 | 141 | 190 | 141 | 190 | 35 | 43 | 35 | 43 |
| 1360 -61 | 235 | 355 | 235 | 355 | 29 | 41 | 29 | 41 |
| 1361 -62 | 152 | 292 | 152 | 292 | 65 | 96 | 65 | 96 |
| 1362 -63 | 232 | | 232 | *2 339 | 108 | | 108 | *5 201 |
| 1363 -64 | 255 | | 255 | *2 368 | 140 | | 140 | *5 268 |
| 1364 -65 | 95 | | 95 | *2 167 | 59 | | 59 | *5 100 |
| 1365 -66 | 141 | | 141 | *2 225 | 58 | | 58 | *5 99 |
| 1366 -67 | 274 | | 274 | *2 392 | 88 | | 88 | *5 160 |
| 1367 -68 | 205 | | 205 | *2 305 | 83 | | 83 | *5 149 |
| 1368 -69 | 113 | | 113 | *2 190 | 66 | | 66 | *5 114 |

(Notes)
1. *1 : Qb1r = ( Qbp - 48.2 )/1.254
2. *2 : Qbpr = 1.254 * Qb1r + 48.2
3. *3 : Qb1r = ( Qg1 - 28.1 )/0.215
4. *4 : Qg1r = 0.215 * Qb1 + 28.1
5. *5 : Qgpr = 2.069 * Qg1r - 22.1

## TABLE A.2.3-5 MONTHLY MAXIMUM DAILY DISCHARGE OF THE BABOL RIVER AT GHARAN TALAR

(Unit:cms)

| Water Year | Meh 7 Oct | | Aba 8 Nov | | Aza 9 Dec | | Dey 10 Jan | | Bah 11 Feb | | Esf 12 Mar | | Far 1 Apr | | Ord 2 May | | Kho 3 Jun | | Tir 4 Jul | | Mor 5 Aug | | Sha 6 Sep | | Maximum Instantaneous | | | | Annual | Far-Mor | Sha-Esf | Mor-Sha | Sha-Meh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | Date | | Qmax | Qmax/ Qday | Max | Apr-Aug | Sep-Mar | Aug-Sep | Sep-Oct |
| | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | mm | dd | | | | | | | |
| 1328 -29 | | | | | | | | 30 | | 6 | | 10 | | 16 | | 8 | | 30 | | 10 | | 19 | | 27 | | | | | 30 | 30 | 55 | 27 | 32 |
| 1329 -30 | 6 | 32 | 10 | 55 | 16 | 20 | 15 | 19 | 4 | 20 | 22 | 36 | 10 | 45 | 19 | 57 | 7 | 9 | 8 | 13 | 17 | 6 | 20 | 35 | | | | | 57 | 57 | 80 | 35 | 55 |
| 1330 -31 | 3 | 55 | 18 | 80 | 15 | 29 | 14 | 6 | 23 | 32 | 11 | 23 | 26 | 31 | 4 | 93 | 21 | 14 | 23 | 42 | 24 | 4 | 3 | 80 | | | | | 93 | 93 | 80 | 80 | 80 |
| 1331 -32 | | 38 | | 17 | | 11 | | 23 | | 15 | | 34 | | 89 | | 16 | | 43 | | 11 | | 110 | | 21 | | | | | 110 | 110 | 55 | 110 | 55 |
| 1332 -33 | 3 | 55 | 2 | 53 | 5 | 10 | 12 | 15 | 18 | 7 | 28 | 31 | 18 | 30 | 28 | 55 | 18 | 4 | 19 | 43 | 6 | 65 | 30 | 58 | | | | | 65 | 65 | 58 | 65 | 58 |
| 1333 -34 | 8 | 19 | 16 | 16 | 5 | 14 | 16 | 11 | 7 | 4 | 23 | 18 | 21 | 19 | 17 | 17 | 16 | 20 | 1 | 13 | 26 | 15 | 25 | 14 | | | | | 20 | 20 | 36 | 15 | 36 |
| 1334 -35 | 7 | 36 | 20 | 19 | 10 | 10 | 24 | 13 | 23 | 15 | 23 | 17 | 15 | 19 | 12 | 10 | 5 | 20 | 31 | 11 | 27 | 15 | 31 | 16 | | | | | 36 | 20 | 83 | 18 | 83 |
| 1335 -36 | 1 | 83 | 22 | 16 | 20 | 16 | 4 | 8 | 24 | 16 | 8 | 12 | 9 | 26 | 11 | 7 | 15 | 108 | 15 | 24 | 16 | 11 | 22 | 8 | | | | | 108 | 108 | 62 | 11 | 62 |
| 1336 -37 | 16 | 62 | 18 | 59 | 1 | 34 | 27 | 12 | 1 | 8 | 10 | 9 | 17 | 23 | 15 | 21 | 31 | 85 | 22 | 34 | 13 | 47 | 28 | 54 | | | | | 85 | 85 | 85 | 54 | 54 |
| 1337 -38 | 18 | 37 | 16 | 85 | 19 | 22 | 12 | 14 | 13 | 61 | 27 | 36 | 16 | 61 | 11 | 84 | 11 | 31 | 11 | 15 | 19 | 19 | 18 | 36 | | | | | 85 | 84 | 114 | 38 | 64 |
| 1338 -39 | 11 | 64 | 7 | 114 | 3 | 32 | 1 | 10 | 4 | 5 | 29 | 17 | 4 | 45 | 11 | 48 | 16 | 14 | 7 | 40 | 1 | 21 | 28 | 50 | | | | | 114 | 48 | 94 | 50 | 50 |
| 1339 -40 | 11 | 17 | 17 | 94 | 11 | 12 | 10 | 28 | 20 | 11 | 12 | 23 | 27 | 48 | 4 | 10 | 17 | 87 | 26 | 5 | 17 | 53 | 11 | 53 | | | | | 94 | 87 | 113 | 53 | 53 |
| 1340 -41 | 5 | 44 | 2 | 113 | 26 | 49 | 21 | 9 | 16 | 62 | 22 | 12 | 30 | 47 | 30 | 26 | 20 | 103 | 22 | 19 | 13 | 21 | 26 | 117 | | | | | 117 | 103 | 126 | 117 | 117 |
| 1341 -42 | 19 | 85 | 22 | 126 | 24 | 14 | 2 | 7 | 14 | 9 | 8 | 33 | 8 | 31 | 28 | 238 | 27 | 40 | 3 | 17 | 13 | 37 | 5 | 158 | | | 465 | *1.95 | 238 | 238 | 570 | 158 | 570 |
| 1342 -43 | 26 | 570 | 3 | 23 | 20 | 23 | 11 | 18 | 13 | 38 | 23 | 30 | 21 | 74 | 3 | 30 | 2 | 2 | 15 | 11 | 30 | 56 | 25 | 185 | | | | | 570 | 74 | 185 | 185 | 185 |
| 1343 -44 | 21 | 28 | 7 | 30 | 27 | 19 | 4 | 15 | 27 | 12 | 22 | 19 | 25 | 20 | 14 | 70 | 31 | 3 | 21 | 16 | 17 | 72 | 31 | 38 | | | | | 72 | 72 | 38 | 72 | 38 |
| 1344 -45 | 9 | 15 | 4 | 22 | 30 | 19 | 6 | 33 | 30 | 27 | 11 | 33 | 10 | 27 | 5 | 56 | 27 | 5 | 16 | 9 | 15 | 37 | 21 | 14 | | | | | 56 | 56 | 204 | 37 | 204 |
| 1345 -46 | 15 | 204 | 18 | 10 | 12 | 2 | 7 | 6 | 24 | 17 | 17 | 24 | 4 | 64 | 8 | 20 | 15 | 63 | 31 | 4 | 7 | 9 | 30 | 13 | | | | | 204 | 64 | 73 | 13 | 73 |
| 1346 -47 | 30 | 73 | 1 | 25 | 28 | 40 | 21 | 42 | 14 | 21 | 27 | 40 | 14 | 51 | 5 | 55 | 19 | 60 | 21 | 77 | 27 | 20 | 26 | 54 | | | 149 | *1.93 | 77 | 77 | 97 | 54 | 54 |
| 1347 -48 | 1 | 3 | 30 | 97 | 1 | 27 | 13 | 6 | 13 | 15 | 9 | 19 | 25 | 40 | 2 | 8 | 26 | 11 | 4 | 45 | 9 | 50 | 20 | 112 | | | | | 112 | 50 | 112 | 112 | 112 |
| 1348 -49 | 22 | 54 | 4 | 37 | 15 | 47 | 4 | 33 | 11 | 16 | 29 | 38 | 4 | 38 | 4 | 22 | 21 | 41 | 25 | 6 | 5 | 46 | 25 | 77 | 6 | 25 | 192 | 2.51 | 77 | 46 | 77 | 77 | 77 |
| 1349 -50 | 24 | 30 | 9 | 32 | 23 | 23 | 18 | 21 | 19 | 46 | 15 | 21 | 13 | 24 | 6 | 9 | 29 | 12 | 5 | 11 | 30 | 3 | 10 | 6 | 8 | 2 | 78 | 1.69 | 46 | 24 | 21 | 6 | 6 |
| 1350 -51 | 9 | 4 | 21 | 21 | 30 | 5 | 10 | 17 | 30 | 14 | 12 | 19 | 16 | 36 | 17 | 72 | 22 | 60 | 6 | 17 | 11 | 26 | 20 | 8 | 3 | 22 | 94 | 1.31 | 72 | 72 | 24 | 26 | 8 |
| 1351 -52 | 16 | 3 | 25 | 6 | 16 | 24 | 10 | 8 | 19 | 15 | 13 | 22 | 9 | 22 | 15 | 19 | 17 | 15 | 3 | 14 | 22 | 4 | 6 | 40 | 6 | 6 | 62 | 1.57 | 40 | 22 | 40 | 40 | 40 |
| 1352 -53 | 4 | 33 | 15 | 13 | 28 | 13 | 9 | 8 | 30 | 14 | 27 | 33 | 12 | 40 | 11 | 15 | 18 | 10 | 23 | 36 | 11 | 16 | 7 | 1 | 7 | 4 | 63 | 1.59 | 40 | 40 | 1 | 16 | 1 |
| 1353 -54 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1354 -55 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1355 -56 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 39 | | 27 |
| 1356 -57 | 8 | 27 | 23 | 39 | 11 | 7 | 21 | 7 | 1 | 21 | 22 | 16 | 25 | 17 | 12 | 34 | 2 | 38 | 5 | 20 | 29 | 14 | 16 | 11 | 8 | 23 | 48 | 1.23 | 39 | 38 | 32 | 14 | 11 |
| 1357 -58 | 10 | 11 | 28 | 20 | 26 | 23 | 8 | 10 | 28 | 32 | 25 | 12 | 7 | 25 | 18 | 36 | 25 | 17 | 18 | 8 | 10 | 35 | 28 | 28 | 2 | 18 | 52 | 1.45 | 36 | 36 | 37 | 35 | 28 |
| 1358 -59 | 27 | 7 | 15 | 13 | 25 | 37 | 1 | 11 | 30 | 17 | 14 | 22 | 9 | 19 | 26 | 10 | 6 | 7 | 3 | 7 | 20 | 17 | 31 | 15 | 9 | 25 | 49 | 1.34 | 37 | 19 | 35 | 17 | 33 |
| 1359 -60 | 29 | 33 | 27 | 35 | 2 | 15 | 6 | 16 | 15 | 7 | 3 | 13 | 15 | 29 | 27 | 22 | 8 | 18 | 29 | 32 | 23 | 11 | 11 | 27 | 8 | 27 | 43 | 1.21 | 35 | 32 | 29 | 27 | 29 |
| 1360 -61 | 1 | 29 | 24 | 9 | 1 | 24 | 8 | 14 | 16 | 17 | 12 | 18 | 5 | 10 | 19 | 11 | 7 | 13 | 7 | 27 | 19 | 16 | 26 | 5 | 7 | 1 | 41 | 1.40 | 29 | 27 | 65 | 16 | 65 |
| 1361 -62 | 14 | 65 | 24 | 28 | 9 | 33 | 23 | 6 | 5 | 14 | 25 | 19 | 3 | 23 | 5 | 13 | 9 | 38 | 6 | 55 | 3 | 14 | 23 | 51 | | | 96 | *1.28 | 65 | 55 | 108 | 51 | 108 |
| 1362 -63 | 20 | 108 | 14 | 8 | 24 | 22 | 20 | 80 | 25 | 17 | 26 | 36 | 10 | 17 | 23 | 47 | 26 | 18 | 3 | 10 | 21 | 37 | 8 | 32 | | | | | 108 | 47 | 140 | 37 | 70 |
| 1363 -64 | 23 | 70 | 15 | 40 | 9 | 140 | 1 | 15 | 4 | 14 | 29 | 25 | 1 | 18 | 8 | 2 | 2 | 3 | 13 | 5 | 10 | 5 | 29 | 15 | | | | | 140 | 18 | 59 | 15 | 24 |
| 1364 -65 | 10 | 24 | 9 | 59 | 16 | 20 | 9 | 24 | 22 | 20 | 11 | 18 | 14 | 29 | 1 | 13 | 31 | 8 | 1 | 12 | 14 | 4 | 8 | 5 | | | | | 59 | 29 | 44 | 5 | 27 |
| 1365 -66 | 8 | 27 | 3 | 44 | 12 | 39 | 10 | 13 | 17 | 16 | 29 | 32 | 16 | 56 | 1 | 13 | 9 | 4 | 1 | 0 | 31 | 6 | 4 | 20 | | | | | 56 | 56 | 88 | 20 | 88 |
| 1366 -67 | 18 | 88 | 5 | 42 | 23 | 44 | 11 | 18 | 14 | 22 | 15 | 32 | 12 | 26 | 16 | 38 | 30 | 5 | 27 | 49 | 14 | 40 | 9 | 39 | | | | | 88 | 49 | 83 | 40 | 83 |
| 1367 -68 | 9 | 83 | 29 | 36 | 1 | 12 | 24 | 10 | 1 | 7 | 25 | 58 | 10 | 27 | 10 | 8 | 8 | 5 | 28 | 1 | 31 | 5 | 28 | 56 | | | | | 83 | 27 | 56 | 56 | 56 |
| 1368 -69 | 30 | 18 | 1 | 49 | 12 | 12 | 16 | 9 | 27 | 26 | 25 | 24 | 14 | 23 | 23 | 66 | 2 | 26 | 9 | 15 | 9 | 24 | 12 | 26 | | | | | 66 | 66 | 26 | 26 | 26 |
| 1369 -70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAX | | 570 | | 126 | | 140 | | 80 | | 62 | | 58 | | 89 | | 238 | | 108 | | 77 | | 110 | | 185 | | | 465 | 2.51 | 570 | 238 | 570 | 185 | 570 |
| MEAN | | 60 | | 43 | | 26 | | 17 | | 19 | | 25 | | 34 | | 36 | | 29 | | 21 | | 27 | | 42 | | | 110 | 1.59 | 91 | 59 | 85 | 48 | 73 |
| MIN | | 3 | | 6 | | 2 | | 6 | | 4 | | 9 | | 10 | | 2 | | 2 | | 0 | | 3 | | 1 | | | 41 | 1.21 | 20 | 18 | 1 | 5 | 1 |

(Note) 1. This table depends on Iranian Calendar, it is, therefore, approximately 10 days different from Gregorian Calender.
2. Data Source : Hydrological Year Book (MOE) except *. ( * : Table 6-3, Hydrological Report, HWDP-1 )

## TABLE A.2.3-6 MONTHLY MAXIMUM DAILY DISCHARGE OF THE BABOL RIVER AT BABOL

(Unit:cms)

| Water Year | Meh 7 Oct | | Aba 8 Nov | | Aza 9 Dec | | Dey 10 Jan | | Bah 11 Feb | | Esf 12 Mar | | Far 1 Apr | | Ord 2 May | | Kho 3 Jun | | Tir 4 Jul | | Mor 5 Aug | | Sha 6 Sep | | Maximum Instantaneous | | | | Annual Max | Far-Mor Apr-Aug | Sha-Esf Sep-Mar | Mor-Sha Aug-Sep | Sha-Meh Sep-Oct |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | Date | | | Qmax/ Qday | | | | | | |
| | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | mm | dd | Qmax | | | | | | | |
| 1328 -29 | | 80 | | 160 | | 35 | | 160 | | 47 | | 42 | | 67 | | 110 | | 105 | | 16 | | 88 | | 110 | | | | | 160 | 110 | 110 | 110 | 110 |
| 1329 -30 | 6 | 51 | 10 | 82 | 16 | 42 | 21 | 46 | 4 | 39 | 23 | 73 | 10 | 58 | 20 | 49 | 3 | 2 | 8 | 9 | 5 | 1 | 24 | 24 | | | 102 | *1.24 | 82 | 58 | 300 | 24 | 86 |
| 1330 -31 | 18 | 86 | 18 | 300 | 1 | 69 | 4 | 17 | 23 | 86 | 21 | 67 | 26 | 90 | 4 | 163 | 20 | 26 | 23 | 76 | 1 | 4 | 26 | 72 | | | 420 | *1.40 | 300 | 163 | 108 | 72 | 72 |
| 1331 -32 | 3 | 16 | 14 | 91 | 20 | 11 | 22 | 108 | 24 | 74 | 18 | 74 | 23 | 136 | 15 | 35 | 7 | 185 | 11 | 14 | 10 | 305 | 14 | 115 | | | 510 | *1.67 | 305 | 305 | 115 | 305 | 115 |
| 1332 -33 | 4 | 90 | 2 | 103 | 1 | 17 | 16 | 17 | 10 | 16 | 27 | 81 | 19 | 88 | 28 | 123 | 1 | 11 | 20 | 59 | 7 | 81 | 31 | 113 | | | 175 | *1.42 | 123 | 123 | 282 | 113 | 282 |
| 1333 -34 | 1 | 282 | 21 | 230 | 6 | 56 | 12 | 16 | 7 | 11 | 18 | 70 | 21 | 245 | 18 | 38 | 5 | 167 | 1 | 26 | 26 | 25 | 19 | 25 | | | 370 | *1.31 | 282 | 245 | 70 | 25 | 70 |
| 1334 -35 | 6 | 70 | 20 | 58 | 13 | 28 | 25 | 50 | 22 | 65 | 6 | 41 | 5 | 68 | 1 | 28 | 20 | 56 | 30 | 20 | 8 | 28 | 18 | 50 | | | 91 | *1.30 | 70 | 68 | 151 | 50 | 151 |
| 1335 -36 | 4 | 151 | 22 | 23 | 16 | 28 | 19 | 14 | 17 | 47 | 24 | 33 | 16 | 51 | 31 | 14 | 16 | 286 | 13 | 179 | 24 | 376 | 1 | 13 | | | 374 | *0.99 | 376 | 376 | 240 | 378 | 215 |
| 1336 -37 | 20 | 215 | 28 | 240 | 1 | 93 | 1 | 44 | 1 | 21 | 10 | 15 | 30 | 55 | 15 | 20 | 23 | 50 | 1 | 140 | 13 | 64 | 28 | 99 | | | 416 | *1.73 | 240 | 140 | 238 | 99 | 99 |
| 1337 -38 | 19 | 58 | 17 | 208 | 8 | 83 | 12 | 59 | 4 | 238 | 23 | 71 | 17 | 112 | 12 | 137 | 12 | 40 | 11 | 21 | 29 | 21 | 18 | 60 | | | 288 | *1.21 | 238 | 137 | 394 | 60 | 80 |
| 1338 -39 | 11 | 80 | 8 | 394 | 21 | 111 | 2 | 35 | 4 | 21 | 22 | 65 | 4 | 87 | 29 | 52 | 17 | 22 | 18 | 83 | 1 | 50 | 11 | 70 | | | 443 | *1.12 | 394 | 87 | 190 | 70 | 70 |
| 1339 -40 | 11 | 39 | 18 | 190 | 1 | 44 | 18 | 106 | 8 | 40 | 19 | 37 | 28 | 94 | 12 | 18 | 17 | 161 | 25 | 2 | 17 | 82 | 12 | 156 | | | 266 | *1.40 | 190 | 161 | 248 | 156 | 245 |
| 1340 -41 | 5 | 246 | 2 | 248 | 3 | 90 | 20 | 58 | 19 | 90 | 3 | 45 | 30 | 83 | 1 | 55 | 28 | 109 | 22 | 29 | 13 | 15 | 27 | 56 | | | 311 | *1.25 | 248 | 109 | 150 | 56 | 101 |
| 1341 -42 | 19 | 101 | 22 | 150 | 24 | 71 | 15 | 13 | 15 | 22 | 29 | 67 | 8 | 81 | 28 | 202 | 28 | 45 | 3 | 31 | 13 | 76 | 5 | 140 | | | | | 202 | 202 | 700 | 140 | 700 |
| 1342 -43 | 26 | 700 | 13 | 100 | 20 | 112 | 11 | 100 | 14 | 66 | 25 | 208 | 21 | 237 | 3 | 54 | 8 | 3 | 23 | 12 | 30 | 99 | 25 | 253 | | | 620 | *0.89 | 700 | 237 | 253 | 253 | 253 |
| 1343 -44 | 21 | 68 | 20 | 69 | 28 | 38 | 5 | 53 | 28 | 28 | 22 | 58 | 26 | 41 | 14 | 315 | 27 | 5 | 21 | 30 | 18 | 91 | 31 | 67 | | | 328 | *1.04 | 315 | 315 | 105 | 91 | 67 |
| 1344 -45 | 13 | 48 | 1 | 80 | 30 | 57 | 8 | 88 | 18 | 19 | 11 | 105 | 10 | 50 | 5 | 164 | 28 | 10 | 1 | 4 | 15 | 131 | 30 | 30 | | | 267 | *1.63 | 164 | 164 | 170 | 131 | 170 |
| 1345 -46 | 17 | 170 | 2 | 21 | 13 | 6 | 9 | 19 | 25 | 69 | 18 | 73 | 4 | 149 | 8 | 32 | 16 | 67 | 12 | 1 | 4 | 6 | 30 | 81 | | | 289 | *1.70 | 170 | 149 | 256 | 81 | 256 |
| 1346 -47 | 30 | 256 | 1 | 242 | 28 | 44 | 3 | 65 | 15 | 80 | 27 | 97 | 15 | 134 | 5 | 157 | 19 | 53 | 22 | 91 | 28 | 28 | 26 | 77 | | | 540 | *2.11 | 256 | 157 | 301 | 77 | 77 |
| 1347 -48 | 1 | 8 | 30 | 301 | 1 | 123 | 14 | 19 | 13 | 61 | 21 | 74 | 25 | 198 | 2 | 18 | 7 | 11 | 5 | 45 | 16 | 90 | 21 | 335 | | | 470 | *1.40 | 335 | 198 | 335 | 335 | 335 |
| 1348 -49 | 22 | 89 | 27 | 177 | 15 | 119 | 12 | 89 | 8 | 78 | 29 | 117 | 5 | 104 | 18 | 35 | 21 | 75 | | | 3 | 57 | 26 | 132 | 8 | 27 | 243 | 1.37 | 177 | 104 | 132 | 132 | 132 |
| 1349 -50 | 24 | 23 | 9 | 41 | 24 | 50 | 19 | 45 | 19 | 71 | 5 | 38 | 14 | 47 | 6 | 18 | 30 | 7 | 5 | 2 | 15 | 1 | 12 | 3 | 11 | 19 | 168 | 2.37 | 71 | 47 | 85 | 3 | 38 |
| 1350 -51 | 9 | 38 | 21 | 85 | 30 | 9 | 10 | 32 | 30 | 31 | 30 | 71 | 16 | 85 | 18 | 123 | 1 | 61 | 6 | 18 | 11 | 102 | 20 | 13 | 2 | 18 | 224 | 1.82 | 123 | 123 | 83 | 102 | 13 |
| 1351 -52 | 16 | 11 | 18 | 18 | 16 | 83 | 11 | 44 | 17 | 44 | 1 | 26 | 9 | 70 | 15 | 32 | 17 | 23 | 3 | 25 | 24 | 3 | 29 | 97 | 6 | 29 | 190 | 1.95 | 97 | 70 | 97 | 97 | 97 |
| 1352 -53 | 4 | 77 | 16 | 49 | 28 | 42 | 9 | 34 | 30 | 45 | 26 | 71 | 12 | 86 | 6 | 45 | 19 | 20 | 23 | 81 | 21 | 29 | 8 | 38 | 7 | 4 | 128 | 1.49 | 86 | 86 | 78 | 38 | 78 |
| 1353 -54 | 2 | 75 | 17 | 16 | 23 | 20 | 24 | 26 | 23 | 49 | 13 | 68 | 1 | 25 | 4 | 55 | 14 | 10 | 1 | 1 | 27 | 6 | 26 | 23 | 12 | 13 | 83 | 1.07 | 78 | 55 | 83 | 23 | 83 |
| 1354 -55 | 14 | 83 | 26 | 49 | 8 | 64 | 11 | 34 | 28 | 31 | 19 | 61 | 3 | 70 | 18 | 135 | 17 | 48 | 31 | 65 | 1 | 14 | 22 | 34 | 2 | 18 | 219 | 1.62 | 135 | 135 | 257 | 34 | 156 |
| 1355 -56 | 26 | 158 | 8 | 257 | 27 | 53 | 11 | 78 | 10 | 33 | 6 | 31 | 12 | 38 | 2 | 25 | 1 | 7 | 27 | 57 | 29 | 45 | 8 | 121 | 7 | 12 | 404 | 1.57 | 257 | 57 | 180 | 121 | 121 |
| 1356 -57 | 15 | 104 | 23 | 180 | 22 | 33 | 7 | 18 | 23 | 53 | 10 | 37 | 26 | 15 | 19 | 34 | 3 | 159 | 1 | 48 | 29 | 11 | 3 | 8 | 7 | 15 | 450 | 2.50 | 180 | 159 | 110 | 11 | 10 |
| 1357 -58 | 5 | 10 | 14 | 35 | 29 | 30 | 2 | 53 | 28 | 110 | 2 | 21 | 8 | 92 | 19 | 52 | 28 | 5 | 1 | 5 | 10 | 33 | 29 | 16 | 11 | 28 | 134 | 1.22 | 110 | 92 | 16 | 33 | 16 |
| 1358 -59 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 55 | | 55 |
| 1359 -60 | 1 | 55 | 20 | 19 | 29 | 9 | 2 | 7 | 30 | 5 | 4 | 31 | 13 | 141 | 27 | 102 | 3 | 2 | 31 | 4 | 4 | 4 | 31 | 126 | 1 | 13 | 190 | 1.35 | 141 | 141 | 235 | 126 | 235 |
| 1360 -61 | 1 | 235 | 1 | 18 | 8 | 6 | 27 | 8 | 16 | 16 | 14 | 13 | 9 | 17 | 1 | 7 | 7 | 6 | 4 | 14 | 31 | 4 | 1 | 4 | 7 | 1 | 355 | 1.51 | 235 | 17 | 137 | 4 | 137 |
| 1361 -62 | 14 | 137 | 24 | 74 | 9 | 105 | 24 | 39 | 5 | 38 | 16 | 55 | 4 | 24 | 6 | 28 | 10 | 42 | 7 | 107 | 17 | 11 | 23 | 152 | | | 292 | *1.92 | 152 | 107 | 232 | 152 | 232 |
| 1362 -63 | 20 | 232 | 4 | 14 | 5 | 89 | 20 | 54 | 26 | 32 | 26 | 87 | 7 | 32 | 12 | 12 | 26 | 48 | 3 | 23 | 21 | 88 | 9 | 38 | | | | | 232 | 88 | 255 | 88 | 146 |
| 1363 -64 | 23 | 146 | 15 | 82 | 9 | 255 | 27 | 35 | 4 | 43 | 28 | 75 | 6 | 91 | 7 | 3 | 27 | 4 | 20 | 7 | 10 | 1 | 30 | 41 | | | | | 255 | 91 | 95 | 41 | 54 |
| 1364 -65 | 30 | 54 | 9 | 73 | 23 | 59 | 9 | 95 | 1 | 71 | 18 | 61 | 1 | 50 | 28 | 32 | 25 | 13 | 2 | 14 | 15 | 11 | 9 | 9 | | | | | 95 | 50 | 141 | 11 | 105 |
| 1365 -66 | 8 | 105 | 3 | 141 | 12 | 45 | 11 | 99 | 17 | 37 | 29 | 80 | 16 | 81 | 1 | 28 | 10 | 8 | 14 | 2 | 26 | 8 | 5 | 54 | | | | | 141 | 81 | 274 | 54 | 274 |
| 1366 -67 | 18 | 274 | 5 | 165 | 23 | 101 | 30 | 175 | 10 | 94 | 15 | 70 | 4 | 48 | 13 | 81 | 11 | 18 | 19 | 75 | 5 | 141 | 30 | 112 | | | | | 274 | 141 | 205 | 141 | 205 |
| 1367 -68 | 30 | 205 | 30 | 115 | 9 | 36 | 25 | 33 | 7 | 36 | 25 | 203 | 11 | 76 | 10 | 16 | 18 | 5 | 20 | 4 | 28 | 77 | 29 | 109 | | | | | 205 | 77 | 113 | 109 | 109 |
| 1368 -69 | 19 | 94 | 1 | 113 | 16 | 14 | 12 | 23 | 5 | 52 | 25 | 69 | 28 | 40 | 24 | 82 | 2 | 48 | 10 | 17 | 10 | 53 | 12 | 55 | | | | | 113 | 82 | 55 | 55 | 55 |
| 1369 -70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAX | | 700 | | 394 | | 255 | | 175 | | 238 | | 208 | | 245 | | 315 | | 286 | | 179 | | 376 | | 335 | | | 620 | 2.50 | 700 | 376 | 700 | 376 | 700 |
| MEAN | | 126 | | 125 | | 60 | | 52 | | 53 | | 67 | | 83 | | 68 | | 51 | | 37 | | 59 | | 78 | | | 302 | 1.50 | 208 | 133 | 186 | 100 | 144 |
| MIN | | 8 | | 14 | | 6 | | 7 | | 5 | | 13 | | 15 | | 3 | | 2 | | 1 | | 1 | | 3 | | | 83 | 0.89 | 70 | 17 | 16 | 3 | 10 |

(Note) 1. This table depends on Iranian Calendar, it is, therefore, approximately 10 days different from Gregorian Calender.
2. Data Source : Hydrological Year Book (MOE) except *. ( * : Table 8-3, Hydrological Report, HWDP-1 )

## TABLE A.2.3-7 MONTHLY MAXIMUM DAILY DISCHARGE OF THE KELA RUD RIVER AT DIVA

(Unit:cms)

| Water Year | Meh 7 Oct | | Aba 8 Nov | | Aza 9 Dec | | Dey 10 Jan | | Bah 11 Feb | | Esf 12 Mar | | Far 1 Apr | | Ord 2 May | | Kho 3 Jun | | Tir 4 Jul | | Mor 5 Aug | | Sha 6 Sep | | Maximum Instantaneous | | | Annual | Far-Mor | Sha-Esf | Mor-Sha | Sha-Meh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | Date mm | dd | Qmax | Qmax/ Qday | Max | Apr-Aug | Sep-Mar | Aug-Sep | Sep-Oct |
| 1328 -29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1329 -30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1330 -31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1331 -32 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1332 -33 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1333 -34 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1334 -35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1335 -36 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1336 -37 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1337 -38 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1338 -39 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1339 -40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1340 -41 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1341 -42 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1342 -43 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1343 -44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1344 -45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1345 -46 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1346 -47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1347 -48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1348 -49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1349 -50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1350 -51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1351 -52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1352 -53 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1353 -54 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1354 -55 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1355 -56 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.25 | 0.83 |
| 1356 -57 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1357 -58 | 5 | 0.83 | 11 | 0.79 | 30 | 1.25 | 30 | 1.12 | 28 | 1.12 | 13 | 1.08 | 28 | 0.95 | 7 | 0.95 | 27 | 0.91 | 1 | 0.87 | 10 | 3.80 | 29 | 1.75 | 6 | 29 | 1.75 | 0.46 | 3.80 | 3.80 | 12.85 | 3.80 | 9.33 |
| 1358 -59 | 26 | 9.33 | 19 | 3.98 | 25 | 12.77 | 1 | 5.18 | 24 | 4.94 | 14 | 12.85 | 9 | 7.17 | 1 | 2.04 | 8 | 1.25 | 1 | 1.51 | 31 | 2.04 | 17 | 2.95 | 12 | 14 | 15.75 | 1.23 | 12.85 | 7.17 | 31.24 | 2.95 | 31.24 |
| 1359 -60 | 28 | 31.24 | 27 | 5.25 | 2 | 4.75 | 11 | 3.24 | 14 | 2.57 | 28 | 2.32 | 12 | 5.75 | 27 | 3.42 | 4 | 3.42 | 28 | 4.50 | 23 | 8.48 | 31 | 2.60 | 7 | 28 | 33.40 | 1.07 | 31.24 | 8.48 | 6.40 | 8.48 | 6.40 |
| 1360 -61 | 1 | 6.40 | 14 | 2.05 | 2 | 3.56 | 5 | 4.33 | 16 | 2.95 | 12 | 4.64 | 9 | 4.18 | 19 | 4.64 | 23 | 4.33 | 3 | 4.49 | 2 | 4.02 | 1 | 1.05 | 7 | 1 | 7.04 | 1.10 | 6.40 | 4.64 | 2.79 | 4.02 | 1.87 |
| 1361 -62 | 17 | 1.87 | 24 | 1.88 | 9 | 2.79 | 14 | 2.69 | 5 | 2.12 | 15 | 2.20 | 3 | 3.59 | 5 | 2.92 | 21 | 2.90 | 7 | 7.26 | 17 | 2.21 | 23 | 5.27 | | | | | 7.26 | 7.26 | 14.39 | 5.27 | 5.27 |
| 1362 -63 | 15 | 3.91 | 14 | 2.11 | 21 | 8.68 | 20 | 14.39 | 20 | 10.99 | 26 | 8.93 | 3 | 4.80 | 12 | 4.82 | 26 | 5.77 | 3 | 3.14 | 19 | 3.50 | 10 | 5.97 | | | | | 14.39 | 5.77 | 6.49 | 5.97 | 5.97 |
| 1363 -64 | 23 | 5.00 | 25 | 1.91 | 9 | 4.90 | 26 | 3.90 | 17 | 5.64 | 4 | 6.49 | 1 | 4.10 | 1 | 2.18 | 1 | 1.26 | 13 | 1.59 | 8 | 2.30 | 29 | 7.90 | | | | | 7.90 | 4.10 | 46.00 | 7.90 | 19.00 |
| 1364 -65 | 30 | 19.00 | 9 | 46.00 | 29 | 3.06 | 9 | 5.10 | 3 | 5.90 | 17 | 4.70 | 1 | 5.50 | 1 | 2.29 | 1 | 1.32 | 2 | 0.88 | 14 | 1.68 | 30 | 1.47 | 8 | 9 | 120.00 | 2.61 | 46.00 | 5.50 | 1.47 | 1.68 | 1.47 |
| 1365 -66 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1366 -67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1367 -68 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1368 -69 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1369 -70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAX | | 31.24 | | 46.00 | | 12.77 | | 14.39 | | 10.99 | | 12.85 | | 7.17 | | 4.82 | | 5.77 | | 7.26 | | 8.48 | | 7.90 | | | 120.00 | 2.61 | 46.00 | 8.48 | 46.00 | 8.48 | 31.24 |
| MEAN | | 9.70 | | 8.00 | | 5.20 | | 5.00 | | 4.50 | | 5.40 | | 4.50 | | 2.90 | | 2.60 | | 3.00 | | 3.50 | | 3.60 | | | 35.59 | 1.29 | 18.20 | 5.80 | 13.70 | 5.00 | 9.00 |
| MIN | | 0.83 | | 0.79 | | 1.25 | | 1.12 | | 1.12 | | 1.08 | | 0.95 | | 0.95 | | 0.91 | | 0.87 | | 1.68 | | 1.05 | | | 1.75 | 0.46 | 3.80 | 3.80 | 1.25 | 1.68 | 0.83 |

## TABLE A.2.3-8 MONTHLY MAXIMUM DAILY DISCHARGE OF THE SAJJAD RUD RIVER AT BANDPAY

(Unit:cms)

| Water Year | Meh 7 Oct | | Aba 8 Nov | | Aza 9 Dec | | Dey 10 Jan | | Bah 11 Feb | | Esf 12 Mar | | Far 1 Apr | | Ord 2 May | | Kho 3 Jun | | Tir 4 Jul | | Mor 5 Aug | | Sha 6 Sep | | Maximum instantaneous | | | Annual | Far-Mor | Sha-Esf | Mor-Sha | Sha-Meh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | dd | Qday | Date mm | dd | Qmax | Qmax/Qday | Max | Apr-Aug | Sep-Mar | Aug-Sep | Sep-Oct |
| 1328 -29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1329 -30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1330 -31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1331 -32 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1332 -33 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1333 -34 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1334 -35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1335 -36 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1336 -37 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1337 -38 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1338 -39 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1339 -40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1340 -41 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1341 -42 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1342 -43 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1343 -44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1344 -45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1345 -46 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1346 -47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1347 -48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1348 -49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1349 -50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1350 -51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1351 -52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1352 -53 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1353 -54 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 13.60 | | 6.70 |
| 1354 -55 | 26 | 6.70 | 14 | 13.60 | 8 | 10.10 | 3 | 6.70 | 25 | 2.10 | 18 | 4.24 | 2 | 9.70 | 18 | 7.47 | 17 | 3.40 | 31 | 0.62 | 1 | 1.99 | 19 | 2.95 | 2 | 18 | 26.24 | 1.93 | 13.60 | 9.70 | 5.20 | 2.95 | 2.95 |
| 1355 -56 | | | | | | | 10 | 5.20 | 18 | 3.50 | 13 | 4.20 | 12 | 4.40 | 1 | 2.34 | 1 | 2.10 | 27 | 3.06 | 10 | 4.60 | 8 | 6.58 | | | | | 6.58 | 4.60 | 6.58 | 6.58 | 6.58 |
| 1356 -57 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1357 -58 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5.61 | | 2.56 |
| 1358 -59 | 26 | 2.56 | 19 | 3.02 | 26 | 4.14 | 1 | 3.16 | 30 | 3.93 | 14 | 5.61 | 27 | 5.82 | 26 | 0.71 | 12 | 0.71 | 3 | 0.51 | 22 | 0.99 | 16 | 3.02 | 1 | 27 | 5.82 | 1.00 | 5.82 | 5.82 | 22.62 | 3.02 | 22.62 |
| 1359 -60 | 30 | 22.62 | 1 | 14.98 | 3 | 11.93 | 23 | 11.62 | 1 | 4.55 | 26 | 5.07 | 15 | 12.23 | 27 | 6.69 | 18 | 2.90 | 29 | 8.68 | | | | | | | | | 22.62 | 12.23 | 22.20 | | |
| 1360 -61 | | | 16 | 3.17 | 10 | 7.50 | 24 | 6.35 | 30 | 5.43 | 11 | 22.20 | 19 | 7.50 | 1 | 5.90 | 12 | 5.77 | 1 | 2.69 | 1 | 1.72 | 1 | 0.75 | | | | | 22.20 | 7.50 | 6.48 | 1.72 | 3.30 |
| 1361 -62 | 26 | 3.30 | 24 | 6.17 | 1 | 3.64 | 17 | 1.78 | 27 | 2.36 | 25 | 6.48 | 3 | 9.61 | 1 | 5.68 | 18 | 6.26 | 7 | 9.61 | 17 | 1.28 | 23 | 42.08 | | | | | 42.08 | 9.61 | 42.08 | 42.08 | 42.08 |
| 1362 -63 | 20 | 28.72 | 1 | 2.29 | 23 | 14.26 | 20 | 21.80 | 25 | 6.95 | 26 | 10.47 | 3 | 6.25 | 27 | 11.99 | 26 | 4.94 | 3 | 3.54 | 21 | 3.48 | 8 | 6.04 | | | | | 28.72 | 11.99 | 6.04 | 6.48 | 6.04 |
| 1363 -64 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 9.60 | | 7.84 |
| 1364 -65 | 10 | 7.84 | 9 | 9.80 | 16 | 4.51 | 9 | 4.90 | 18 | 5.88 | 18 | 4.61 | 15 | 9.31 | 1 | 3.18 | 24 | 5.88 | 1 | 2.60 | 14 | 1.14 | 8 | 25.60 | 6 | 8 | 67.40 | 2.63 | 25.60 | 9.31 | 25.60 | 25.60 | 25.60 |
| 1365 -66 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1366 -67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1367 -68 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1368 -69 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1369 -70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAX | | 28.72 | | 14.98 | | 14.26 | | 21.80 | | 6.95 | | 22.20 | | 12.23 | | 11.99 | | 5.26 | | 9.61 | | 6.48 | | 42.08 | | | 67.40 | 2.63 | 42.08 | 12.23 | 42.08 | 42.08 | 42.08 |
| MEAN | | 12.00 | | 7.60 | | 8.00 | | 7.70 | | 4.30 | | 7.90 | | 8.10 | | 5.50 | | 4.00 | | 4.30 | | 2.60 | | 12.40 | | | 33.15 | 1.85 | 20.90 | 8.30 | 15.10 | 12.60 | 12.60 |
| MIN | | 2.56 | | 2.29 | | 3.64 | | 1.78 | | 2.10 | | 4.20 | | 4.40 | | 0.71 | | 0.71 | | 0.51 | | 0.99 | | 0.75 | | | 5.82 | 1.00 | 5.82 | 4.60 | 5.20 | 1.72 | 2.56 |

## TABLE A.2.3-9 RUNOFF DISCHARGE OF THE KARI RUD

Flood Flopy ¥Runoffds¥~~Alesh~~Kari.mpd

Runoff Discharge (cms)

| Station | Basin | Drainage Area | | | Accumulated D.A | | | 1/10 years | | | | | | 1/25 years | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Instantaneous | | | Daily | | | Instantaneous | | | Daily | | |
| | | Hilly (sq.km) | Farm (ha) | Total (sq.km) | Hilly (sq.km) | Farm (ha) | Total (sq.km) | Hilly (cms) | Farm (cms) | Total (cms) | Hilly (cms) | Farm (cms) | Total (cms) | Hilly (cms) | Farm (cms) | Total (cms) | Hilly (cms) | Farm (cms) | Total (cms) |
| Kari Right | DKR1 | 0.73 | 0 | 0.73 | | | | | | | | | | | | | | | |
| | DKR2 | 0.00 | 89 | 0.89 | | | | | | | | | | | | | | | |
| | DKR3 | 2.24 | 122 | 3.46 | | | | | | | | | | | | | | | |
| | DKR4 | 0.40 | 113 | 1.53 | | | | | | | | | | | | | | | |
| | DKR5 | 8.17 | 189 | 10.06 | | | | | | | | | | | | | | | |
| | DKR6 | 0.00 | 55 | 0.55 | | | | | | | | | | | | | | | |
| | DKR7 | 0.00 | 100 | 1.00 | | | | | | | | | | | | | | | |
| No.24+400 | Total | 11.54 | 668 | 18.22 | 11.54 | 668 | 18.22 | 8.1 | 3.5 | 11.6 | 4.1 | 3.5 | 7.6 | 11.0 | 4.3 | 15.4 | 5.5 | 4.3 | 9.8 |
| Kari Left | DKL1 | 0.00 | 43 | 0.43 | | | | | | | | | | | | | | | |
| | DKL2 | 0.00 | 28 | 0.28 | | | | | | | | | | | | | | | |
| | DKL3 | 0.00 | 33 | 0.33 | | | | | | | | | | | | | | | |
| | DKL4 | 0.00 | 300 | 3.00 | | | | | | | | | | | | | | | |
| No.24.400 | Total | 0.00 | 404 | 4.04 | 0 | 404 | 4.04 | 0.0 | 2.3 | 2.3 | 0.0 | 2.3 | 2.3 | 0.0 | 2.8 | 2.8 | 0.0 | 2.8 | 2.8 |
| Garma Rud | Garma | 92.00 | 0 | 92.00 | | | | | | | | | | | | | | | |
| | Tribut | 11.90 | 0 | 11.90 | | | | | | | | | | | | | | | |
| | DKR8 | 0.00 | 61 | 0.61 | | | | | | | | | | | | | | | |
| | DKR9 | 0.00 | 172 | 1.72 | | | | | | | | | | | | | | | |
| | DKR10 | 3.73 | 475 | 8.48 | | | | | | | | | | | | | | | |
| | DKR11 | 0.00 | 115 | 1.15 | | | | | | | | | | | | | | | |
| Kari Rud | DKR12 | 0.00 | 62 | 0.62 | | | | | | | | | | | | | | | |
| No.24+400 | Total | 107.63 | 885 | 116.48 | 107.63 | 885 | 116.48 | 75.3 | 4.4 | 79.7 | 38.6 | 4.4 | 43.0 | 103.0 | 5.5 | 108.5 | 50.9 | 5.5 | 56.4 |
| No.24+400 | Total | 119.17 | 1,957 | 138.74 | 119.17 | 1,957 | 138.74 | 83.4 | 8.5 | 92.0 | 42.8 | 8.5 | 51.3 | 114.0 | 10.6 | 124.7 | 56.4 | 10.6 | 67.0 |
| Kari Right | DKR13 | 0.00 | 83 | 0.83 | | | | | | | | | | | | | | | |
| | DKR14 | 0.00 | 518 | 5.18 | | | | | | | | | | | | | | | |
| | DKR15 | 0.00 | 103 | 1.03 | | | | | | | | | | | | | | | |
| | DKR16 | 0.00 | 462 | 4.62 | | | | | | | | | | | | | | | |
| No.18+400 | Total | 0.00 | 1,166 | 11.66 | 0.00 | 1,166 | 11.66 | 0.0 | 5.5 | 5.5 | 0.0 | 5.5 | 5.5 | 0.0 | 6.9 | 6.9 | 0.0 | 6.9 | 6.9 |
| Kari Left | DKL5 | 0.00 | 106 | 1.06 | | | | | | | | | | | | | | | |
| | DKL6 | 0.00 | 8 | 0.08 | | | | | | | | | | | | | | | |
| | DKL7 | 0.00 | 8 | 0.08 | | | | | | | | | | | | | | | |
| No.18+400 | Total | 0.00 | 122 | 1.22 | 0.00 | 122 | 1.22 | 0.0 | 0.8 | 0.8 | 0.0 | 0.8 | 0.8 | 0.0 | 1.1 | 1.1 | 0.0 | 1.1 | 1.1 |
| No.18+400 | Total | 119.17 | 3,245 | 151.62 | 119.17 | 3,245 | 151.62 | 83.4 | 13.0 | 96.4 | 42.8 | 13.0 | 55.8 | 114.0 | 16.2 | 130.2 | 56.4 | 16.2 | 72.5 |
| Kari Left | DKL8 | 0 | 27 | 0.27 | | | | | | | | | | | | | | | |
| | DKL9 | 0 | 31 | 0.31 | | | | | | | | | | | | | | | |
| No.12+800 | Total | 0 | 58 | 0.58 | 0.00 | 58 | 0.58 | 0.0 | 0.5 | 0.5 | 0.0 | 0.5 | 0.5 | 0.0 | 0.6 | 0.6 | 0.0 | 0.6 | 0.6 |
| No.12+800 | Total | 119.17 | 3303 | 152.2 | 119.17 | 3.303 | 152.20 | 83.4 | 13.2 | 96.6 | 42.8 | 13.2 | 56.0 | 114.0 | 16.4 | 130.5 | 56.4 | 16.4 | 72.8 |

## TABLE A.2.3-10 RUNOFF DISCHARGE OF THE ALESH RIVER

Flood Flopy ¥Runoffds¥Alesh.mpd

Runoff Discharge (cms)

| Station | Basin | Drainage Area | | | Accumulated D.A | | | 1/10 years | | | | | | 1/25 years | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Instantaneous | | | Daily | | | Instantaneous | | | Daily | | |
| | | Hilly (sq.km) | Farm (ha) | Total (sq.km) | Hilly (sq.km) | Farm (ha) | Total (sq.km) | Hilly (cms) | Farm (cms) | Total (cms) | Hilly (cms) | Farm (cms) | Total (cms) | Hilly (cms) | Farm (cms) | Total (cms) | Hilly (cms) | Farm (cms) | Total (cms) |
| | Alesh1 | 128.9 | 590 | 134.80 | | | | | | | | | | | | | | | |
| | DHW1 | 11.8 | 1,147 | 23.27 | | | | | | | | | | | | | | | |
| | DHW2 | 0 | 460 | 4.60 | | | | | | | | | | | | | | | |
| No.24+500 | Total | 140.7 | 2,197 | 162.67 | 140.7 | 2,197 | 162.7 | 98.5 | 9.4 | 107.9 | 50.5 | 9.4 | 59.9 | 134.6 | 11.7 | 146.3 | 66.6 | 11.7 | 78.2 |
| | Alesh2 | 69.4 | 1,540 | 84.80 | | | | | | | | | | | | | | | |
| | DHW3 | 0 | 275 | 2.75 | | | | | | | | | | | | | | | |
| No.21 | Total | 69.4 | 1,815 | 87.55 | 210.1 | 4,012 | 250.2 | 147.1 | 15.5 | 162.6 | 75.4 | 15.5 | 90.9 | 201.1 | 19.3 | 220.4 | 99.4 | 19.3 | 118.7 |
| | Alesh3 | 56.8 | 1,240 | 69.20 | | | | | | | | | | | | | | | |
| | DHW4 | 0 | 666 | 6.66 | | | | | | | | | | | | | | | |
| No.16 | Total | 56.8 | 1,906 | 75.86 | 266.9 | 5,918 | 326.1 | 186.8 | 21.5 | 208.3 | 95.8 | 21.5 | 117.3 | 255.4 | 26.7 | 282.1 | 126.2 | 26.7 | 152.9 |
| | Alesh4 | 23.3 | 2,850 | 51.80 | | | | | | | | | | | | | | | |
| No.13 | Total | 23.3 | 2,850 | 51.80 | 290.2 | 8,768 | 377.9 | 203.1 | 29.8 | 232.9 | 104.2 | 29.8 | 134.0 | 277.7 | 37.0 | 314.7 | 137.3 | 37.0 | 174.3 |
| | DHW5 | 0 | 14,721 | 147.21 | | | | | | | | | | | | | | | |
| No.10 | Total | 0 | 14,721 | 147.21 | 290.2 | 23,489 | 525.1 | 203.1 | 67.7 | 270.8 | 104.2 | 67.7 | 171.9 | 277.7 | 84.1 | 361.9 | 137.3 | 84.1 | 221.4 |
| | DAW1 | 0 | 330 | 3.30 | | | | | | | | | | | | | | | |
| No.5+200 | Total | 0 | 330 | 3.30 | 290.2 | 23,819 | 528.4 | 203.1 | 68.5 | 271.6 | 104.2 | 68.5 | 172.7 | 277.7 | 85.1 | 362.8 | 137.3 | 85.1 | 222.4 |
| | DAW2 | 0 | 851 | 8.51 | | | | | | | | | | | | | | | |
| No.4+500 | Total | 0 | 851 | 8.51 | 290.2 | 24,670 | 536.9 | 203.1 | 70.5 | 273.6 | 104.2 | 70.5 | 174.7 | 277.7 | 87.6 | 365.4 | 137.3 | 87.6 | 224.9 |
| | DAW3 | 0 | 2,980 | 29.80 | | | | | | | | | | | | | | | |
| NO.0+500 | Total | 0 | 2,980 | 29.80 | 290.2 | 27,650 | 566.7 | 203.1 | 77.5 | 280.7 | 104.2 | 77.5 | 181.7 | 277.7 | 96.4 | 374.1 | 137.3 | 96.4 | 233.7 |

## TABLE A.2.3-11 FLOOD DISCHARGE OF THE BABOL RIVER

Flood Flopy ¥Runoffds¥Babol.mpd

Runoff Discharge (cms)

| Station | Basin | Drainage Area | | | Accumulated D.A | | | 1/10 years | | | | | | 1/25 years | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Instantaneous | | | Daily | | | Instantaneous | | | Daily | | |
| | | (sq.km) | Farm (ha) | Total (sq.km) | (sq.km) | Farm (ha) | Total (sq.km) | (cms) | Farm (cms) | Total (cms) | (cms) | Farm (cms) | Total (cms) | (cms) | Farm (cms) | Total (cms) | (cms) | Farm (cms) | Total (cms) |
| No.40+500 | Total | 1.643 | | 1.643.0 | 1.643 | | 1.643.0 | 471.0 | | 471.0 | 327.0 | | 327.0 | 560.0 | | 560.0 | 401.0 | | 401.0 |
| | DHE20-22 | | | | | | | | | | | | | | | | | | |
| | DBB 1-6 | | 4.257 | 42.6 | | | | | | | | | | | | | | | |
| No.21+600 | Total | 0 | 4.257 | 42.6 | 1.643 | 4.257 | 1685.6 | 471.0 | 16.3 | 487.3 | 327.0 | 16.3 | 343.3 | 560.0 | 20.3 | 580.3 | 401.0 | 20.3 | 421.3 |
| | AEMD | | 22.834 | 228.3 | | | | | | | | | | | | | | | |
| No.21+600 | Total | 0 | 22.834 | 228.3 | 1.643 | 27.091 | 1913.9 | 471.0 | 76.2 | 547.2 | 327.0 | 76.2 | 403.2 | 560.0 | 94.8 | 654.8 | 401.0 | 94.8 | 495.8 |
| | DAE18-25 | | 3.176 | 31.8 | | | | | | | | | | | | | | | |
| No.0+000 | Total | 0 | 3.176 | 31.8 | 1.643 | 30.267 | 1945.7 | 471.0 | 83.6 | 554.6 | 327.0 | 83.6 | 410.6 | 560.0 | 103.9 | 663.9 | 401.0 | 103.9 | 504.9 |

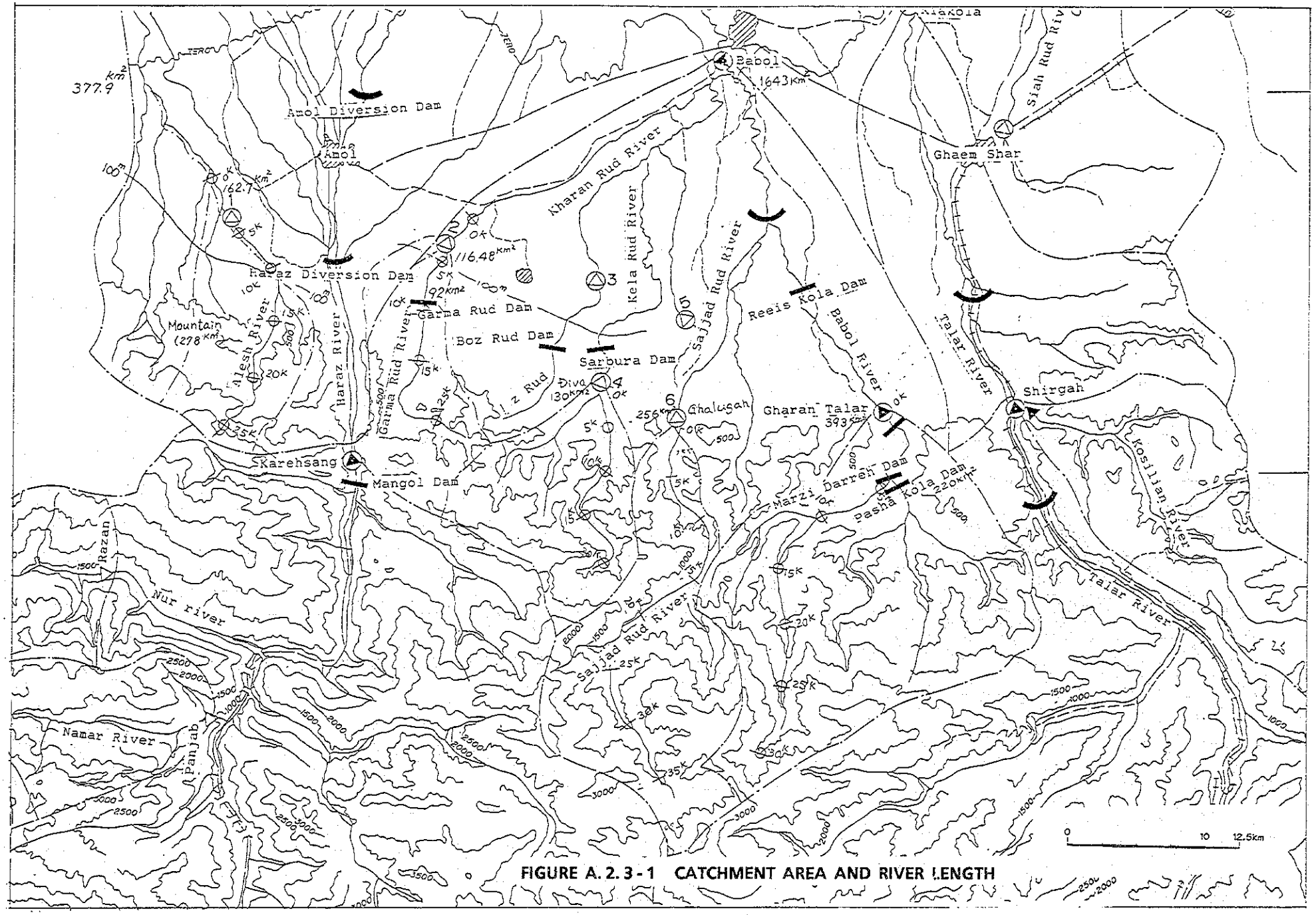



FIGURE A. 2. 3 - 1 CATCHMENT AREA AND RIVER LENGTH

## A. 2. 4 Caspian Sea Level

### 1. General

Design sea level of the Caspian Sea is not obtained directly by statistical analysis, because sea level fluctuation relates to global climate change. As seeing in the Figure A. 2. 3-2, sea level generally rises during cooling period, and regresses during warming period. Important factors related to temperature are inflow by rivers, especially by the Volga river, and evaporation from sea surface which take large share of inflow and outflow.

In this study, considering above phenomena, design sea level has been reviewed.

### 2. Design Sea Level

Design sea level should be determined taking an economical view-point into consideration. As seeing Figure A. 2 .3-1, sea level rose around at (-)25 m PGD in latter half of 1800s. On the other hand, up-coming of sea level needed distinct cooling when sea level rose to (-)22 m PGD beyond (-)25 m PGD as shown in Figure A. 2. 3-2. Up-coming to (-)22 m PGD may need cooling by 0.5°C to 1.0°C. Recent global climate change is suffered toward warming due to increase of $CO_2$. Consequently, following design sea level will be imposed;

Maximum Design Sea Level : (-)25.0 m PGD
Minimum Design Sea Level : (-)28.5 m PGD

Additional surcharge may be required taking the effects of wind and atmospheric pressure into consideration. Strong wind velocity is in the range of 20 to 40 knots at Babolsar, so that surcharge may be 0.35 m from statistic sea level. Therefore, structural design sea level might be higher than the above mentioned sea level.

Maximum Structural design Sea Level : (-) 24.65 m PGD

Maximum design sea level of (-)25.3 m studied by the Master Plan shall be raised by 0.3 m, and revised to (-)25.0 m PGD.

## 3. Anomalous Sea Level

As discussed above, sea level may not deviate above design sea level range in a period coming 100 years. However, as a possible sea level, following anomalous sea levels will be considered;

Anomalous Maximum Sea Level : (-)22 m PGD
Anomalous Minimum Sea Level : (-)30 m PGD

FIGURE A. 2. 4-1 CASPIAN SEA LEVEL FLUCTUATION RECENT 150 YEARS

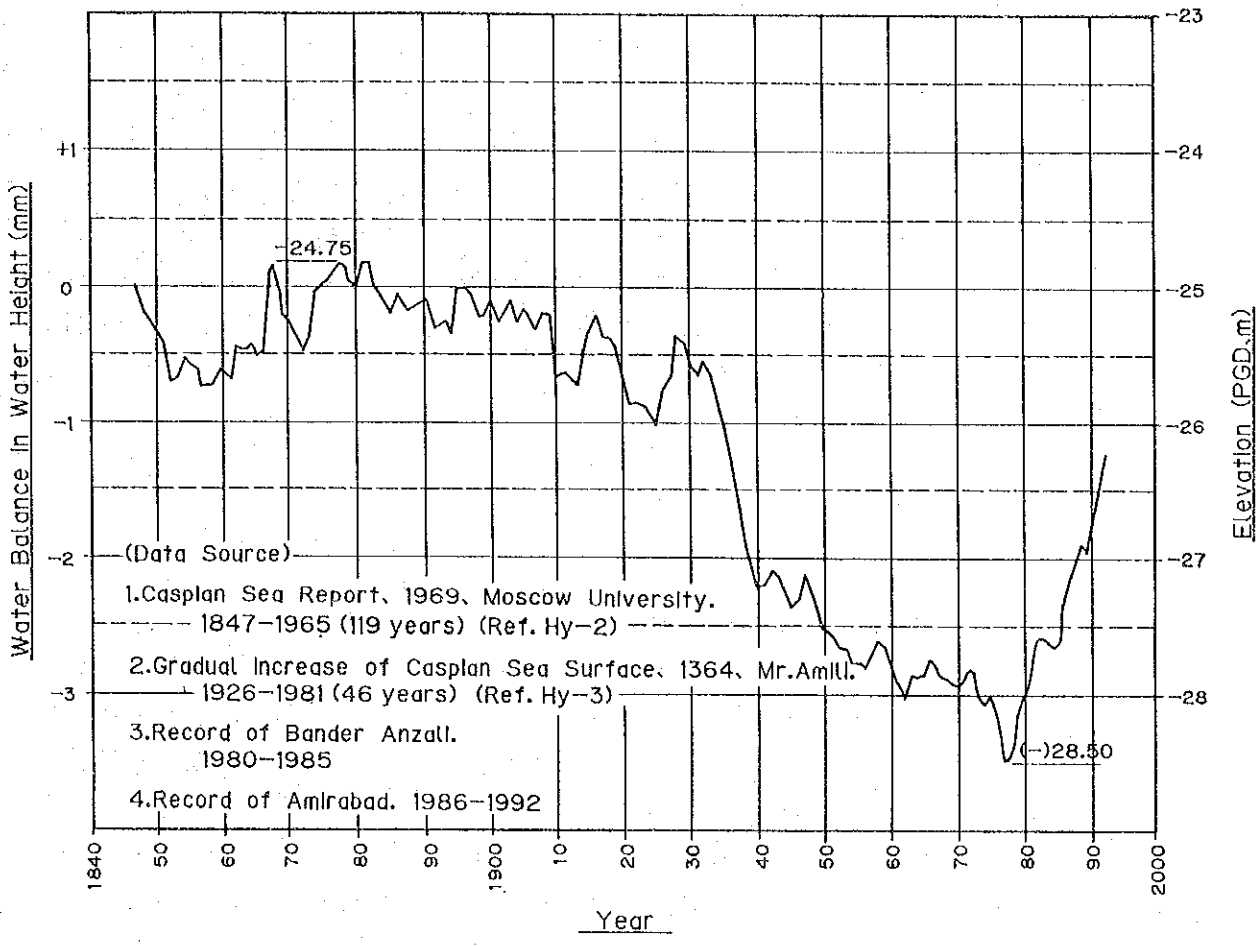



FIGURE A. 2. 4-2 CASPIAN SEA LEVEL FLUCTUATION RELATING TO GLOBAL CLIMATIC CHANGES

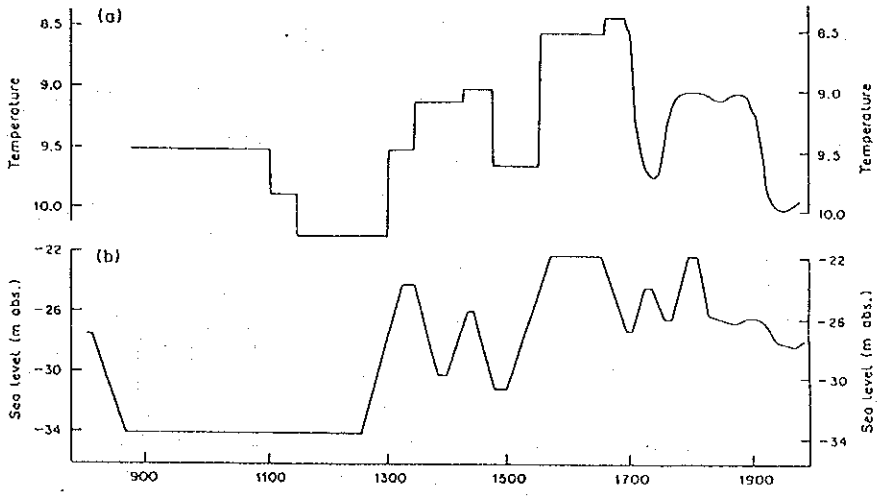



Fig. 4. Comparison of variations of average yearly temperature in England (a) with fluctuations of the Caspian Sea level (b) over the last 1100 y.

(Data Source) Reference HY-1

## A. 2. 5 Water Quality

### 1. General

As one of the evaluation factors on the environmental impact assessment, present water quality was monitored at several points for rivers, canals and groundwater. Water samples were sent to laboratory after preliminary in-site test. The purposes of this water quality monitoring were to clarify followings;

1) Seasonal fluctuation of water quality
2) Effects of agri-chemicals on water quality

### 2. Location of Water Quality Monitoring

Water quality was scheduled to monitor at 13 sites as shown below. However, monitoring has been conducted at 11 sites as a result. Some sites were omitted in the course of monitoring due to low importance because of less fluctuation on water quality especially deep wells (GW1, GW6, GW8). And, monitoring of shallow wells (GW2, GW5, GW7) were stopped after irrigation period because these wells were not operated after irrigation, and a monitoring staff could not operate these shallow wells. Furthermore, any data at two sites (SW4, SW5) which were scheduled to observe effect of agri-chemicals on water quality were not obtained due to destruction of sampled water.

Location of Water Quality Monitoring

| Site | Water | Sampling Site | Period Data Obtained |
|---|---|---|---|
| SW1 | Surface Water | Haraz River | Apr/1991 - Apr/1992 |
| SW2 | 〃 | Said Rud Canal | 〃 |
| SW3 | 〃 | Suteh Keleh Canal | 〃 |
| (SW4) | 〃 | Paddy Field | Samples were destroyed |
| (SW5) | 〃 | Paddy Field | 〃 |
| GW1 | Groundwater | Deep Well | Apr - May/1991 |
| GW2 | 〃 | Shallow Well | Apr - Jun/1991 |
| GW3 | 〃 | Artesian Well | Apr/1991 - Apr/1992 |
| GW4 | 〃 | Spring | Apr/1991 - Apr/1992 |
| GW5 | 〃 | Shallow Well | Apr - Jun/1991 |
| GW6 | 〃 | Deep Well | Apr/1991 |
| GW7 | 〃 | Shallow Well | Apr - Jun/1991 |
| GW8 | 〃 | Deep Well | Apr - May/1991 |

## 3. Analyzed Item

In the water quality monitoring, 3 items were analyzed at sites, and 15 items were analyzed in laboratory. However, accuracy of field analysis is low except temperature, because of inadequate maintenance of field equipment. In laboratory analysis, it was not able to analyze some of 15 items constantly because of limitation of laboratory.

Furthermore, some items of laboratory analysis, which were desirable for evaluating pollution level or hazard to crops, were omitted because of limitation of laboratory functions. Those are ammonium-nitrogen (NH4-N), phosphate phosphorous (PO4-P), chemical oxygen demand (COD) or biological oxygen demand (BOD) for pollution, and boron (B) for hazard to crops.

In this monitoring, following items were analyzed;

Analyzed Items in the Water Quality Monitoring

| Analyzed Item | Unit | Descriptions |
|---|---|---|
| I. Field Analysis | | |
| Temperature (T) | °C | |
| pH | | accuracy is low |
| Electrical conductivity (EC) | micromhos/cm at T°C | |
| II. Laboratory Analysis | | |
| pH | | |
| Electrical conductivity (EC) | micromhos/cm at 25 °C | |
| Total dissolved solid (TDS) | mg/lit | partly |
| Cations | | |
| Potassium (K) | ppm | partly |
| Calcium (Ca) | meq/lit | |
| Magnesium (Mg) | meq/lit | |
| Sodium (Na) | meq/lit | |
| Iron (Fe) | ppm | partly |
| Anions | | |
| Sulphate (SO4) | meq/lit | partly |
| Chloride (C1) | meq/lit | |
| Bicarbonate (HCO3) | meq/lit | |
| Carbonate (CO3) | meq/lit | partly |
| Nitrogen | | |
| Nitrate-Nitrogen (N-NO3) | ppm | partly |
| Silicic acid (SiO2) | ppm | only one time |

## 4. Results of Water Quality Analysis in the Project Area

Results of analysis of water quality in the Project Area are described in the DATA BOOK - I. Mean, maximum and minimum values at each monitored site are summarized as below. Seasonal fluctuation of key items is illustrated in Figure A. 2. 5 - 2.

**Summary of Water Quality in the Project Area**

| Item | SW1 Haraz | SW2 Said Rud | SW3 Suteh | GW1 D.Well | GW2 S.Well | GW3 A.Well | GW4 Spring | GW5 S. Well | GW6 D.Well | GW7 S. Well | GW8 D. Well |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T (°C) | 14 | 17 | 19 | 18 | 17 | 23 | 17 | 17 | 19 | 19 | 19 |
| Max | 22 | 24 | 30 | | | 24 | 20 | | | | |
| Min | 3 | 10 | 6 | | | 22 | 11 | | | | |
| EC ($x10^6$) | 628 | 818 | 1071 | 733 | 799 | 744 | 844 | 1103 | 872 | 837 | 1177 |
| Max | 757 | 1054 | 1401 | | | 858 | 881 | | | | |
| Min | 424 | 506 | 736 | | | 680 | 760 | | | | |
| TDS | Not enough numbers of analysis | | | | | | | | | | |
| pH | 7.8 | 7.8 | 7.7 | 7.6 | 7.4 | 7.8 | 7.2 | 7.5 | 7.5 | 7.6 | 7.5 |
| Cations (Meq/lit) | | | | | | | | | | | |
| Ca | 4.5 | 4.4 | 5.2 | Ca+Mg | 〃 | 3.6 | 4.8 | 8.0 | Ca+Mg | 〃 | 〃 |
| Mg | 1.8 | 2.5 | 2.3 | (6.9) | (7.0) | 1.8 | 2.6 | 2.2 | (8.0) | (6.8) | (6.2) |
| Na | 0.8 | 1.1 | 3.0 | 0.7 | 0.8 | 2.4 | 0.6 | 1.1 | 0.9 | 1.6 | 5.3 |
| Total | 7.1 | 8.0 | 10.5 | 7.6 | 7.7 | 7.8 | 8.0 | 11.3 | 8.9 | 8.4 | 11.5 |
| Anions (Meq/lit) | | | | | | | | | | | |
| HCO3 | 5.7 | 6.4 | 6.6 | 5.4 | 5.7 | 5.4 | 7.1 | 8.3 | 7.0 | 7.1 | 6.1 |
| Cl | 0.6 | 1.1 | 3.5 | 0.5 | 0.6 | 1.7 | 0.8 | 1.0 | 0.7 | 0.7 | 5.0 |
| SO4 | | | | 1.5 | 1.5 | | | | 1.1 | 0.7 | |
| Total | 6.3 | 7.5 | 10.1 | 7.4 | 7.8 | 7.1 | 7.9 | 8.3 | 8.8 | 8.5 | 11.1 |
| Others (ppm) | | | | | | | | | | | |
| K | 4.7 | 5.3 | 6.5 | | | 10.8 | 4.7 | 6.0 | | | |
| Fe | 0.05 | 0.04 | 0.05 | | | 0.08 | 0.02 | 0.15 | | | |
| N-NO4 | 0.6 | 1.3 | 0.6 | | | 0.2 | 2.0 | 0.2 | | | |
| SiO2 | 9.0 | 2.3 | 4.6 | 1.8 | 1.5 | 1.8 | 1.8 | 1.6 | 1.9 | | |
| SSP | 11 | 14 | 27 | 8 | 10 | 31 | 7 | 10 | 19 | 10 | 46 |
| SAR | 0.4 | 0.6 | 1.5 | 0.4 | 0.5 | 1.5 | 0.3 | 0.5 | 0.9 | 0.5 | 3.0 |
| Class | C2S1 to C3S1 | C2S1 to C3S1 | C2S1 to C3S1 | C2S1 | C2S1 to C3S1 | C2S1 to C3S1 | C3S1 | C3S1 | C3S1 | C3S1 | C3S1 |

(Note) (1) Water classification depends on "Saline and Alkali Soils" by USDA
(2) Detail description of water equality at each site is shown in DATABOOK -I

FIGURE A.2.5-1 LOCATION MAP OF WATER QUALITY MONITORING SITES

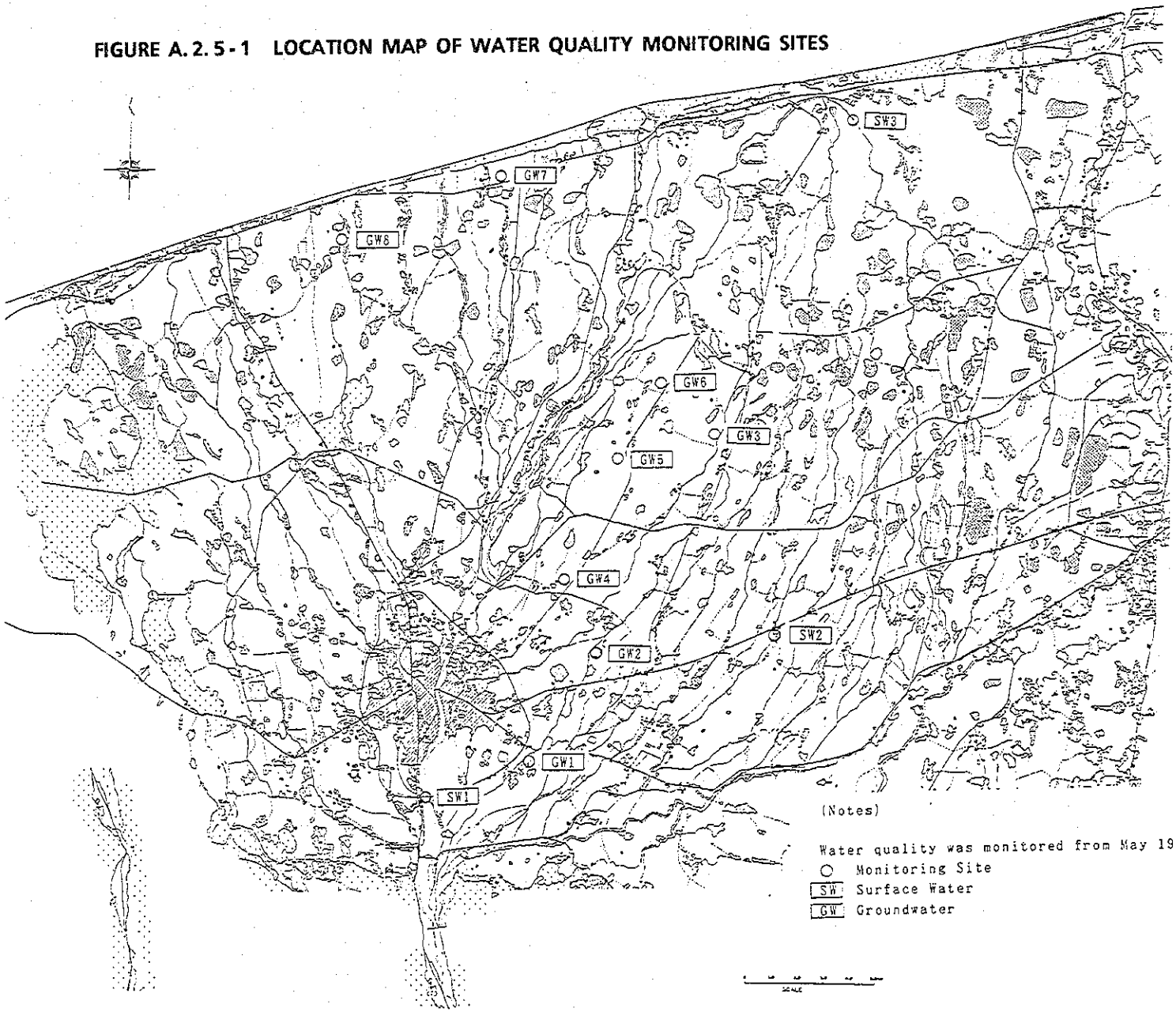
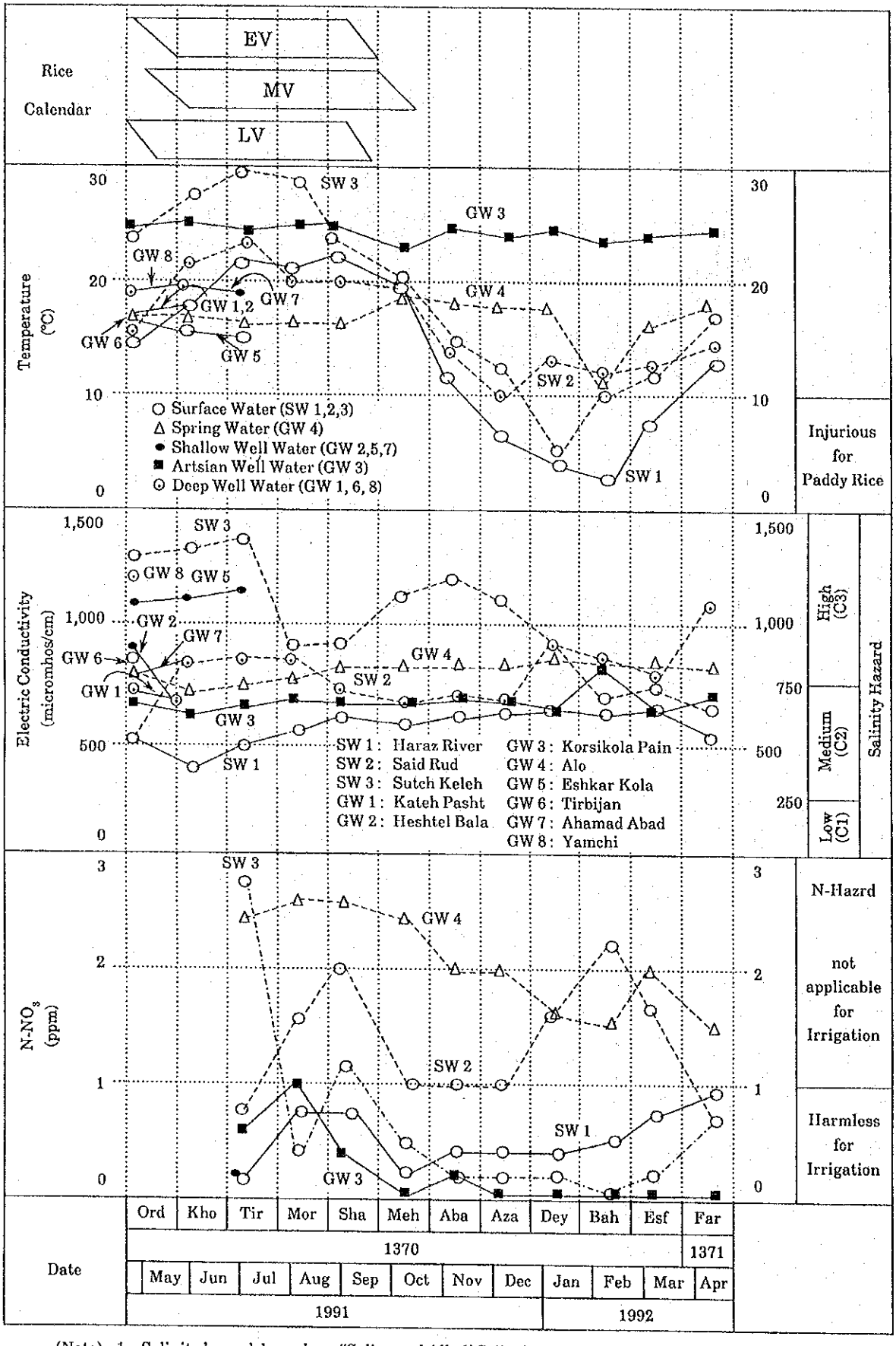


FIGURE A. 2. 5-2 SEASONAL FLUCTUATION OF WATER QUALITY IN THE PROJECT AREA



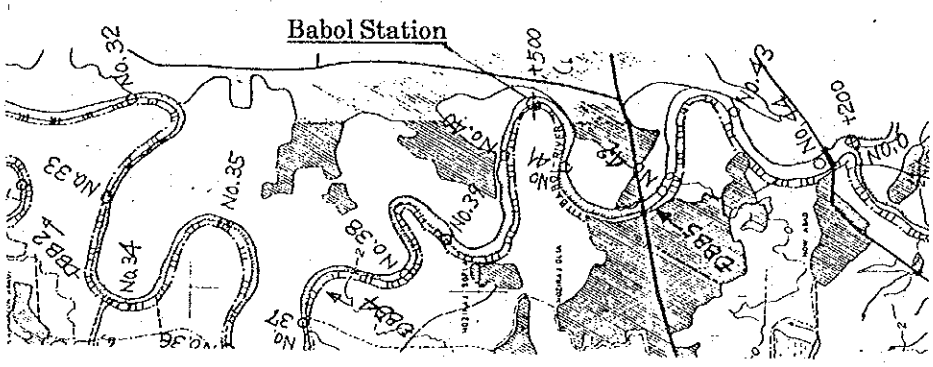

(Note) 1. Salinity hazard depends on "Saline and Alkali Soils" by USDA
2. N- Hazard depends on "Water Quality Hazard Standard for Irrigation Water" by the Ministry of Agriculture, Forestry and Fisheries, Japan.

## A. 2. 6 Roughness Coefficient of the River

### 1. Roughness Coefficient of the Babol River

Roughness coefficient of the Babol river has been examined using the rating curve and cross-section (hydrological year 1356 - 57 to 1357 - 58) at Babol Hydrological station, which locates at No. 40 + 500, and the results of flood-mark survey. From elevations of the flood-marks at adjacent points of said station, the hydraulic gradient of flood is estimated at about 1/2,700. Using this hydraulic gradient and rating curve, roughness coefficient has been examined by Manning Formula. Roughness coefficient has been computed at different depths, and results are as follows;

Location of the Babol Station




Roughness Coefficient in the Babol River

| Depth (h) (m) | Area (A) (m2) | Discharge (Q) (cms) | Velocity (V) (m/sec) | Wet Perimeter (P) (m) | Radius (R) (m) | Roughness Coefficient (N) |
|---|---|---|---|---|---|---|
| 6.00 | 348 | 450 | 1.293 | 81.1 | 4.291 | 0.0393 |
| 5.40 | 302 | 378 | 1.242 | 77.1 | 3.917 | 0.0382 |
| 4.60 | 243 | 286 | 1.177 | 75.7 | 3.210 | 0.0356 |
| 4.00 | 206 | 222 | 1.078 | 73.5 | 2.803 | 0.0355 |
| 3.00 | 136 | 132 | 0.971 | 69.7 | 1.951 | 0.0310 |
| 2.00 | 69.3 | 62 | 0.895 | 65.9 | 1.052 | 0.0222 |

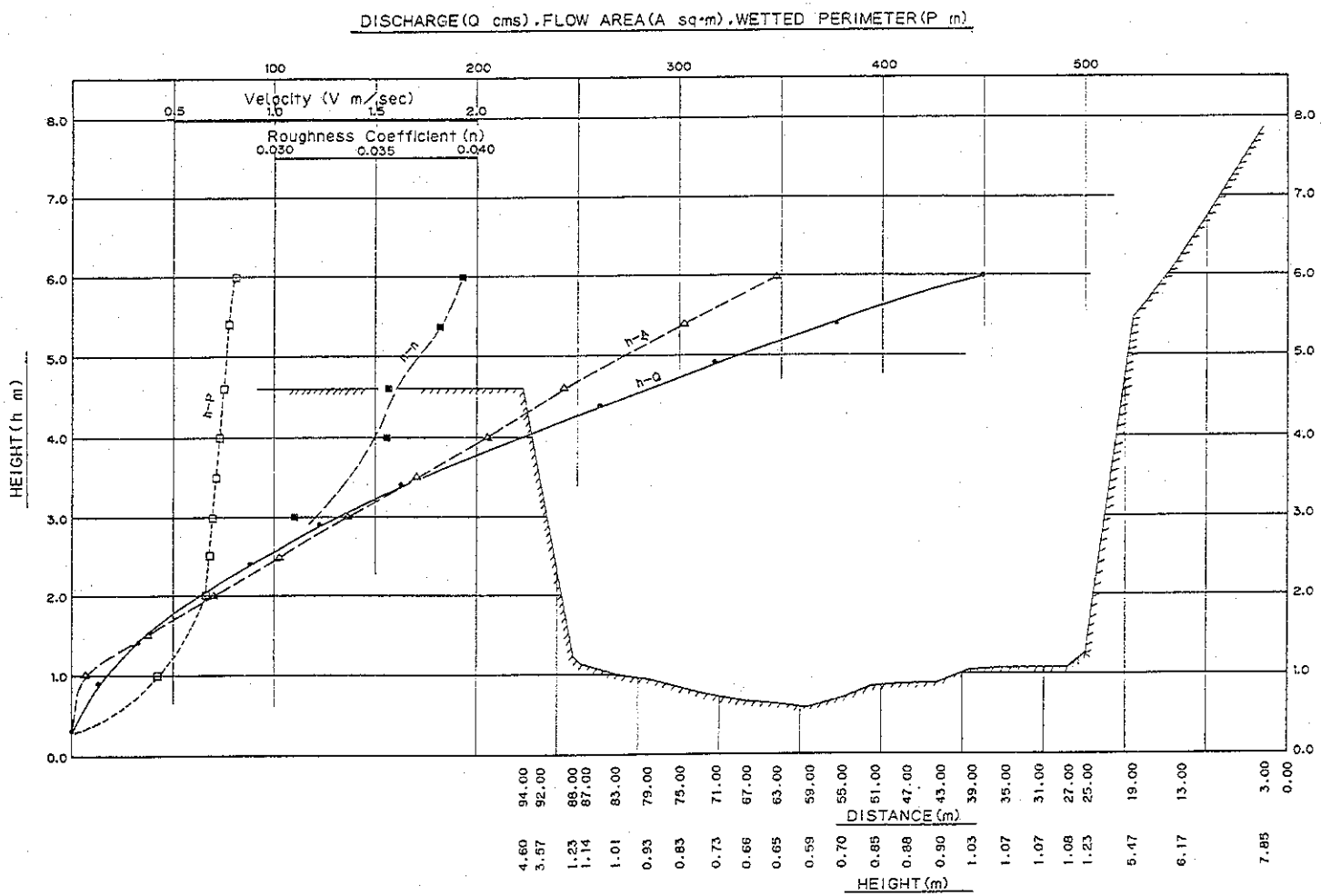
Above results are shown in the Figure A. 2. 6-1.

## 2. Application of Roughness Coefficient

From the Figure A. 2. 6-1, following conclusions are obtained;

- Roughness coefficient (n) varies from 0.022 to 0.0393, and smaller as 0.022 at lower water stage and larger as 0.0393 at higher water stage.
- Therefore, if the river is maintained under good condition, roughness coefficient will be kept within 0.035, otherwise, it will be 0.040 or more.

## FIGURE A. 2. 6 - 1 ROUGHNESS COEFFICIENT OF THE BABOL RIVER




(NOTES) 1. CROSS-SECTION WAS GIVEN BY THE MRWB.
2. h-Q CURVE REFERS TO THE RATING CURVE OF 1356-57 & 1357-58 IN THE HYDROLOGICAL YEAR BOOK.
3. FLOW AREA (A) AND WETTED PERIMETER(P) ARE MEASURED BY THE CROSS-SECTION.
4. ROUGHTNESS COEFFICIENTS(n) ARE ESTIMATED WITH A HYDRAULIC GRADIENT OF 1/2700.

# APPENDIX A. 3 GROUNDWATER

## CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## A. 3. 1 General

### 1. Physiography

The catchment area of Project Area is bordered to the south by the northern slope of Alborz Mountain which have a height peak of Damavand summit more than 5,670 m. The watershed of Haraz river occupies the wider as well as higher range in whole project area where cover the 4,061 $km^2$ at Karehsang station :

To the down stream, the river in this area namely "Haraz River" descends perpendicularly the geological structure, axes of anticline or syncline along north-south direction, and is fan out to the Haraz Plain.

The plain ranges 50 km along the southern coast of the Caspian Sea which is covered extensively by the alluvial plain. The alluvial plain, however, turns its physiographic features as down to the stream, especially at about 15 kilometers from the mountain front, which is corresponded to the middle land of plain, the terrain is changed suddenly.

Its northern part is pronounce to be a dominance of flat low plain while the south is made up of a steeper convex aspect relatively. In the both areas, not only physiography but geologic and pedologic characteristics are also different, consequently, their terminology are adopter to "Alluvail Lowland to Backland" for the downstream area and "Alluvial Fan or Coalescing Alluvial Fan" for the upstream individually. Furthermore, the "Coastal Sand Dune" fringes the Alluvial Lowland with several 100 metres wide, and the backswamp is also arranged behind it sparsely.

Otherwise near the mountain front, the Alluvial Terrace along valley is clearly traced out with more than 100 m of relative height from the present river bed, in addition to this, the terrace plane continues to further inland accompanied with several levels of them.

The slope gradient of Alluvial Fan is generally shown about 10/1,000 in the elevation of 20 m PDG to 190 m PDG. And the Alluvial Lowland slope becomes flatter to downstream abruptly up to 1.5/1,000 to 3/1,000 ranging in the elevation of 20 m PDG to (-)27 m PDG which is correlative with the present

Caspian Sea level. As general aspect through whole Project Area, the steeper terrain of Alluvial Fan is dominant only in the western half of Project Area, contrary to this, the east, ranging the Feridon Kenar to Babolsar, is occupied wider by the Alluvial lowland as far as their mountain front. The bird's eye view and topographical cross section of Haraz basin, shown in Figure A. 3.1, and 2, expresses these physiographic characteristic involving Project Area strongly.

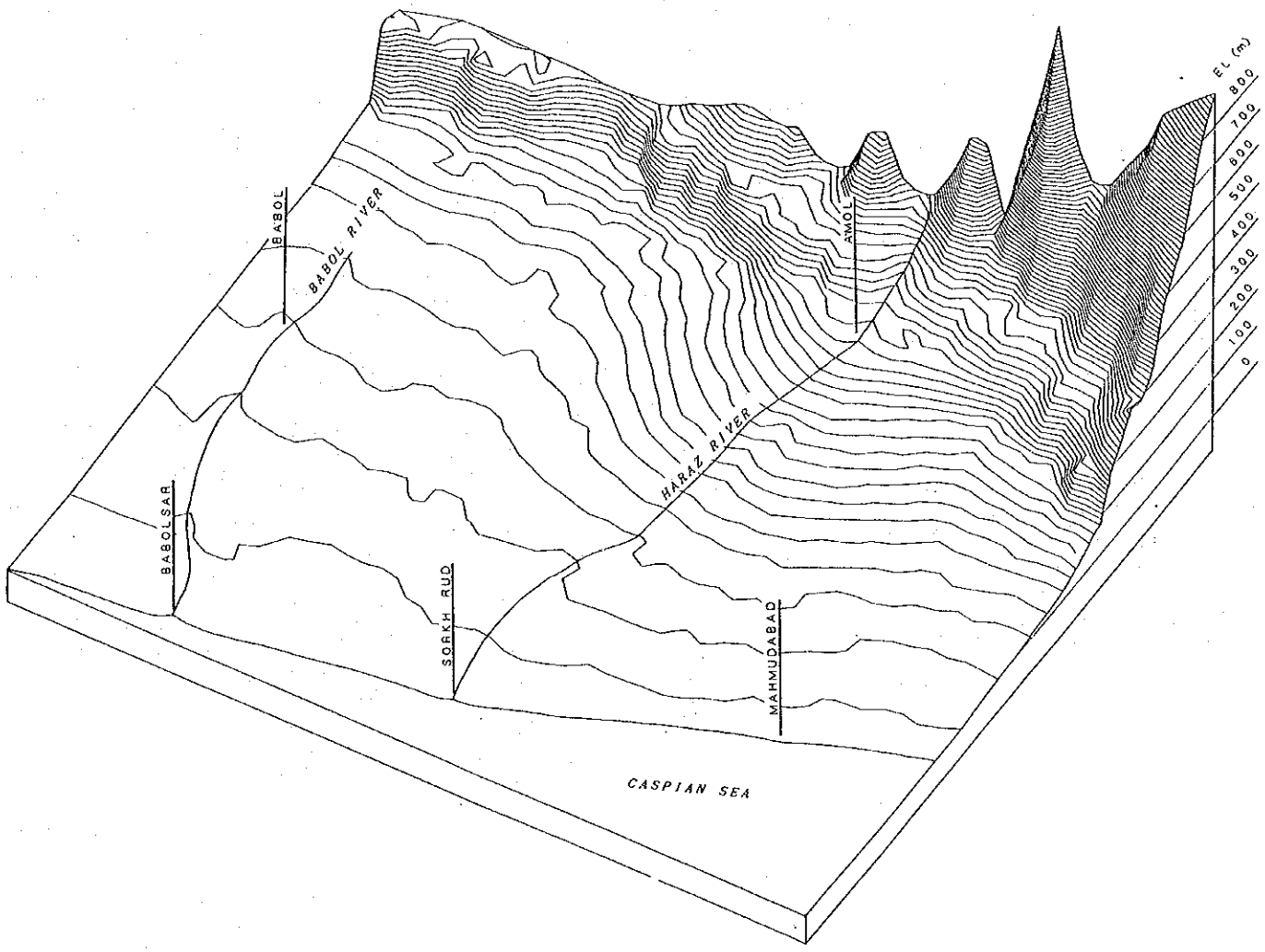



Figure A.3.1 Bird's Eye view of Project Area from Northeast

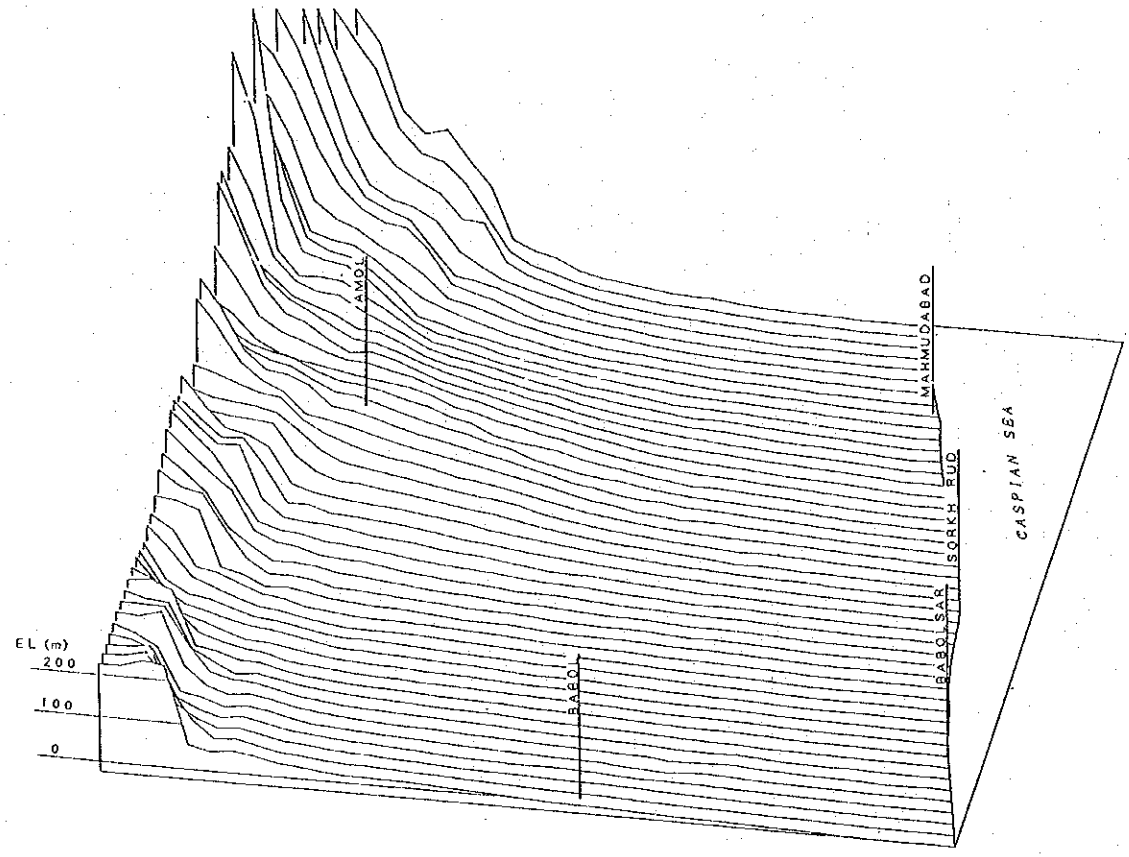



Figure A.3.2 Topographical Cross Section of Haraz Basin

## 2. Geology

On the basis of conducted studies of geology, the Alborz mountains have been seen to be connected to some parts of Alps Himaliya folding system. These mountain ranges in the eastern and central regions have formed an anticlinorium in the northern boundaries of central Iran.

As shown in Figure A. 3. 3 of Geological Map, the descriptive geological sequences in Haraz river drainage is recognizable as a various geological members ranging Palaeozoic to Quarternary.

The oldest formation in the watershed possesses an outcrop belonging to Permian age at their upper stream as the schistose facies. In south of Amol, the upper most part of it is situated under the Triassic sediments in a paracomformable manner. And it is composed of calcalious layer with common appearance of micro fossils. The dolomitic layer also containing the layer of gypsum on these sediments proves the existence of evaporation basins which are sparsely formed.

The Traissic to Jurassic succession is interruptedly aspect due to sea regression prior to Lias. However, Jurassic to Cretaceous member had been continuously occurring in such a manner that limestone belonging to Tithonian age have been found in most parts.

The Palaocene sediments have not been found in Alborz region, and the Cenozoic sediments rest upon the upper Cretaceous schist and marl with an unconformity.

Neogene series overlie the basin connecting the northern part of Alborz fault so far as the coastal plain of Caspian Sea, and the sedimentary is affected by folding, especially between Northern Alborz fault and Khazar fault by the tectonics. And these foldings were form a series of anticlines and synclines in the E-W axis extension. These foldings were broken under the effects of more recent activities of the fault with N-W, NW-SE and NE-SW.

Quatenary sediments have lain the Neogene sediment with conformity. And although the Quatenary deposit, except for alluvial sediment, is exposed out on the surface scarcely, their existence have been ascertained by

exploratory investigation. These deposits are divisible into following member on the basis of borehole data.

- Lower Layer (Sediment of Asheronian Epoch):

  The facies not consists of blue, gray and green marl, fine gained sand, gravelly layer and intercalation of volcanic ash occasionally.

- Middle Layer (Ancient Caspian Sediments):

  The layer lay on the Apsheronian sediment with 450 m thickness, it consist of alternate layer of gray, green and blue marls, fine sandstone with slight cement material, and thin gavel layer interbedded.

- Upper Layer (Novo Caspian Sediments):

  The thickness is observable as 30 m to 160 m, the layer consisting of loess in the alluvial terrace in addition to marine sediment near the sea coast.

- Upper Layer (Alluvial Fan Deposit):

  The facies comprises mostly weathering conglomerate soil consisting of the coarser deposit and intercalation of silt layer, and it piles on/beside the recent marine sediment. The thickness, however, is unknown yet since the lowest boundary is obscure.

The basement rock making up of Haraz basin is correlative with the Miocene to Pliocene Conglomerate facies which is exposed out on the southern hill area between mountain front of Alborz height and Alluvial fan. And the surface of basement is marked by the highly undulations as shown in Figure A. 3. 4. And the sediment sequence laid upon the basement is Ancient Caspian Sediment, Novo Caspian Sediment or Alluvial Fan deposit in order of the lower member. At the upper most horizon, the top soil layer having several meters thick is traced out as a distribution of thicker layer to the downstream.

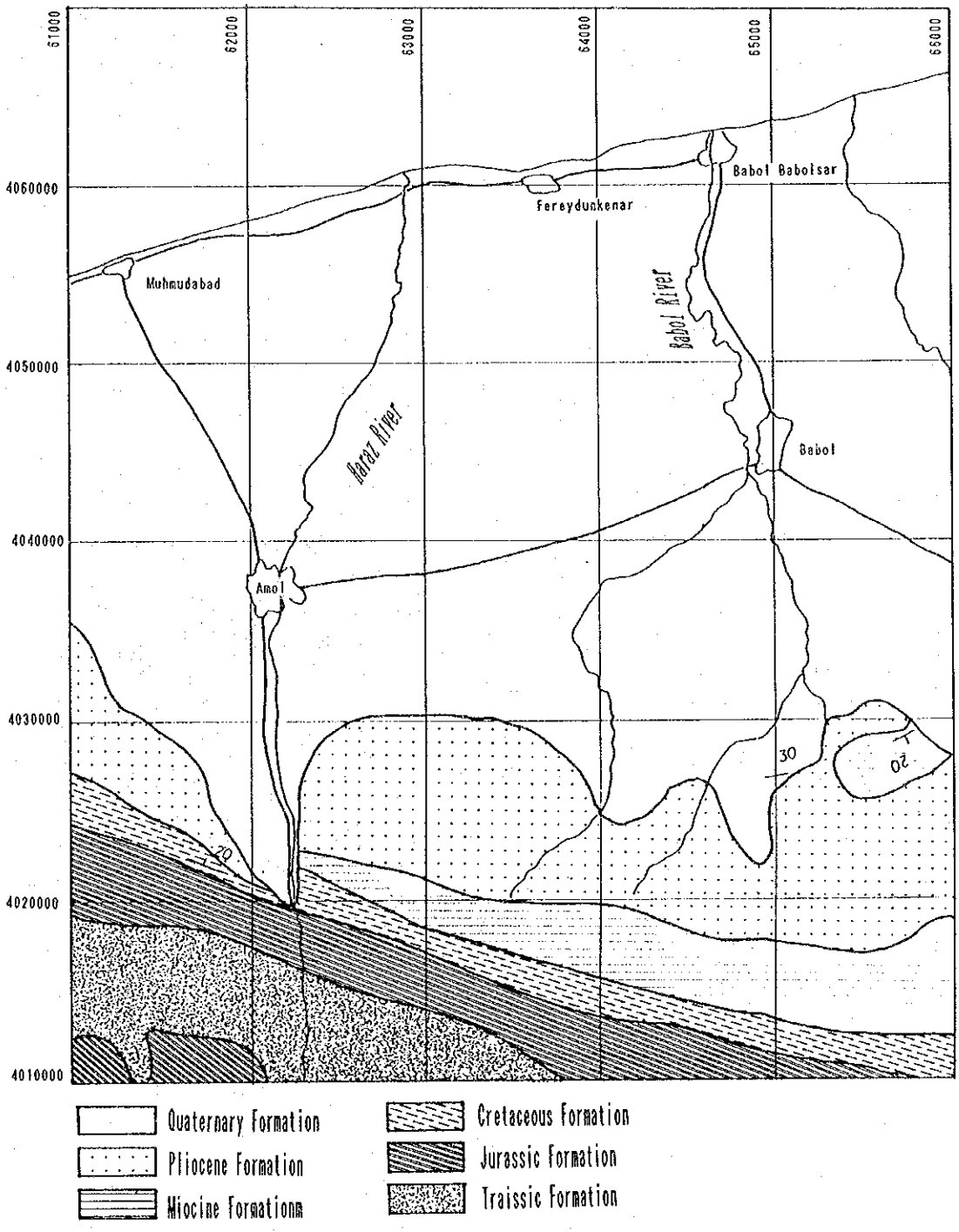



Figure A.3.3 Geological Map of Project Area

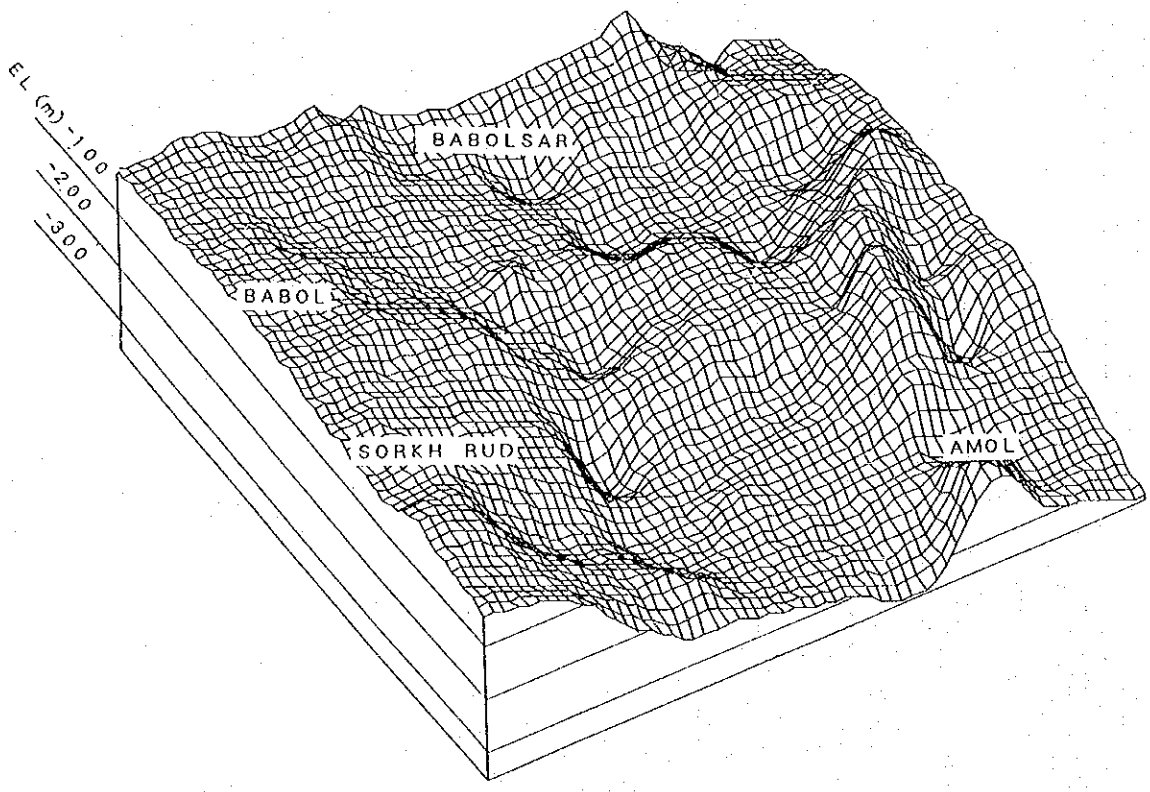



Figure A.3.4 Bird's Eye view of Base of Alluvium from Northeast

## A. 3. 2 References on Groundwater

### 1. Groundwater and Spring

(1) Hydrogeological Aspect

The area bears highly productivity yield attributable to the extensive watershed, which covers over 4,000 km$^2$ of Alborz highlands, and to the thick aquifer involving Alluvial Fan deposit. Accordingly, the groundwater draft had been done from old times. Although the highly productivity as well as sufficient resources, the utilization of groundwater has suddenly increased in recent 10 years for the purpose of irrigated water, so that the groundwater level has been dropped at times which causes the drying up of well and arises a difficulties for pumping up at the shallow level.

On the other hand, the investigation and groundwater resources evaluation has been conducted for treating the future water demand in this region. As the representative suggestion for these, three articles, which are reported in the (a) M/P Report written by JICA Team (in Master Plan of Caspian Sea Coastal Area Agriculture Development Project), (b) HWDP-1 Report and (c) Quantitative and Qualitative Mathematical Investigation Report prepared by the Mahab Godss Consulting Engineers (in Hydrogeological Study on Babol-Talar-Haraz River Plains) are taken up.

Although above, a considerable difference as shown in Table A. 3. 1, especially in the estimation of feasible amount from groundwater resource, appears among three reports. For instance, a feasible amount shows about 346 MCM in the report of HWDP-1 Report, while the only 137 MCM is in that of M/P Report.

Nowadays, these difference has arisen as a large obstacle for considering or planning the agricultural development program as well as that of other purposes in this region.

The difference among studies can be seen as some meaning, and so they are summarized as below.