SUPPORTING REPORT

PAPER 2

IRRIGATION AND WATER RESOURCES DEVELOPMENT

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

SUPPORTING REPORT

PAPER 2 IRRIGATION AND WATER RESOURCES DEVELOPMENT

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Note: The Contents without any reference source were prepared by JICA Study Team.

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CHAPTER 1. IRRIGATION

1.1 MAIN CROP YIELDS UNDER IRRIGATION AND RAINFED

According to the MOJA, main crop yields under irrigation and rainfed in Iran are as shown in Table 1.1.1.

Table 1.1.1 Major Crop Yields under Irrigation and Rainfed

(kg/ha)

Crop	Rice	Wheat	Barley	Alfalfa	Apple	Olive	Potato	Beans
Irrigated	3736	3655	2818	6125	16332	4050	27201	1478
Dry farm	0	1097	931	2090	0	0	0	423

Source: MOJA

1.2 COMPARISON OF RICE YIELD BETWEEN GILAN AND MAZANDARAN

According to the MOJA, rice yield between Gilan and Mazandaran are as shown in Figure 1.2.1.

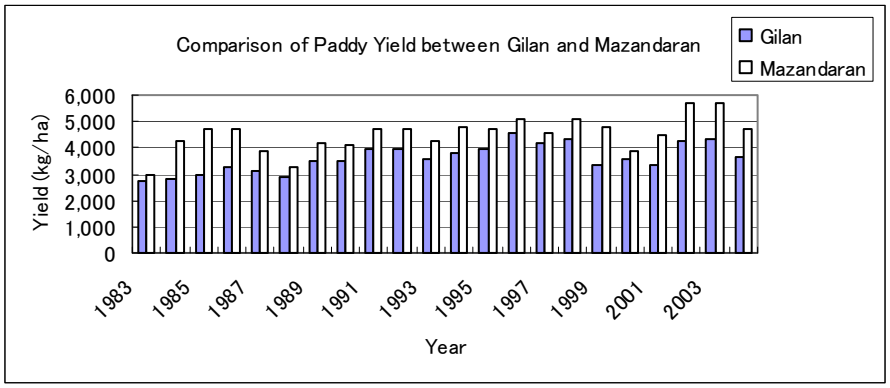


Figure 1.2.1 Comparison of Rice Yield between Gilan and Mazandaran

CHAPTER 2. WATER RESOURCES DEVELOPMENT

2.1 PREDICTION OF DOMESTIC WATER DEMAND

2.1.1 Irrigation Requirement in Gilan Province

Irrigation requirement of main crops in Sefidrud Irrigation and Drainage Network (SIDN) is as shown in Table 2.1.1.

Table 2.1.1 Irrigation Requirement in SIDN

Month		Rice		Tea Orchard		Other Cultivation		Total Irrigation Requirement of Agriculture Land (mcm)
		Gross Requirement (m^3/ha)	Irrigation Requirement (mcm)	Gross Requirement (m^3/ha)	Irrigation Requirement (mcm)	Gross Requirement (m^3/ha)	Irrigation Requirement (mcm)	
Farvardin	Apr.	1,524.00	257.70	212.50	0.72	0.00	0.00	1,994.92
Ordibehesht	May	3,932.00	664.90	450.00	1.52	0.00	0.00	5,048.42
Khordad	Jun.	2,143.00	362.40	950.00	3.21	1,012.50	4.63	4,475.74
Tir	Jul.	2,165.00	366.00	937.50	3.16	1,750.00	8.00	5,229.66
Mordad	Aug.	1,811.00	265.30	937.50	3.16	1,437.50	6.60	4,461.06
Shahrivar	Sep.	0.00	0.00	225.00	0.76	0.00	0.00	225.76
Total		11,575.00	1,916.30	3,712.50	12.53	4,200.00	19.23	21,435.56

Source: The Project of Study on Irrigation and Drainage System Improvement in Gilan Sefidrud River Vol 26: Summary Report, Pandam Consulting Engineer, 2004

2.1.2 Prediction of Provincial Domestic Water Demand in the Study Area

Domestic water demand in each provinces is estimated in Mahab Ghodss Report as shown in Table 2.1.2.

Table 2.1.2 Domestic Water Demand in Each Provinces

Province	Category	2,006		2,011		2,016		2,021		2,026		2,031		2,036	
		Unit Water Demand (L/s)	Annual Demand ('000m3)	Unit Water Demand (L/s)	Annual Demand ('000m3)	Unit Water Demand (L/s)	Annual Demand ('000m3)	Unit Water Demand (L/s)	Annual Demand ('000m3)	Unit Water Demand (L/s)	Annual Demand ('000m3)	Unit Water Demand (L/s)	Annual Demand ('000m3)	Unit Water Demand (L/s)	Annual Demand ('000m3)
Gilan	Urban	2,913	91,864	3,319	104,668	3,725	117,472	4,131	130,275	4,537	143,079	4,943	155,882	5,349	168,686
	Rural	2,330	73,479	2,714	85,599	3,099	97,720	3,483	109,840	3,867	121,960	4,252	134,081	4,636	146,201
	Total	5,243	165,343	6,033	190,267	6,824	215,191	7,614	240,115	8,404	265,039	9,195	289,963	9,985	314,887
Zanjan	Urban	819	25,828	951	30,001	1,084	34,175	1,216	38,348	1,348	42,521	1,481	46,694	1,613	50,868
	Rural	702	22,138	870	27,431	1,038	32,724	1,206	38,017	1,373	43,309	1,541	48,602	1,709	53,895
	Total	1,521	47,966	1,406	44,324	1,290	40,681	1,175	37,039	1,059	33,397	944	29,754	828	26,112
Kordestan	Urban	254	8,010	408	12,851	561	17,692	715	22,532	868	27,373	1,022	32,214	1,175	37,055
	Rural	436	13,750	697	21,986	958	30,222	1,220	38,458	1,481	46,694	1,742	54,930	2,003	63,167
	Total	690	21,760	1,105	34,837	1,519	47,914	1,934	60,991	2,349	74,068	2,763	87,144	3,178	100,221
Ardebil	Urban	115	3,627	134	4,221	153	4,814	172	5,408	190	6,002	209	6,596	228	7,190
	Rural	144	4,541	178	5,608	212	6,675	246	7,742	279	8,809	313	9,876	347	10,943
	Total	259	8,168	312	9,829	364	11,490	417	13,151	470	14,811	522	16,472	575	18,133
East Azerbayjan	Urban	239	7,537	277	8,741	315	9,944	354	11,148	392	12,352	430	13,555	468	14,759
	Rural	428	13,497	529	16,683	630	19,868	731	23,053	832	26,238	933	29,423	1,034	32,608
	Total	667	21,035	806	25,423	945	29,812	1,085	34,201	1,224	38,590	1,363	42,978	1,502	47,367
Tehran & Qazvin	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rural	131	4,131	156	4,920	181	5,708	206	6,496	231	7,285	256	8,073	281	8,862
	Total	131	4,131	156	4,920	181	5,708	206	6,496	231	7,285	256	8,073	281	8,862
Hamedan	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rural	83	2,617	107	3,369	131	4,121	155	4,872	178	5,624	202	6,376	226	7,127
	Total	83	2,617	107	3,369	131	4,121	155	4,872	178	5,624	202	6,376	226	7,127
Total	Urban	4,340	136,866	5,089	160,481	5,838	184,097	6,587	207,712	7,335	231,327	8,084	254,942	8,833	278,557
	Rural	4,254	134,154	5,251	165,596	6,248	197,037	7,245	228,478	8,242	259,920	9,239	291,361	10,236	322,802
	Total	8,594	271,020	9,924	312,969	11,254	354,917	12,585	396,865	13,915	438,813	15,245	480,761	16,575	522,709

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

2.1.3 Prediction of Urban Population in 2031

Urban population is estimated in Mahab Ghodss Report as shown in Table 2.1.3.

Table 2.1.3 Prediction of Urban Population in 2031

Reach	Year		2006	2016	2031	2036
	Total Urban		1,957,780	2,339,086	3,016,174	3,269,137
	(Share)		0.60	0.72	0.92	1.00
R03	Givi	ARD	8,126	9,694	12,555	13,647
R05	Torkamanchai	EAZ	7,159	8,505	10,911	11,860
R11	Mianeh	EAZ	92,626	110,039	141,164	153,439
R16	Hastjin	ARD	6,048	7,215	9,345	10,158
R19	Roudbar	GIL	14,109	47,946	60,087	65,312
R20	Zanjan	ZAN	341,369	408,039	534,767	581,269
R21	Manjil	GIL	17,399	20,574	25,784	28,026
	Lowshan	GIL	16,376	19,364	24,268	26,378
	Sub-total		33,775	39,938	50,052	54,404
R27	Soltanieh	ZAN	6,538	7,816	10,243	11,134
R37	Bijar	KOR	56,414	71,409	102,520	111,435
R41	Divandareh	KOR	24,342	30,812	44,236	48,083
R47	Dehkolan	KOR	19,277	24,401	35,032	38,078
R48	Ghorveh	KOR	78,602	99,494	142,840	155,261
	Serish Abad	KOR	9,108	11,529	16,553	17,992
	Sub-total		87,710	111,023	159,393	173,253
R53	Rasht	GIL	495,181	585,527	734,068	797,900
	Astaneh	GIL	39,659	42,982	58,770	63,880
	Kiashahr	GIL	16,752	19,809	24,824	26,983
	Lasht Nesha	GIL	12,784	15,116	18,944	20,591
	Khoman	GIL	10,176	12,032	15,080	16,391
	Kochesfahan	GIL	10,093	11,934	14,956	16,257
	Sangar	GIL	8,229	9,731	12,548	13,639
	Sub-total		592,874	697,131	27,504	955,641
R59	Khalkhal	ARD	42,525	42,525	65,707	71,421
R60	Hashtroud	EAZ	21,058	25,017	32,093	34,884
	Gharah Aghaj	EAZ	5,361	6,369	8,171	8,881
	Sub-total		26,419	31,386	40,264	43,765
R61	Koldar	ARD	4,372	5,216	6,756	7,344
R63	Geidar	ZAN	22,308	26,664	34,946	37,985

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

2.2 DEVELOPMENT WITH DAM

2.2.1 Discharge for Hydroelectric Generation in Ostor Dam

Water balance of hydropower generation in Ostor dam is arranged as shown in Table 2.2.1.

Table 2.2.1 Water Balance of Hydropower Generation in Ostor Dam

(Middle Term Target Year: 2016)

Item	Unit	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Inflow	'000m^3	37,933	88,268	122,749	131,830	150,522	267,272	356,774	314,009	150,742	62,265	32,260	31,181	1,745,807
Design	'000m^3	23,872	32,841	47,226	59,512	70,036	94,261	111,314	113,966	83,191	41,354	26,945	26,945	731,463
Supply	'000m^3	22,529	32,027	44,748	60,362	74,118	101,011	110,079	111,596	77,309	36,118	23,552	23,726	717,174
Supply Rate	%	94.4	97.5	94.8	101.4	105.8	107.2	98.9	97.9	92.9	87.3	87.4	88.1	98.0

(Long Term Target Year: 2031)

Item	Unit	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Inflow	'000m^3	34,318	72,881	106,526	121,790	144,970	248,523	323,941	268,719	127,180	58,993	31,866	32,328	1,572,037
Design	'000m^3	23,872	32,841	47,226	59,512	70,036	94,261	111,314	113,966	83,191	41,354	26,945	26,945	731,463
Supply	'000m^3	21,768	31,338	43,488	58,338	69,171	92,607	102,883	102,734	73,711	35,107	22,711	23,032	676,886
Supply Rate	%	91.2	95.4	92.1	98.0	98.8	98.2	92.4	90.1	88.6	84.9	84.3	85.5	92.5

Source: WRMC

2.2.2 Questionnaire for Existing and Under Construction

For dam data collection, the following questionnaire (Table 2.2.2 and Table 2.2.5)were delivered to RWC.

Table 2.2.2 Questionnaire for Existing and Under Construction Dams (1/2)

Name and Location					
Name of Dam/Reservoir			Executive Organization		
Name of Consultant					
River			Main river		
Province			Village		
Latitude			Longitude		
History					
Design			Contractor		
Executive Organization			Finance		
Commencement year of construction			Completion year (expected) of construction		
Existence of Rehabilitation	1. Yes ( )				2. No
Purpose of Irrigation				1. Yes	2. No
Name of irrigation area			Province		
Area of irrigation (ha)			Main crop		
Discharge period	～		Maximum discharge		m^3/s
Minimum discharge	m^3/s		Average discharge		m^3/s
Conduction Method	1. River + Intake weir		2. Directly open canal		3. Directly pipeline
Location of intake weir					
Purpose of Power Generation				1. Yes	2. No
Discharge (m^3/s)	Rainy season		Dry season		Average
Annual Output (MKW)	Rainy season		Dry season		Average
Purpose of Drinking Water				1. Yes	2. No
Name of Beneficiary City/Town			Target population		
Standard amount for water consumption (lpcd)			Maximum discharge		m^3/s
Minimum discharge	m^3/s		Average discharge		m^3/s
Conduction Method	1. River + Intake weir		2. Directly open canal		3. Directly pipeline
Location of intake weir					
Purpose of Industrial Water				1. Yes	2. No
Name of Beneficiary City/Town			Maximum discharge		m^3/s
Minimum discharge	m^3/s		Average discharge		m^3/s
Conduction Method	1. River + Intake weir		2. Directly open canal		3. Directly pipeline
Location of intake weir					
Purpose of Water for Environment				1. Yes	2. No
Name of Beneficiary City/Town			Environment		
Discharge period	～		Maximum discharge		m^3/s
Minimum discharge	m^3/s		Average discharge		m^3/s
Purpose of Flood Control				1. Yes	2. No
Design flood control water volume (m^3)					
Other Purpose				1. Yes	2. No

Table 2.2.3 Questionnaire for Existing and Under Construction Dams (2/2)

Catchment Area			
Catchment Area	km^2	Annual Rainfall	mm
Erosion	1. Many	2. Few	3. None
Landslide	1. Many	2. Few	3. None
National Park	1. Yes ( )		2. No
Mining	1. Yes ( )		2. No
Industrial Pollution	1. Yes ( )		2. No
Reservoir			
Gross Reservoir Capacity	million m^3	Design Flood Level	m
Flood Control Storage	million m^3	Surcharge Water Level	m
Effective Reservoir Capacity	million m^3	Normal Full Water Level	m
Dead Storage/Sediment Volume	million m^3	Low Water Level	m
Design unit sediment volume	m^3/km^2/year	Design Life of Dam	years
Dam			
Type of Dam	1. Concrete (Gravity)	2. Concrete (Arch)	3. Concrete (Buttress)
	4. Rockfill	5. Earth	6. Others ( )
Dam Height	m	Volume of Dam Body	x 1,000m^3
Spillway			
Emergency Spillway		Design Discharge	m^3/s
Normal Spillway		Design Discharge	m^3/s
Submerged Spillway		Design Discharge	m^3/s
Total			m^3/s
Sediment Removal Facilities			
Existence of sediment removal facilities			1. Yes / 2. No
Sediment Removal Gates	Height = m	Width = m	gates
Sediment Removal Discharge	m^3/s	Operation season	
Actual Sediment Conditions	1. Massive	2. A little massive	3. Not so much
Estimate Actual Sediment Volume in Reservoir			m^3
Design Discharge			
	Dry Season	Rainy Season	Notes
Irrigation	m^3/s	m^3/s	
Drinking Water	m^3/s	m^3/s	
Industrial	m^3/s	m^3/s	
Power Generation	m^3/s	m^3/s	
River Maintenance/Environment	m^3/s	m^3/s	
Total	m^3/s	m^3/s	
Operation and Maintenance			
Permanent Staff		Daily sift times	
Rain Gauzing Station	sites	Gauging Station	sites
Available water analysis items			
Existence of Operation Rules& Manual for Water Distribution		1. Yes	2. No

Table 2.2.4 Questionnaire for Under Planning Dams (1/2)

Name and Location			
Name of Dam/Reservoir		Executive Organization	
Name of Consultant			
River		Main river	
Province		Village	
Latitude		Longitude	

History			
Stage	Completion Year	Consultant/ Executive Organization	Finance
① Preliminary Design (Dam site, Dam type)			
② Feasibility Study/Basic Design			
③ Detailed Design (Topo-survey, Boring)			
④ Cost Estimation/Construction Planning			
⑤ Initial Environmental Examination (IEE)			

Catchment Area				
Catchment Area	km^2	Annual Rainfall	mm	
Erosion	1. Many	2. Few	3. None	
Landslide	1. Many	2. Few	3. None	
National Park	1. Yes ( )			2. No
Mining	1. Yes ( )			2. No
Industrial Pollution	1. Yes ( )			2. No

Reservoir Area				
Reservoir Area	km^2	Town/Village		
Land Ownership	Governmental land: %	Provincial land: %	Union/Association: %	
	Private land: %	Others: % ( )		
Land Use	Forest: %	Desert: %	Pasture: %	
	Agriculture: %	Residence: %	Others: %	
Submerged households	1. Many ( )	2. Few ( )	3. None	
National Park	1. Yes ( )			2. No
Ruins/Heritage	1. Yes ( )			2. No
Mining	1. Yes ( )			2. No
Scarce animals & plants	1. Yes ( )			2. No
Standard amount for water consumption (lpcd)		Maximum discharge	m^3/s	
Minimum discharge	m^3/s	Average discharge	m^3/s	
Purpose of Industrial Water			1. Yes	2. No
Name of Beneficiary City/Town		Maximum discharge	m^3/s	
Minimum discharge	m^3/s	Average discharge	m^3/s	
Purpose of Water for Environment			1. Yes	2. No
Name of Beneficiary City/Town		Environment		
Discharge period	～	Maximum discharge	m^3/s	
Minimum discharge	m^3/s	Average discharge	m^3/s	
Purpose of Flood Control			1. Yes	2. No
Design flood control water volume (m^3)				
Other Purpose			1. Yes	2. No

Table 2.2.5 Questionnaire for Under Planning Dams (2/2)

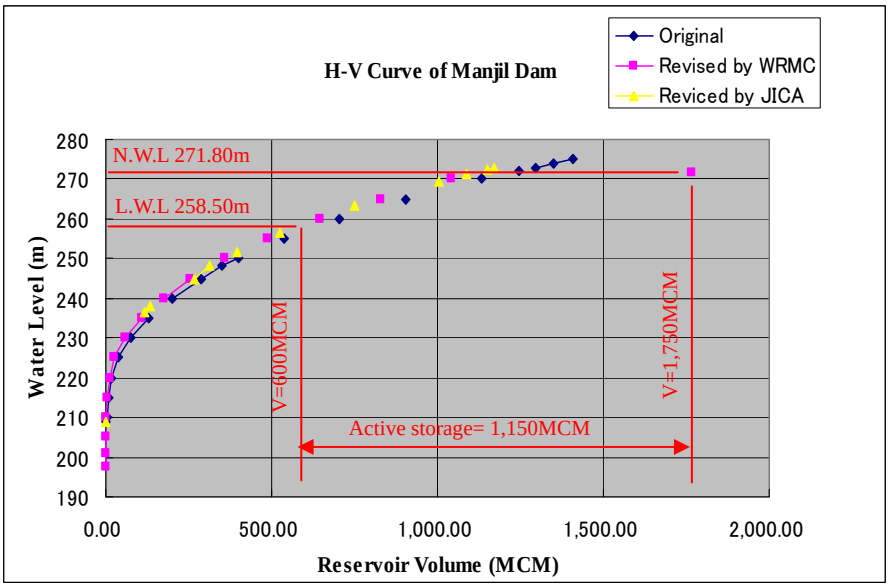
Reservoir			
Gross Reservoir Capacity	million m^3	Design Flood Level	m
Flood Control Storage	million m^3	Surcharge Water Level	m
Effective Reservoir Capacity	million m^3	Normal Full Water Level	m
Dead Storage/Sediment Volume	million m^3	Low Water Level	m
Design unit sediment volume	m^3/km^2/year	Design Life of Dam	years
Dam			
Type of Dam	1. Concrete (Gravity)	2. Concrete (Arch)	3. Concrete (Buttress)
	4. Rockfill	5. Earth	6. Others ( )
Dam Height	m	Volume of Dam Body	x 1,000m^3
Spillway			
Emergency Spillway		Design Discharge	m^3/s
Normal Spillway		Design Discharge	m^3/s
Submerged Spillway		Design Discharge	m^3/s
Total			m^3/s
Sediment Removal Facilities			
Existence of sediment removal facilities			1. Yes / 2. No
Sediment Removal Gates	Height = m	Width = m	gates
Sediment Removal Discharge	m^3/s	Operation season	
Estimate Actual Sediment Volume in Reservoir			m^3
Design Discharge			
	Dry Season	Rainy Season	Notes
Irrigation	m^3/s	m^3/s	
Drinking Water	m^3/s	m^3/s	
Industrial	m^3/s	m^3/s	
Power Generation	m^3/s	m^3/s	
River Maintenance/Environment	m^3/s	m^3/s	
Total	m^3/s	m^3/s	
Operation and Maintenance			
Permanent Staff		Daily sift times	
Rain Gauzing Station	sites	Gauging Station	sites
Available water analysis items			
Existence of Operation Rules& Manual for Water Distribution		1. Yes	2. No

2.2.3 Relations between Water Level and Reservoir Volume (H-V Curve)

According to the information submitted by RWC, the relation between water level and reservoir volume of large dams are as follow:

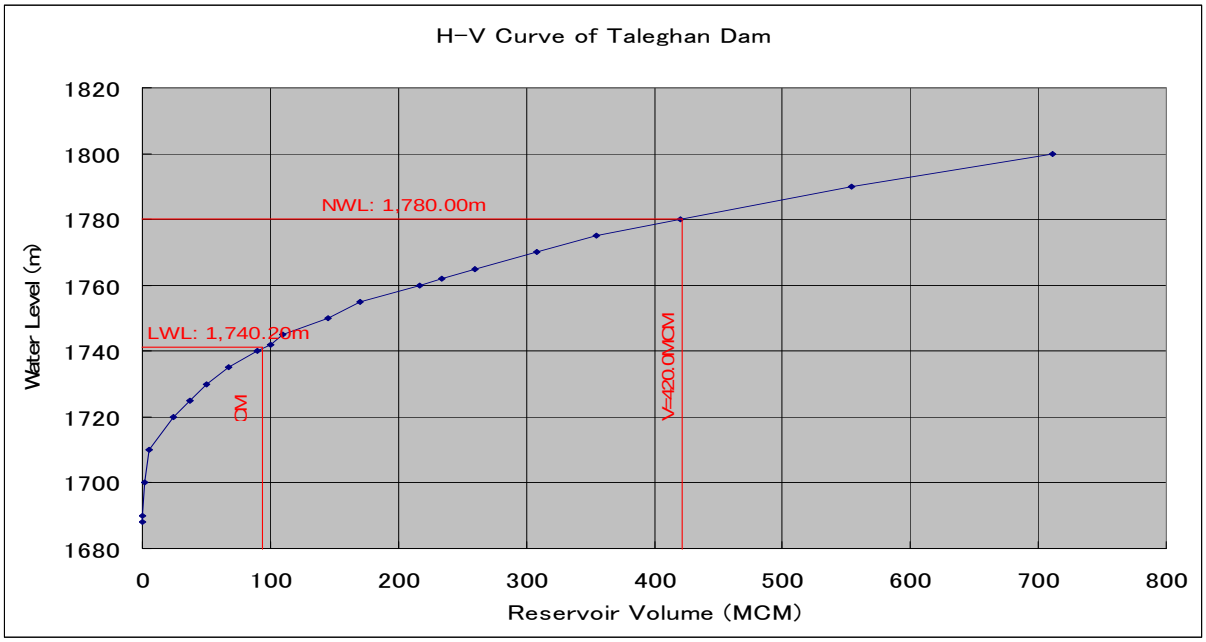
1) Manjil Dam (Existing)

Water Level (m)	Reservoir Volume (MCM)			Note
	At the Planning	Reviced by WRMC	Reviced by JICA	
197.40	0.00			
201.00	0.01			
205.00	0.26			
209.00		0.00	0.00	L.W.L
210.00	1.27	2.44		
215.00	4.40	7.75		
220.00	11.59	18.43		
225.00	26.85	37.62		
230.00	58.46	75.85		
235.00	108.35	130.10		
236.60			116.24	
237.90			132.73	
240.00	173.51	199.70		
245.00	255.80	287.10	266.68	
248.20		351.40	314.13	
250.00	358.96	399.20		
251.80			395.82	
255.00	488.42	538.80		
256.70			523.90	
258.50				L.W.L
260.00	645.70	705.60		
263.40			749.04	
265.00	829.22	902.30		
269.30			1,002.82	
270.00	1,043.00	1,134.00		
271.20			1,089.56	
271.80	1,765.00			N.W.L
272.00		1,245.00		
272.50			1,150.05	
272.90			1,169.10	
273.00		1,295.00		
274.00		1,352.00		
275.00		1,410.00		



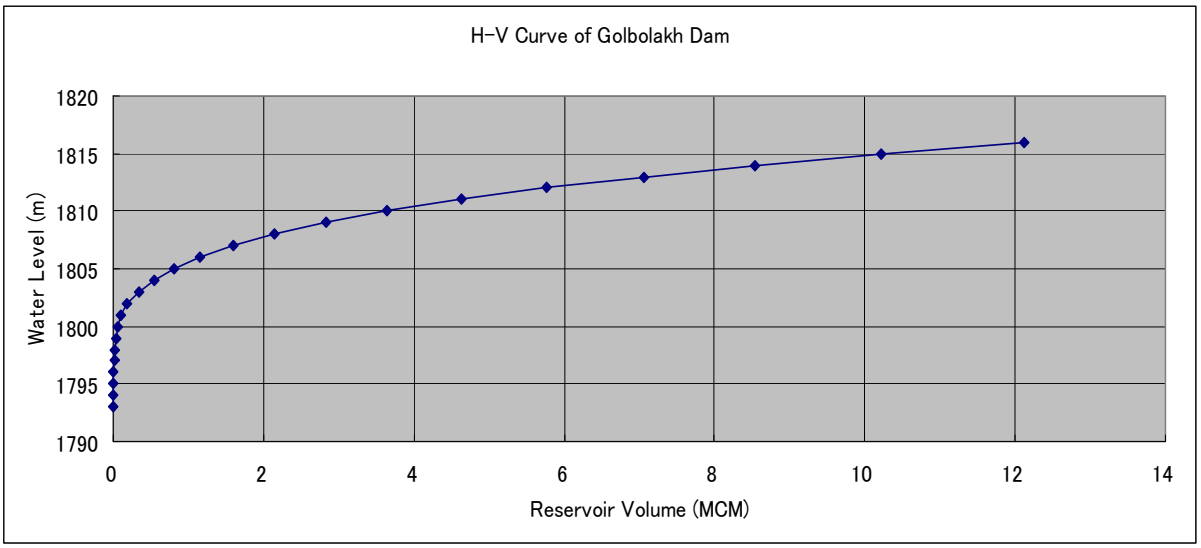
2) Taleghan Dam (Existing)

Water Level (m)	Area ($km^{2)}$	Volume (MCM)	Note
1,688.00	0.00	0.00	
1,690.00	0.02	0.02	
1,700.00	0.40	2.00	
1,710.00	1.10	5.50	
1,720.00	1.90	24.00	
1,725.00	2.40	37.00	
1,730.00	3.10	50.00	
1,735.00	3.60	67.00	
1,740.00	4.90	90.00	
1,740.20		91.00	L.W.L
1,742.00	5.10	100.00	
1,745.00	5.30	110.00	
1,750.00	6.20	145.00	
1,755.00	6.70	170.00	
1,760.00	8.10	217.00	
1,762.00	8.30	234.00	
1,765.00	8.70	260.00	
1,770.00	10.10	308.00	
1,775.00	11.70	355.00	
1,780.00	12.20	420.00	N.W.L
1,790.00	14.50	554.00	
1,800.00	16.90	711.00	



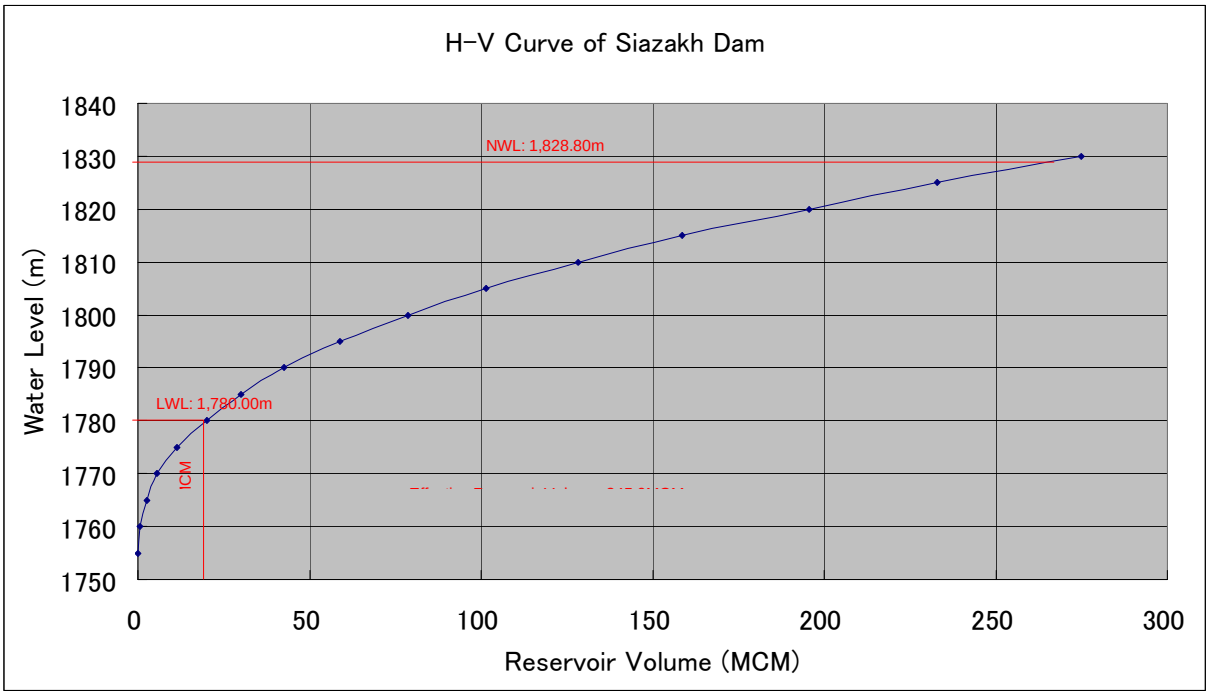
3) Golblagh Dam (Existing)

Water Level (m)	Height (m)	Area (m^2)	Volume (m^3)	Note
1,794.00	0	288	29	
1,795.00	1	1,792	962	
1,796.00	2	5,024	4,234	
1,797.00	3	8,864	11,088	
1,798.00	4	14,048	22,445	
1,799.00	5	21,984	40,313	
1,800.00	6	31,296	66,816	
1,801.00	7	51,232	107,673	
1,802.00	8	113,984	188,217	
1,803.00	9	182,976	335,343	
1,804.00	10	242,208	547,244	
1,805.00	11	302,784	819,177	
1,806.00	12	385,632	1,162,552	
1,807.00	13	491,616	1,600,105	
1,807.70			1,800,000	L.W.L
1,808.00	14	611,040	2,150,352	
1,809.00	15	744,800	2,827,169	
1,810.00	16	903,872	3,650,223	
1,811.00	17	1,064,672	4,633,399	
1,812.00	18	1,214,016	5,771,926	
1,813.00	19	1,380,352	7,068,221	
1,813.90			8,100,000	N.W.L
1,814.00	20	1,560,576	8,537,763	
1,815.00	21	1,799,220	10,216,247	
1,816.00	22	2,009,364	12,119,572	



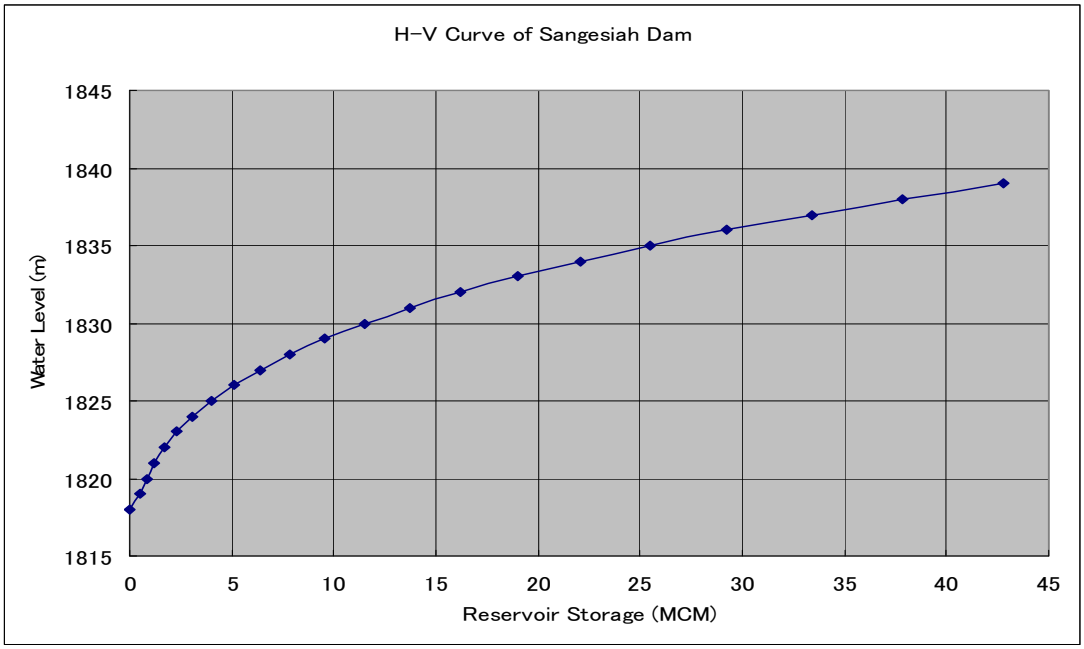
4) Siazakh Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,755.00	0.00	0.00	
1,760.00	0.26	0.70	
1,765.00	0.56	2.50	
1,770.00	0.96	5.40	
1,775.00	1.36	11.40	
1,780.00	1.80	20.00	L.W.L
1,785.00	2.32	30.00	
1,790.00	2.85	42.70	
1,795.00	3.45	59.00	
1,800.00	4.13	78.80	
1,805.00	4.78	101.40	
1,810.00	5.59	128.30	
1,815.00	6.94	158.60	
1,820.00	7.50	195.50	
1,825.00	8.64	233.00	
1,828.80		265.00	N.W.L
1,830.00	10.00	275.00	



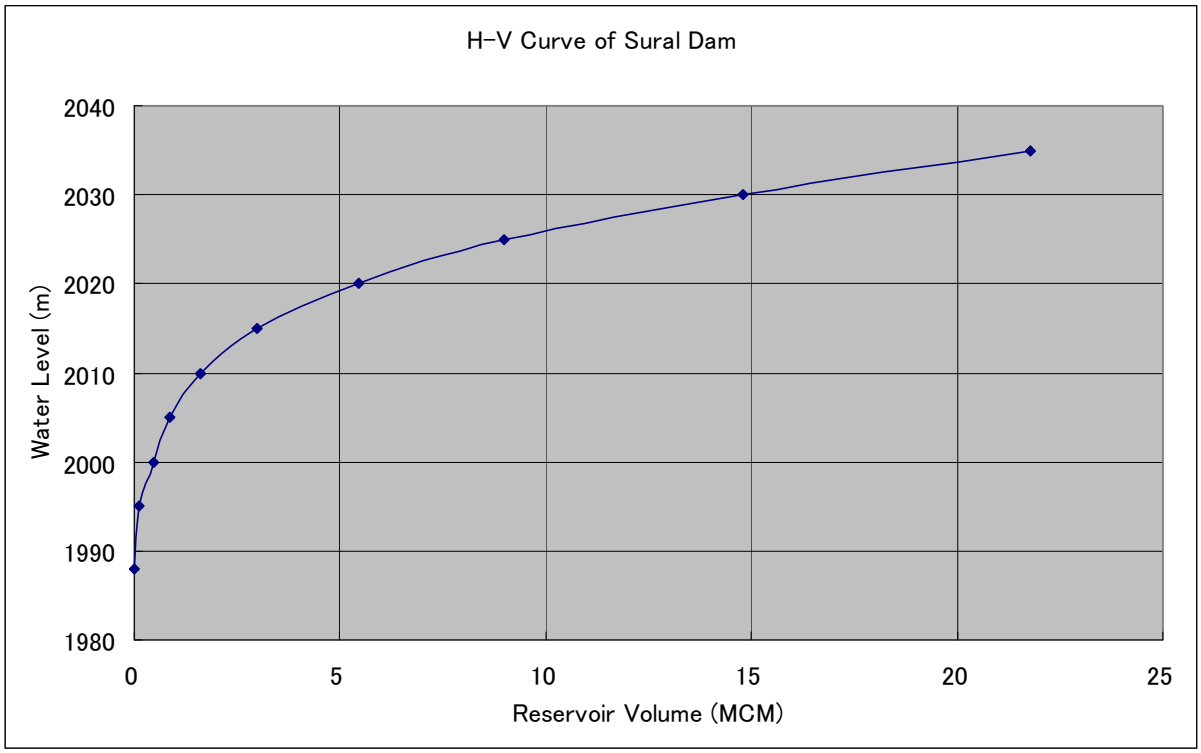
5) Sange Siah Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1819.00	0.23	0.50	L.W.L
1820.00	0.31	0.84	
1821.00	0.40	1.22	
1822.00	0.51	1.72	
1823.00	0.64	2.34	
1824.00	0.77	3.10	
1825.00	0.94	4.02	
1826.00	1.11	5.11	
1827.00	1.31	6.39	
1828.00	1.52	7.87	
1829.00	1.75	9.58	
1830.00	1.99	11.53	
1831.00	2.26	13.73	
1832.00	2.55	16.21	
1833.00	2.85	18.98	
1834.00	3.18	22.06	
1835.00	3.53	25.48	
1836.00	3.90	29.24	
1837.00	4.00	33.37	
1838.00	4.70	37.88	
1839.00	5.14	42.80	
1840.50	5.73	49.30	N.W.L



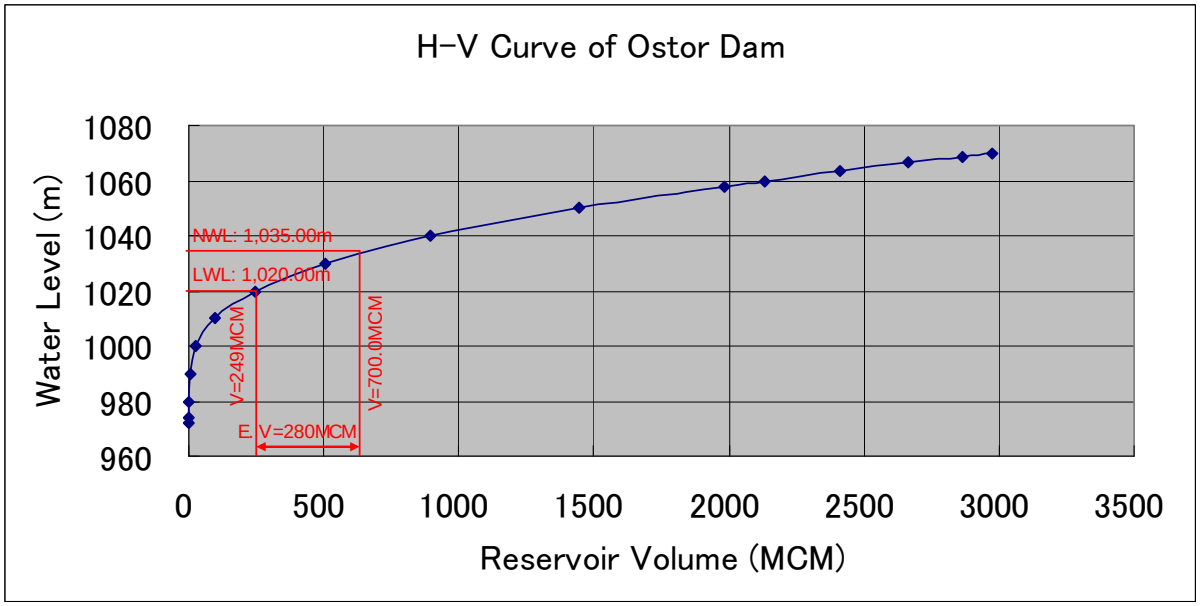
6) Sural Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,988.00	0.00	0.00	
1,990.00	0.01	0.01	
1,995.00	0.03	0.13	
2,000.00	0.06	0.50	L.W.L
2,005.00	0.11	0.85	
2,010.00	0.22	1.60	
2,015.00	0.38	3.00	
2,020.00	0.60	5.45	
2,025.00	0.95	9.00	
2,026.70		11.00	N.W.L
2,030.00	1.30	14.80	
2,035.00	1.66	21.80	



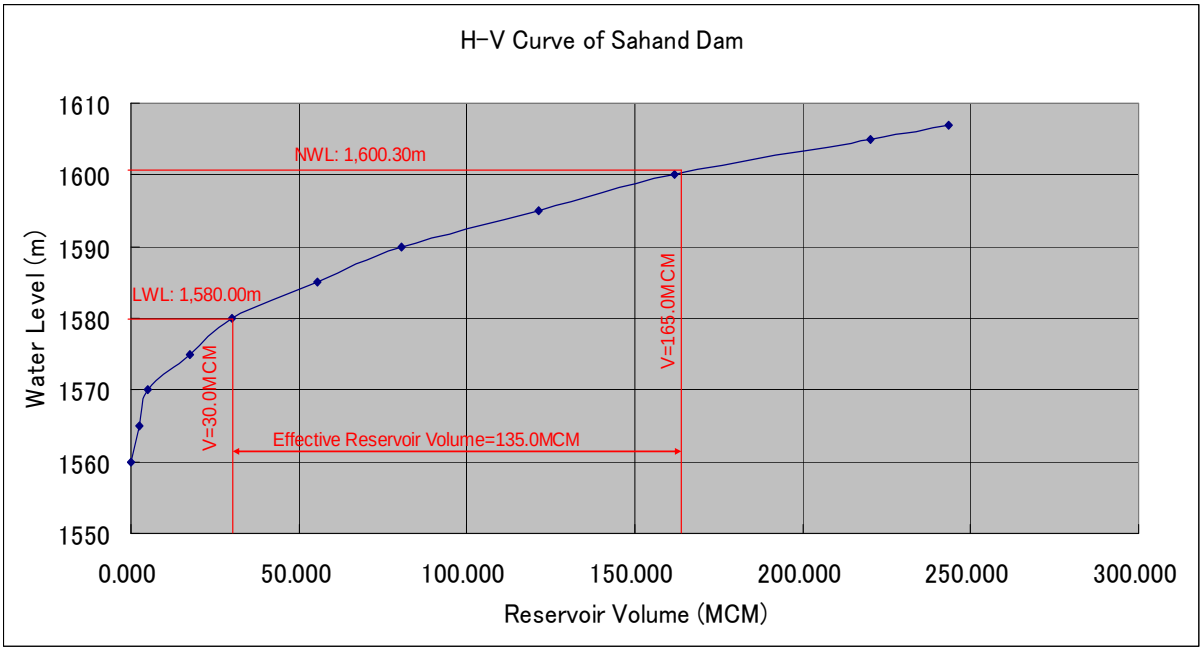
7) Ostor Dam (Under Construction)

Water Level (m)	Height (m)	Area (km2)	Volume (MCM)	Note
972.00	0.0	0.0	0	
974.00	2.0	0.1	0	
980.00	8.0	0.2	1	
990.00	18.0	0.8	5	
1,000.00	28.0	3.1	25	
1,010.00	38.0	10.8	94	
1,020.00	48.0	20.2	249	L.W.L
1,030.00	58.0	30.9	505	
1,035.00	63.0		700	N.W.L
1,040.00	68.0	47.3	896	
1,050.00	78.0	62.9	1,447	
1,058.00	86.0	70.5	1,980	
1,060.00	88.0	78.7	2,129	
1,063.50	91.5	82.4	2,411	
1,066.50	94.5	85.8	2,663	
1,068.80	96.8	88.6	2,864	
1,070.00	98.0	96.3	2,975	



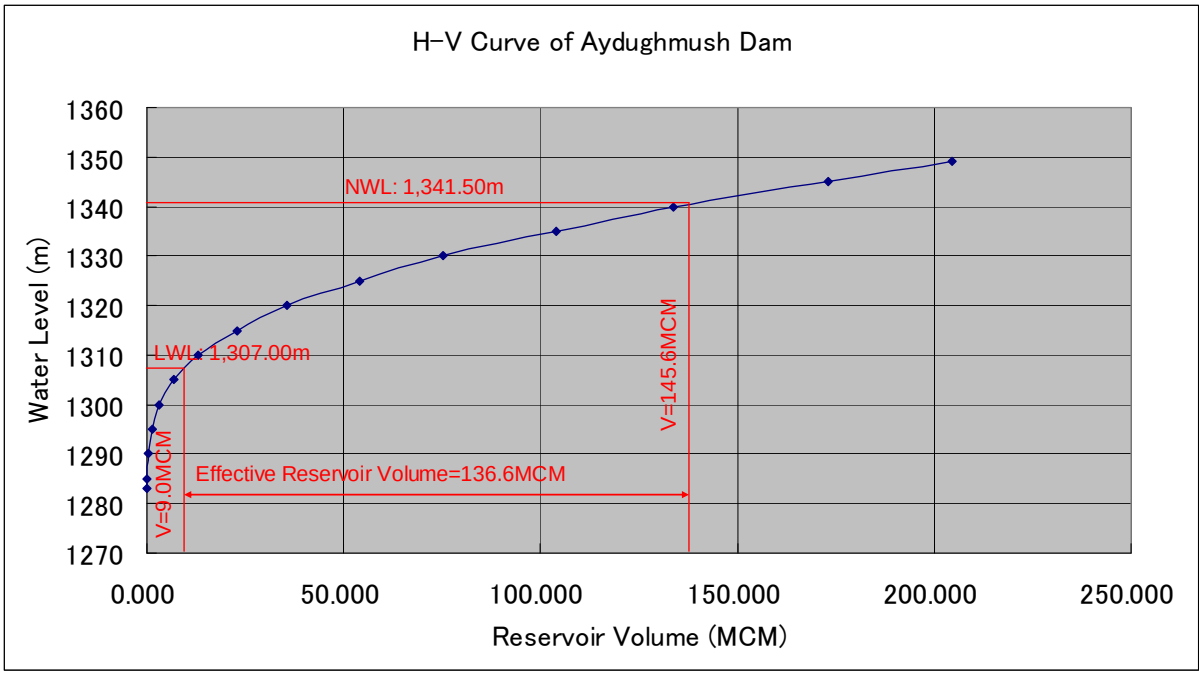
8) Sahand Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,560.00	0.000	0	
1,565.00	0.760	3	
1,570.00	1.530	5	
1,575.00	2.590	18	
1,580.00	3.640	30	L.W.L
1,585.00	5.110	55	
1,590.00	6.570	81	
1,595.00	8.200	121	
1,600.00	9.830	162	
1,600.30		165	N.W.L
1,605.00	11.680	220	
1,607.00	12.410	243	



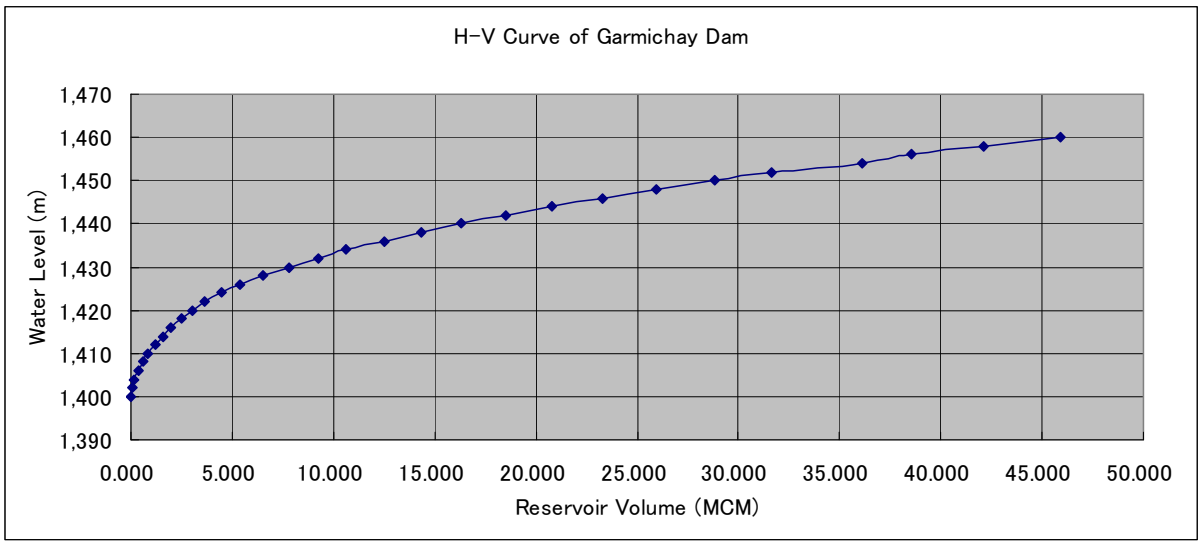
9) Aydughmush Dam (Under Construction)

Water Level (m)	Volume (MCM)	Note
1,283.00	0.000	
1,285.00	0.023	
1,290.00	0.177	
1,295.00	1.238	
1,300.00	2.993	
1,305.00	6.821	
1,307.00	9.000	L.W.L
1,310.00	12.980	
1,315.00	22.836	
1,320.00	35.480	
1,325.00	54.008	
1,330.00	75.140	
1,335.00	104.034	
1,340.00	133.810	
1,341.50	145.600	N.W.L
1,345.00	173.130	
1349	204.586	



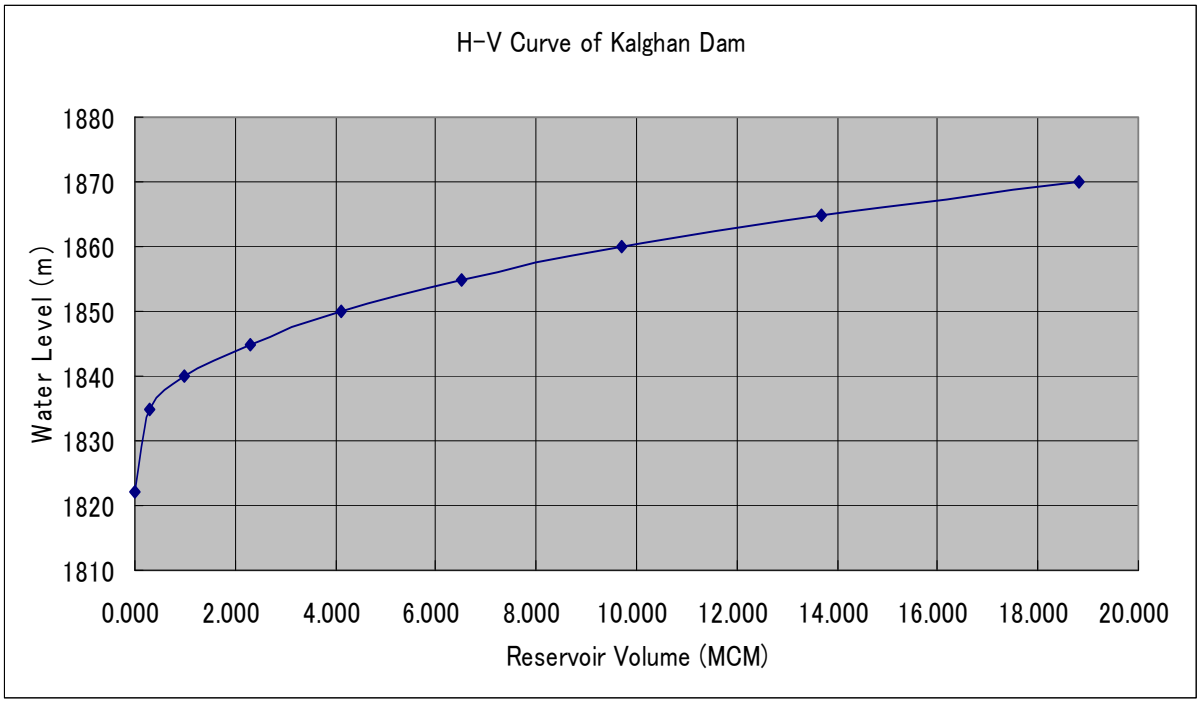
10) Germichay Dam (Under Construction)

Water Level (m)	Area (m^2)	Volume (MCM)	Note
1,400	17,488	0.0	
1,402	43,357	0.1	
1,404	73,427	0.2	
1,406	100,000	0.4	
1,408	127,972	0.6	
1,410	155,044	0.9	
1,412	180,420	1.2	
1,414	200,000	1.6	
1,416	220,976	2.0	
1,418	253,846	2.5	
1,420	292,306	3.0	
1,422	359,441	3.7	
1,424	434,865	4.5	
1,426	517,483	5.4	
1,428	600,000	6.5	L.W.L
1,430	663,217	7.8	
1,432	754,645	9.3	
1,434	817,483	10.6	
1,436	885,315	12.5	
1,438	851,049	14.4	
1,440	1,030,070	16.3	
1,442	1,106,993	18.5	
1,444	1,200,000	20.8	
1,446	1,300,000	23.3	
1,448	1,360,420	26.0	
1,450	1,476,923	28.8	
1,452	1,500,930	31.7	
1,454	1,600,140	36.1	
1,456	1,748,051	38.5	
1,457		40.3	N.W.L
1,458	1,841,858	42.1	
1,460	1,927,072	45.9	



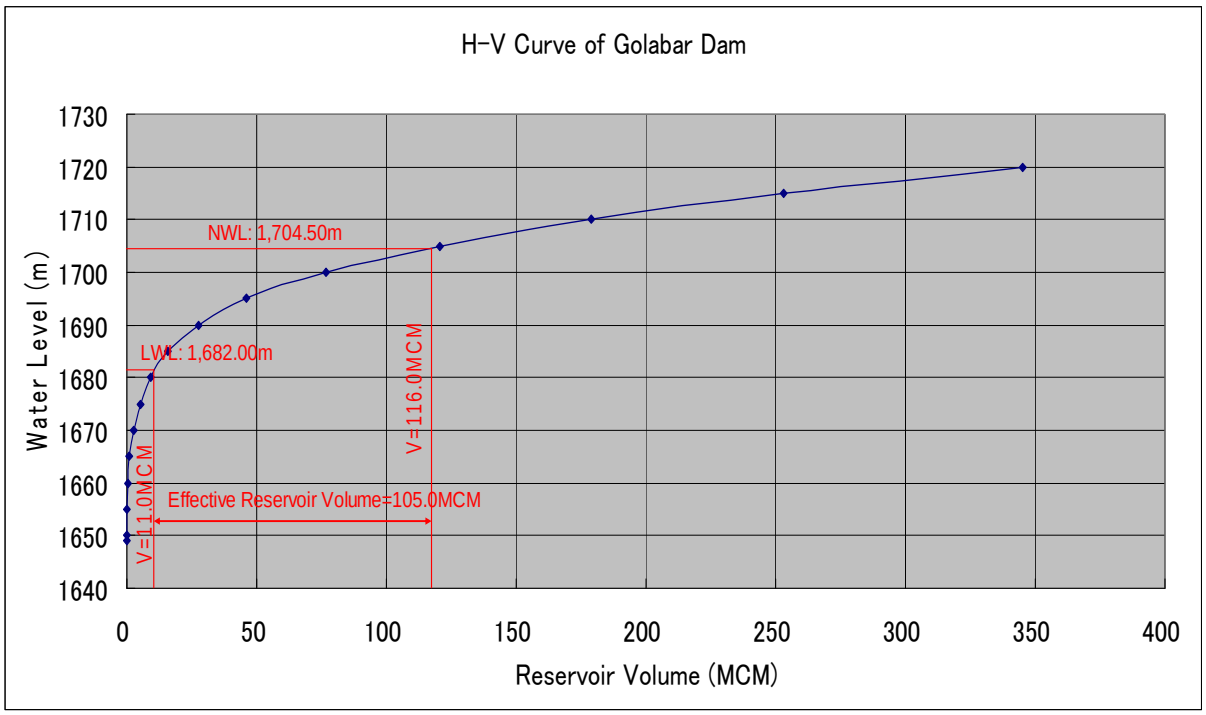
11) Kalghan Dam (Under Construction)

Water Level (m)	Area (ha)	Volume (MCM)	Note
1822	0.000	0.000	
1825	1.400	0.000	
1829	7.300	0.000	
1830	8.800	0.000	
1835	17.600	0.300	L.W.L
1840	27.300	1.000	
1845	38.000	2.300	
1850	50.200	4.100	
1855	62.600	6.500	
1860	77.600	9.700	
1865	98.800	13.700	
1870	121.100	18.800	N.W.L



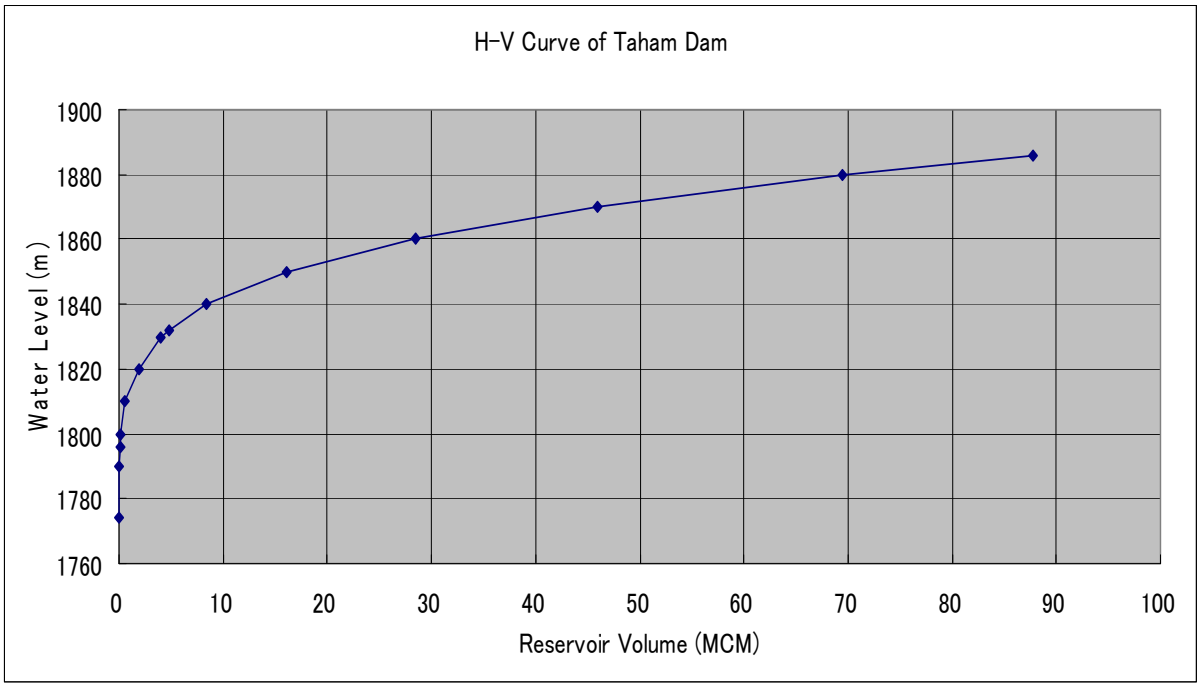
12) Golabar Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,649.00	0.000	0.000	
1,650.00	0.005	0.025	
1,655.00	0.041	0.100	
1,660.00	0.105	0.456	
1,665.00	0.150	1.089	
1,670.00	0.489	2.606	
1,675.00	0.600	5.320	
1,680.00	0.959	9.188	
1,682.00		11.000	L.W.L
1,685.00	1.800	15.970	
1,690.00	2.849	27.570	
1,695.00	4.700	46.180	
1,700.00	7.572	76.570	
1,704.50		116.000	N.W.L
1,705.00	10.100	120.610	
1,710.00	13.299	178.920	
1,715.00	16.500	253.270	
1,720.00	20.415	345.380	



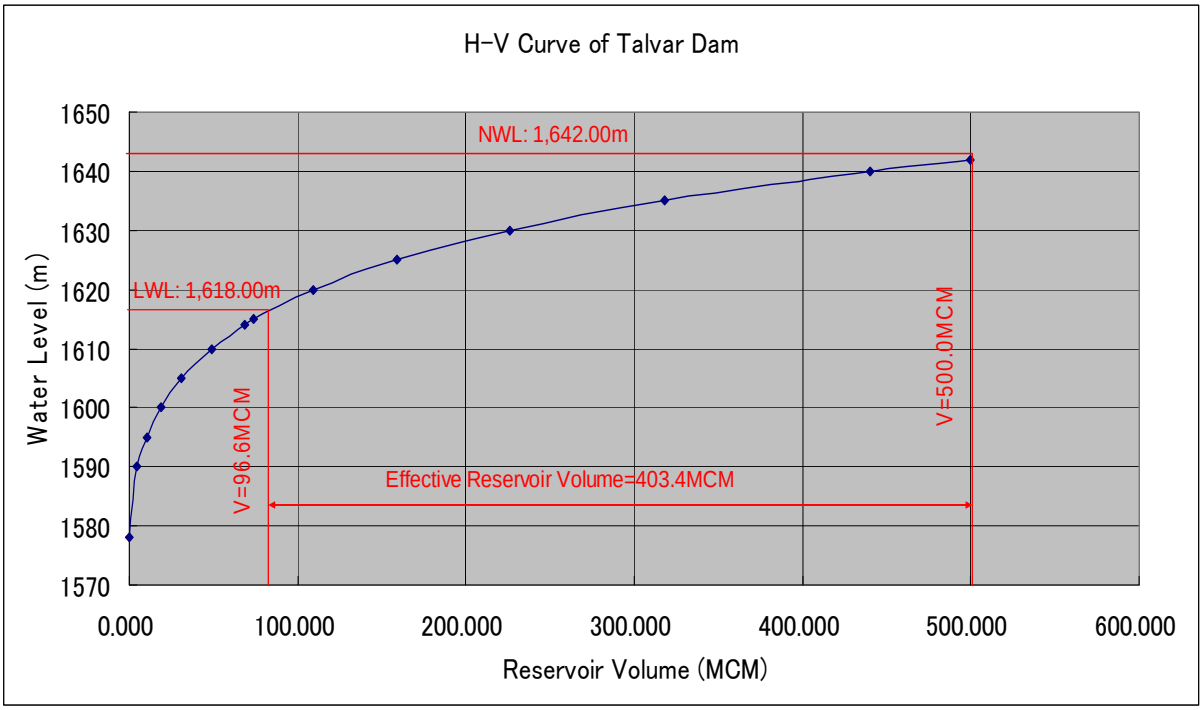
13) Taham Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1774.00	0.000	0.000	
1790.00	0.009	0.008	
1796.00	0.011	0.110	
1800.00	0.012	0.179	
1810.00	0.063	0.517	
1820.00	0.158	1.858	
1830.00	0.323	3.940	
1832.00	0.374	4.829	L.W.L
1840.00	0.579	8.386	
1850.00	0.995	16.160	
1860.00	1.428	28.463	
1870.00	2.030	45.950	
1880.00	2.680	69.423	
1886.00	3.160	87.780	N.W.L



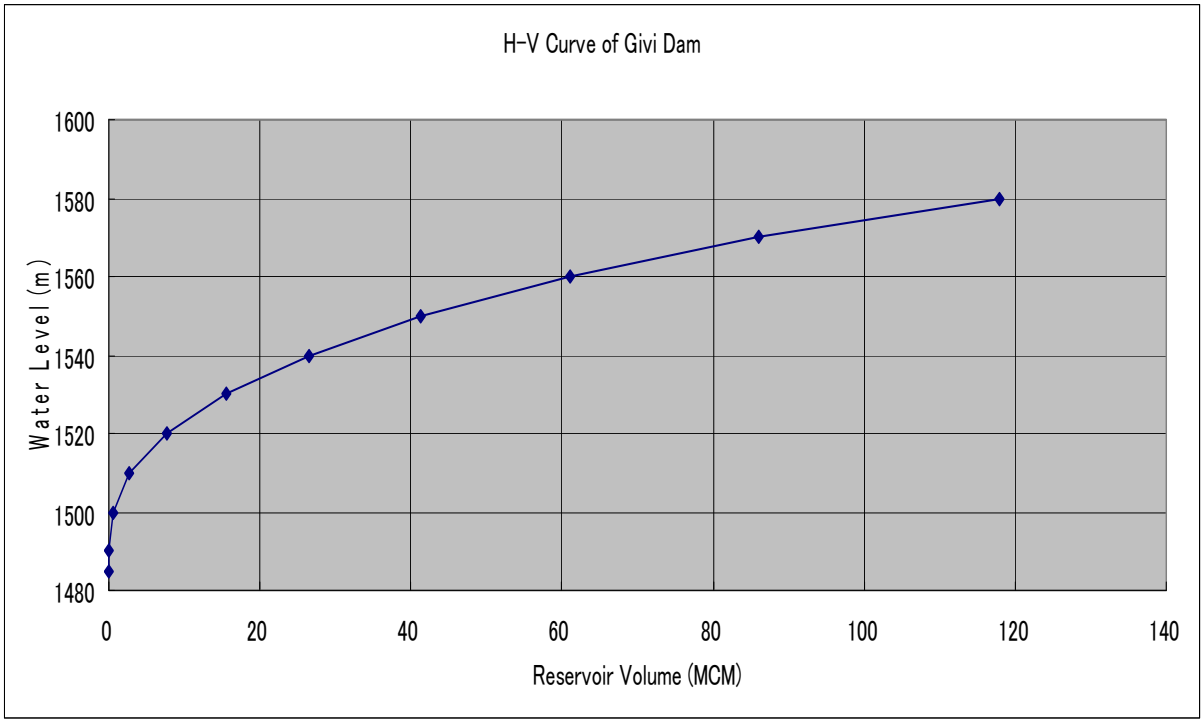
14) Talvar Dam (Under Construction)

Water Level (m)	Area (km2)	Volume (MCM)	Note
1578	0.000	0.000	
1590	0.800	4.800	
1595	1.300	10.460	
1600	1.900	18.940	
1605	2.900	30.900	
1610	4.300	48.700	
1614	5.500	68.300	
1615	5.800	73.900	
1618		96.600	L.W.L
1620	8.400	109.240	
1625	11.500	158.800	
1630	15.500	226.000	
1635	21.400	317.900	
1640	27.700	440.300	
1642	31.200	500.000	N.W.L



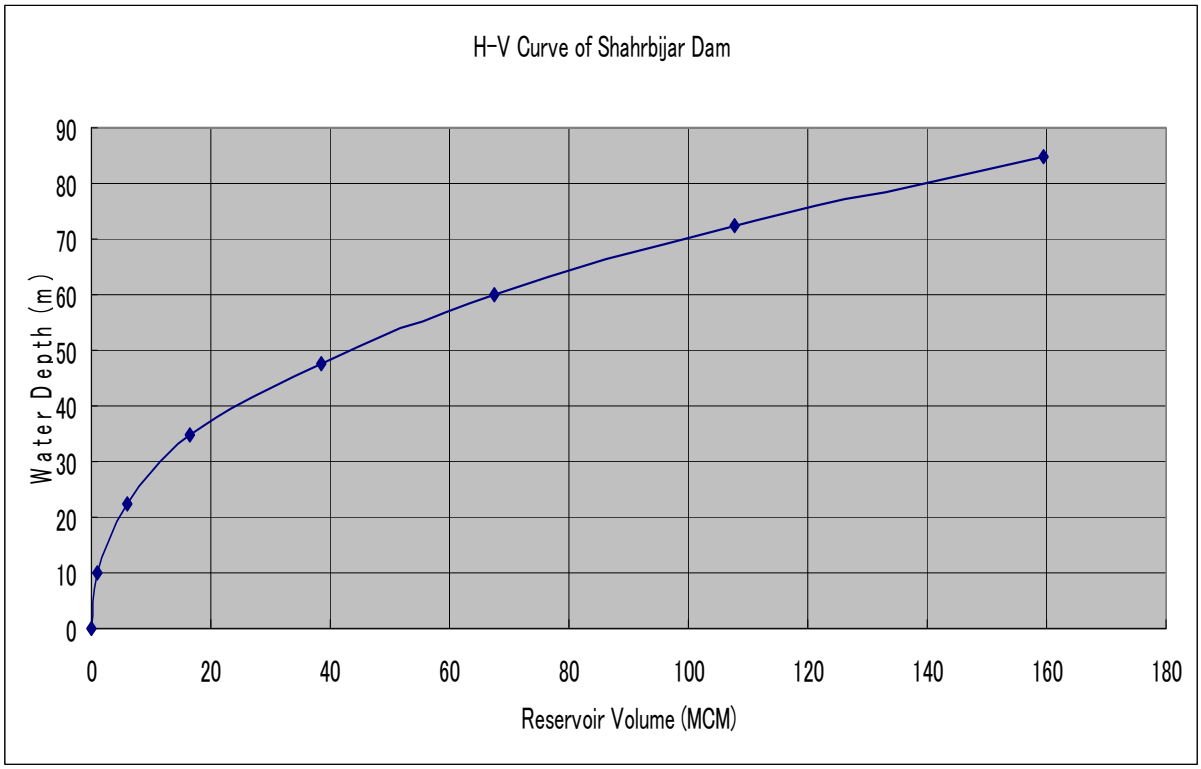
15) Givi Dam (Under Construction)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1485	0.00	0.00	
1490	0.01	0.02	
1500	0.11	0.52	
1510	0.37	2.78	
1513		4.28	L.W.L
1520	0.64	7.77	
1530	0.94	15.63	
1540	1.26	26.58	
1550	1.71	41.37	
1556		53.14	N.W.L
1560	2.22	60.98	
1570	2.82	86.13	
1580	3.40	118.00	



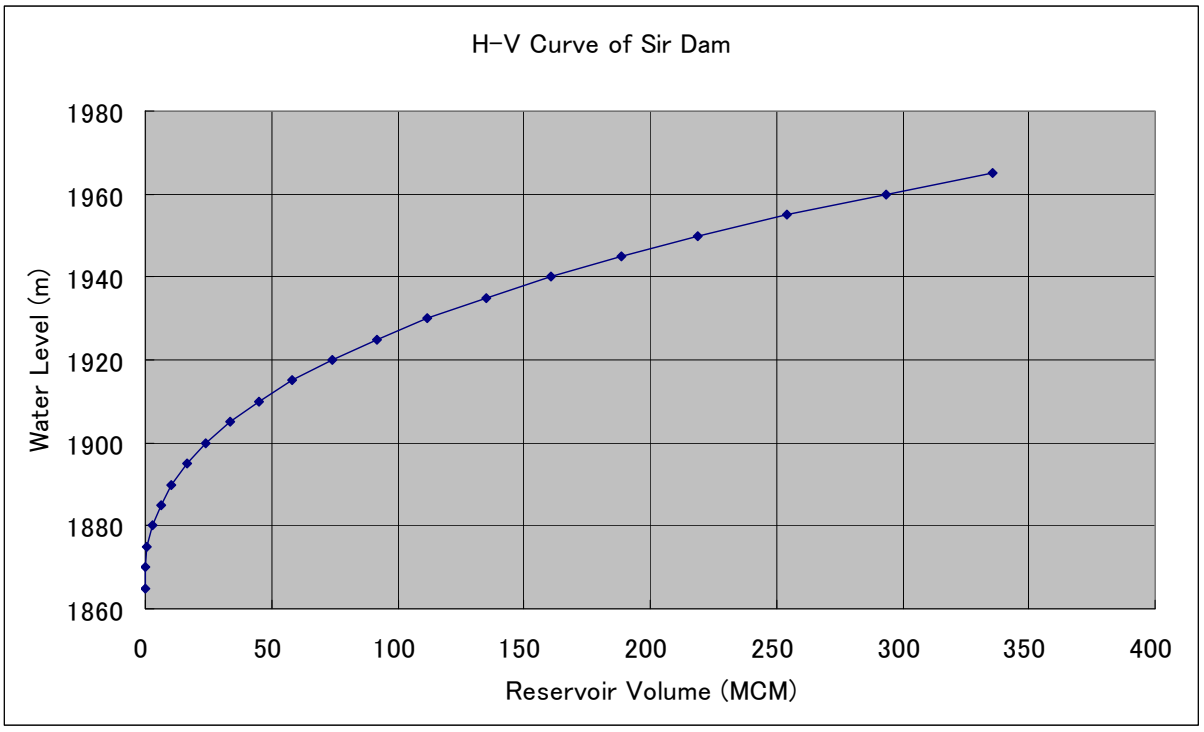
16) Givi Dam (Under Construction)

Water Level) (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
150.00	10.00	0.305	1.017	
160.60			5.200	L.W.L
162.50	22.50	0.490	5.940	
175.00	35.00	1.244	16.416	
187.50	47.50	1.923	38.452	
200.00	60.00	2.768	67.613	
211.50			104.600	N.W.L
212.50	72.50	3.670	107.716	
225.00	85.00	4.616	159.391	



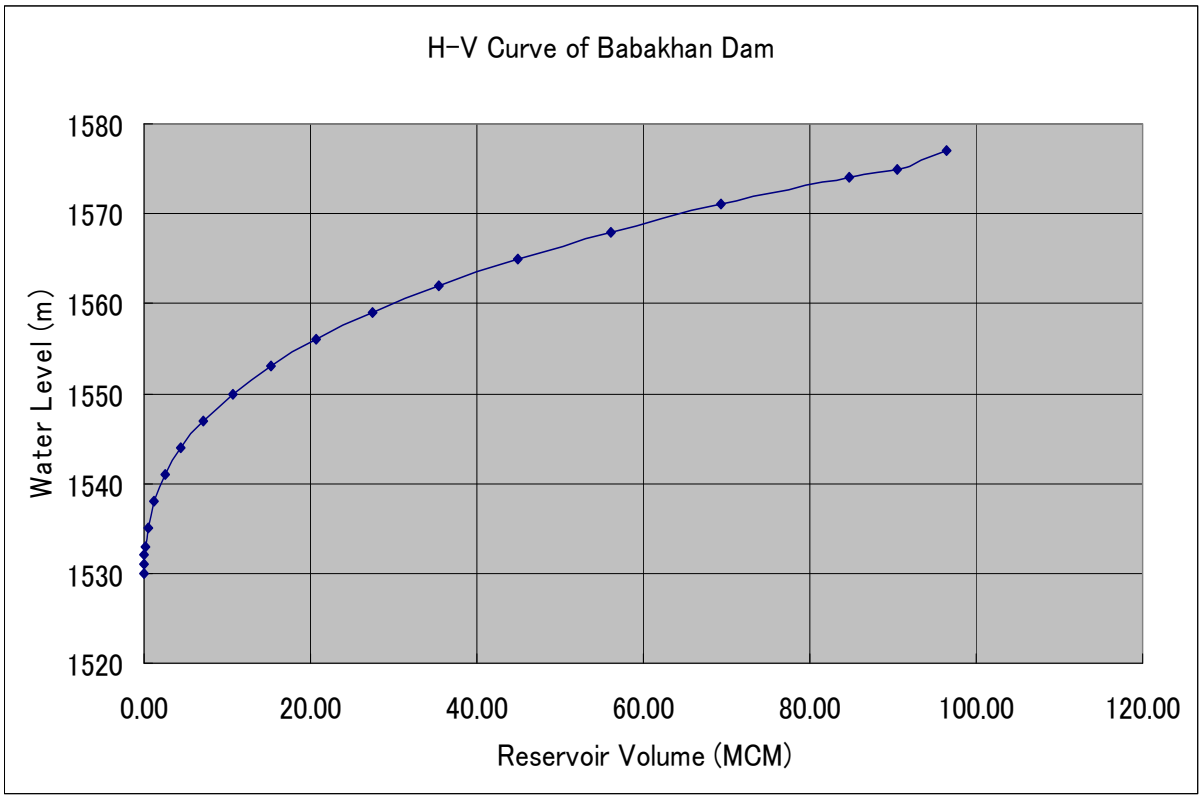
17) Sir Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,865.00	0.00	0.000	0.00	
1,870.00	5.00	0.046	0.11	
1,875.00	10.00	0.265	0.82	
1,880.00	15.00	0.537	2.78	
1,883.40			5.00	L.W.L
1,885.00	20.00	0.761	6.01	
1,890.00	25.00	1.036	10.48	
1,895.00	30.00	1.335	16.40	
1,900.00	35.00	1.708	23.98	
1,905.00	40.00	2.130	33.56	
1,910.00	45.00	2.472	45.05	
1,915.00	50.00	2.868	58.39	
1,920.00	55.00	3.297	73.79	
1,925.00	60.00	3.779	91.46	
1,925.90			95.00	N.W.L
1,930.00	65.00	4.342	111.75	
1,935.00	70.00	4.921	134.89	
1,940.00	75.00	5.500	160.93	
1,945.00	80.00	5.900	188.48	
1,950.00	85.00	6.730	219.05	
1,955.00	90.00	7.399	254.36	
1,960.00	95.00	8.158	293.24	
1,965.00	100.00	8.886	335.84	



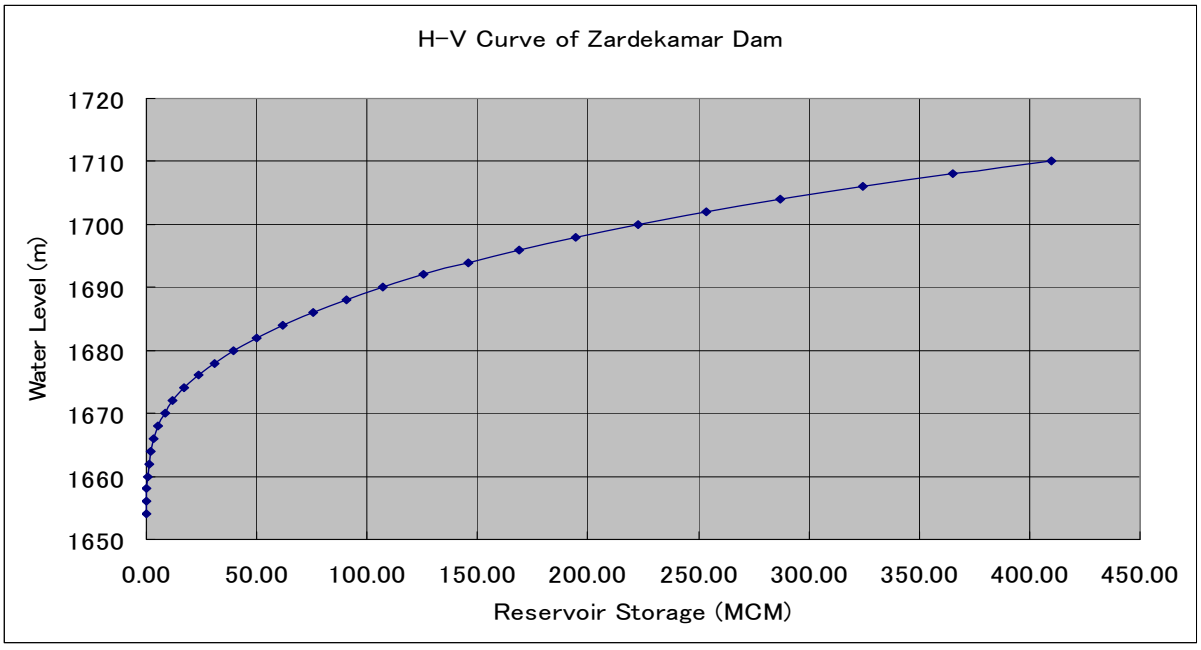
18) Babakhan Dam (Under Planning)

Water Level (m)	Area (ha)	Volume (MCM)	Note
1,530.10	0.00	0.00	
1,531.00	1.33	0.01	
1,532.00	6.91	0.05	
1,533.00	11.39	0.14	
1,535.00	19.74	0.45	
1,538.00	32.49	1.23	
1,541.00	54.40	2.56	
1,544.00	72.98	4.46	
1,547.00	104.71	7.09	
1,550.00	134.72	10.71	
1,553.00	166.65	15.19	
1,553.70		16.50	L.W.L
1,556.00	204.46	20.75	
1,559.00	244.40	27.47	
1,562.00	289.57	35.47	
1,565.00	343.62	44.93	
1,568.00	405.11	56.14	
1,570.00		64.70	N.W.L
1,571.00	475.85	69.33	
1,574.00	555.23	84.80	
1,575.00	580.90	90.48	
1,577.00	609.92	96.44	



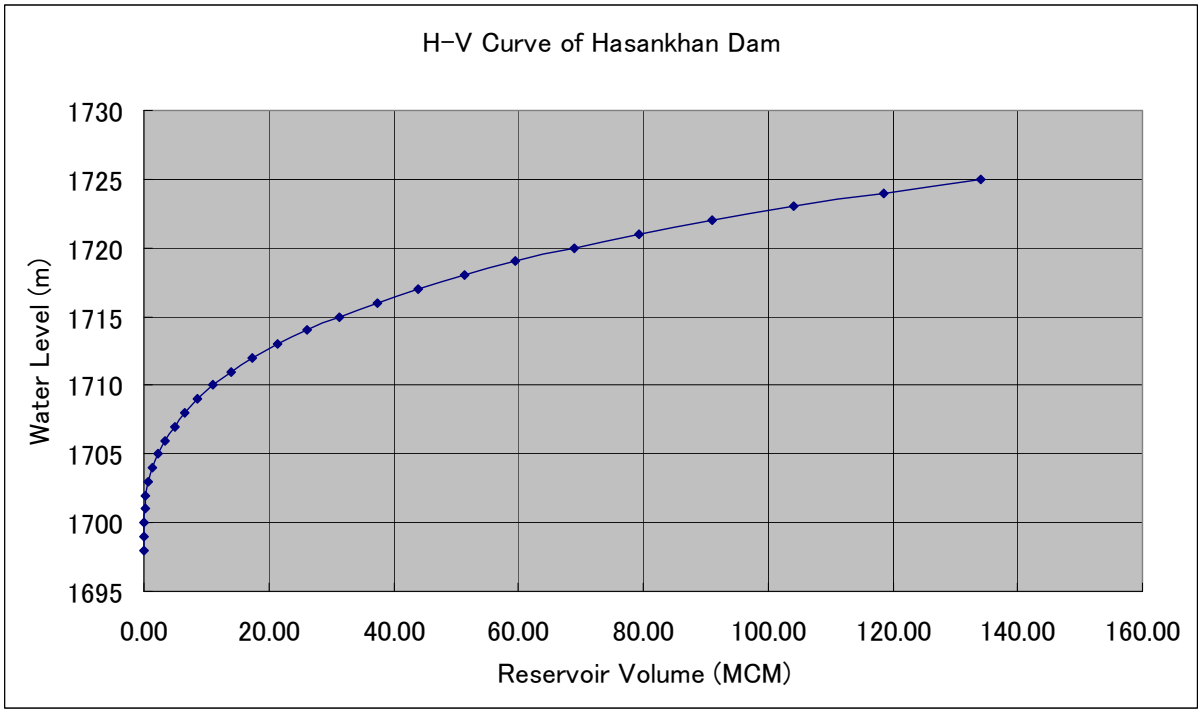
19) Zardekamar Dam (Under Planning)

Elevation (m)	Area (ha)	Volume (MCM)	Note
1,654.08	0.00	0.00	
1,656.00	3.47	0.03	
1,658.00	10.74	0.18	
1,660.00	19.58	0.48	
1,662.00	40.68	1.08	
1,664.00	64.49	2.13	
1,666.00	81.38	3.59	
1,668.00	111.03	5.52	
1,670.00	159.67	8.22	
1,672.00	224.90	12.07	L.W.L
1,674.00	281.74	17.14	
1,676.00	337.79	23.33	
1,678.00	408.84	30.80	
1,680.00	483.51	39.72	
1,682.00	554.16	50.10	
1,684.00	635.80	62.00	N.W.L
1,686.00	714.89	75.50	
1,688.00	793.05	90.58	
1,690.00	878.95	107.30	
1,692.00	963.09	125.72	
1,694.00	1,076.13	146.12	
1,696.00	121.02	168.98	
1,698.00	1,333.96	194.42	
1,700.00	1,473.53	222.49	
1,702.00	1,619.38	253.42	
1,704.00	1,771.57	287.33	
1,706.00	1,944.40	324.49	
1,708.00	2,123.28	365.17	
1,710.00	2,326.58	409.67	



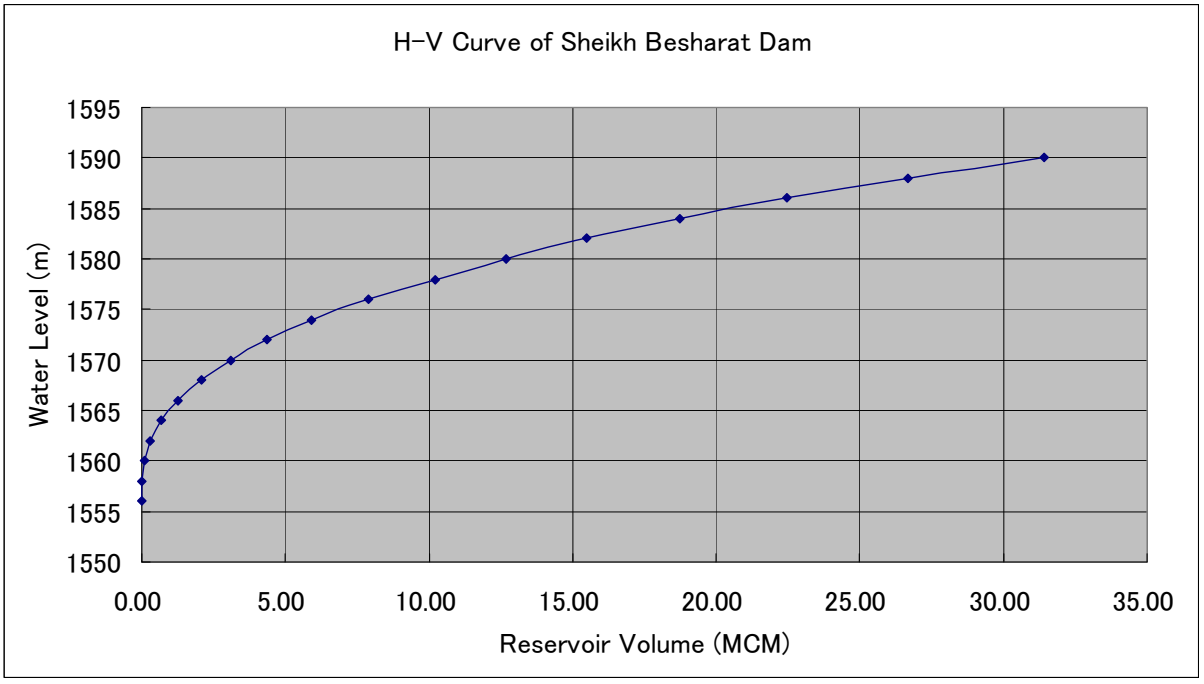
20) Hasankhan Dam (Under Planning)

Water Level (m)	Height (m)	Area (ha)	Volume (MCM)	Note
1,698.00	0.00	0.00	0.00	
1,699.00	1.00	1.35	0.01	
1,700.00	2.00	5.00	0.04	
1,701.00	3.00	11.30	0.12	
1,702.00	4.00	30.50	0.33	
1,703.00	5.00	58.80	0.78	
1,704.00	6.00	76.20	1.45	
1,705.00	7.00	100.20	2.33	
1,706.00	8.00	124.70	3.46	
1,707.00	9.00	152.80	4.85	
1,708.00	10.00	182.70	6.52	
1,709.00	11.00	225.00	8.56	
1,710.00	12.00	267.00	11.02	
1,711.00	13.00	313.00	13.92	
1,712.00	14.00	373.40	17.35	
1,712.70			20.00	L.W.L
1,713.00	15.00	429.00	21.36	
1,714.00	16.00	506.00	26.03	
1,715.00	17.00	562.00	31.37	
1,716.00	18.00	629.00	37.33	
1,717.00	19.00	696.00	43.95	
1,718.00	20.00	779.00	51.33	
1,719.00	21.00	871.40	59.58	
1,720.00	22.00	991.00	68.89	
1,720.70			76.50	N.W.L
1,721.00	23.00	1,111.00	79.40	
1,722.00	24.00	1,235.00	91.12	
1,723.00	25.00	1,368.00	104.14	
1,724.00	26.00	1,503.00	118.50	
1,725.00	27.00	1,624.00	134.12	



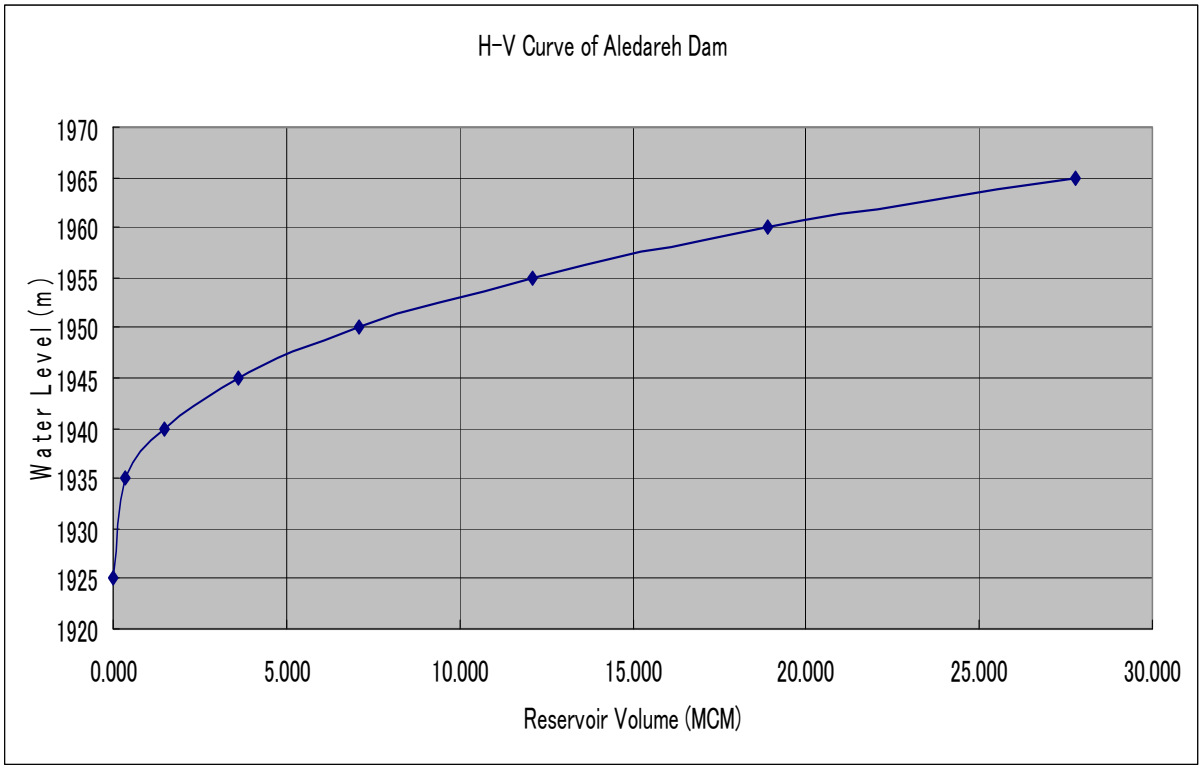
21) Sheikh Besharat Dam (Under Planning)

Water Level (m)	Height (m)	Area (m^2)	Volume (m^3)	Note
1,556.00	0.00	0	0	
1,558.00	2.00	12,970	12,970	
1,560.00	4.00	70,180	96,120	
1,562.00	6.00	142,330	308,630	
1,564.00	8.00	241,353	692,313	
1,566.00	10.00	343,078	1,276,744	
1,568.00	12.00	448,802	2,068,624	
1,570.00	14.00	573,508	3,090,934	
1,572.00	16.00	714,618	4,379,060	
1,574.00	18.00	833,717	5,927,395	
1,576.00	20.00	1,124,550	7,885,662	
1,578.00	22.00	1,183,150	10,193,362	
1,578.60			12,000,000	L.W.L
1,580.00	24.00	1,313,094	12,689,606	
1,582.00	26.00	1,500,820	15,503,520	
1,584.00	28.00	1,741,070	18,745,410	
1,586.00	30.00	1,973,240	22,459,720	
1,588.00	32.00	2,221,250	26,654,210	
1,588.90			30,000,000	N.W.L
1,590.00	34.00	2,535,351	31,410,811	



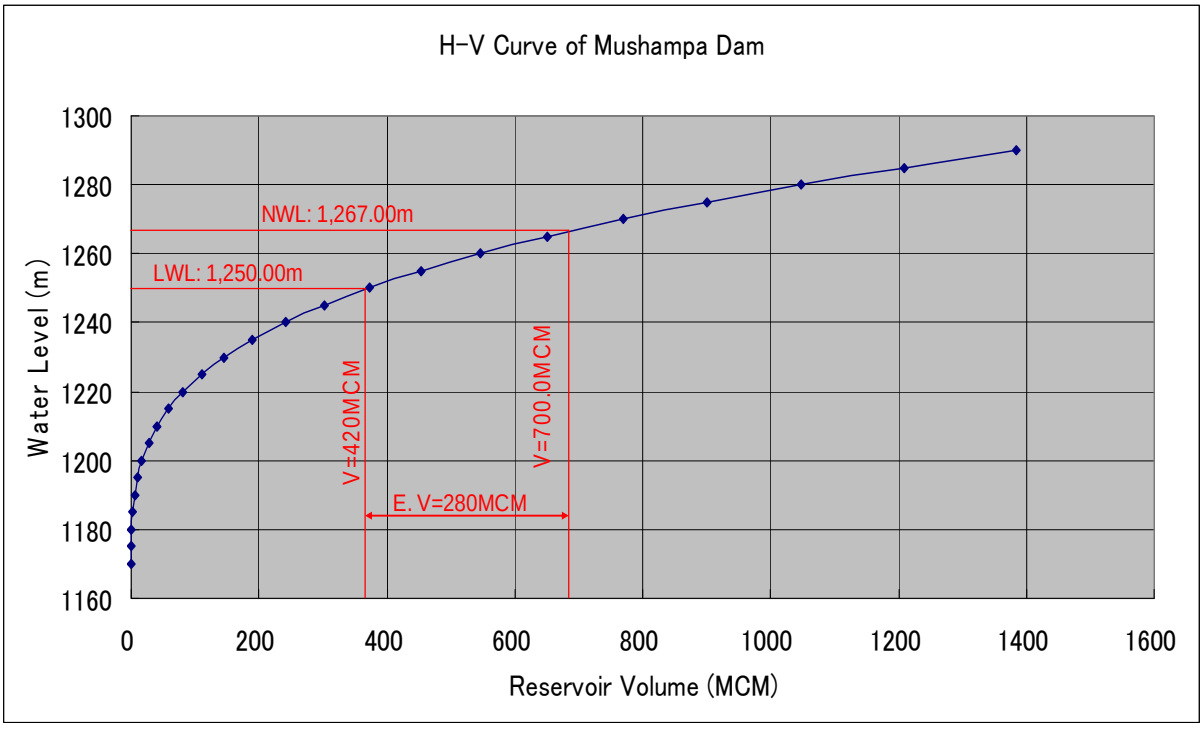
22) Alehdare Dam (Under Planning)

Water Level (m)	Area (ha)	Volume (MCM)	Note
1,925.00	0.00	0.000	
1,930.00	0.20	0.005	
1,935.00	12.70	0.330	
1,936.60		0.700	L.W.L
1,940.00	32.40	1.460	
1,945.00	53.30	3.600	
1,950.00	84.80	7.100	
1,955.00	115.90	12.100	
1,960.00	156.06	18.900	
1,960.40		19.700	N.W.L
1,965.00	202.10	27.800	



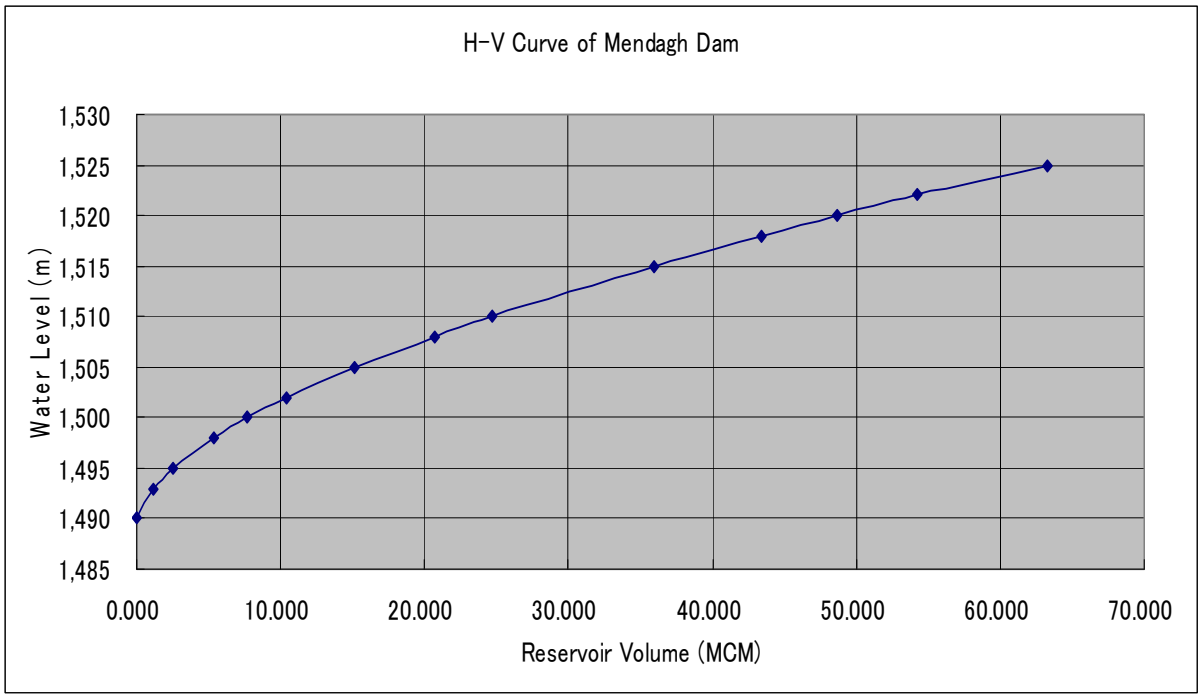
23) Mushampa Dam (Under Planning)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,170.00	0.00	0.00	
1,175.00	0.07	0.14	
1,180.00	0.23	0.81	
1,185.00	0.40	2.32	
1,190.00	0.72	5.13	
1,195.00	1.11	9.81	
1,200.00	1.63	17.03	
1,205.00	2.33	27.59	
1,210.00	3.19	40.01	
1,215.00	4.17	57.75	
1,220.00	5.29	80.78	
1,225.00	6.52	109.86	
1,230.00	7.88	145.75	
1,235.00	9.37	189.21	
1,240.00	11.03	241.01	
1,245.00	12.88	301.91	
1,250.00	14.95	372.68	L.W.L
1,255.00	17.30	454.07	
1,260.00	19.97	546.85	
1,265.00	23.04	651.77	
1,267.00		700.00	N.W.L
1,270.00	26.56	769.62	
1,275.00	30.63	901.13	
1,280.00	35.32	1,047.09	
1,285.00	40.73	1,208.25	
1,290.00	46.97	1,385.38	



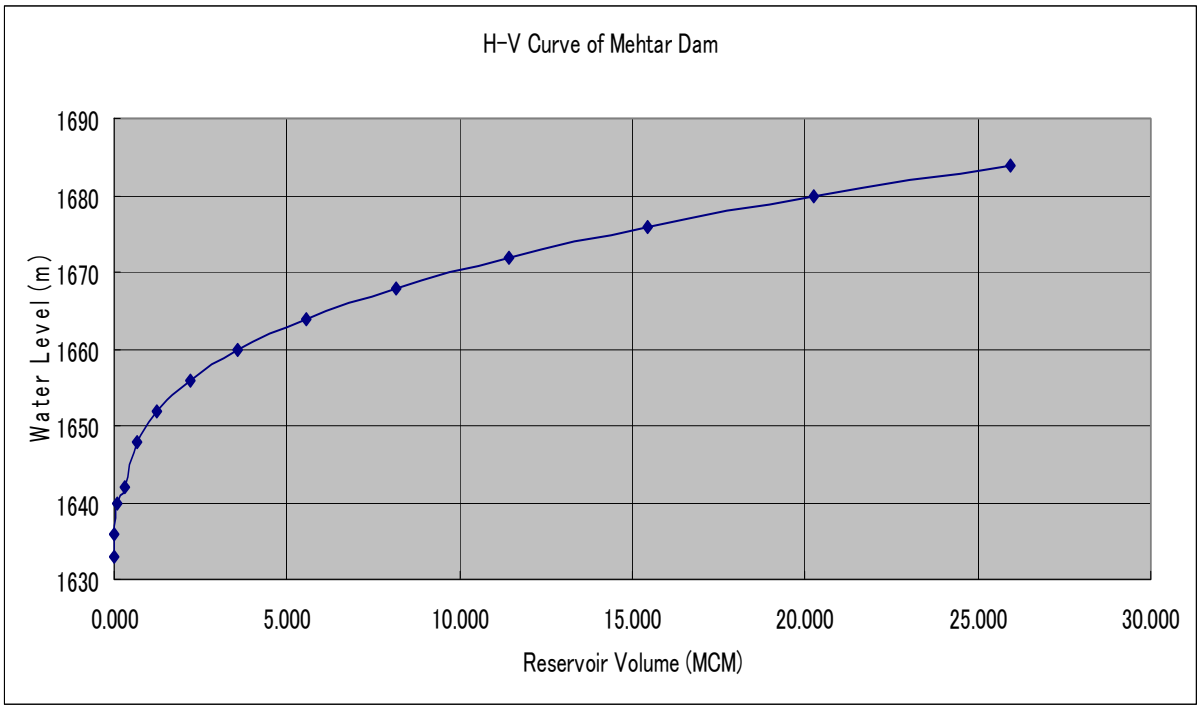
24) Mendagh Dam (Under Planning)

Water Level (m)	Area (ha)	Volume (MCM)	Note
1,490.00	20.00	0.00	
1,493.00	57.00	1.16	
1,495.00	78.00	2.51	
1,498.00	110.00	5.33	L.W.L
1,500.00	129.00	7.72	
1,502.00	145.00	10.46	
1,505.00	170.00	15.18	
1,508.00	195.00	20.66	
1,510.00	209.90	24.70	
1,515.00	239.00	35.93	
1,518.00	258.00	43.38	N.W.L
1,520.00	272.00	48.68	
1,522.00	288.00	54.28	
1,525.00	310.00	63.25	



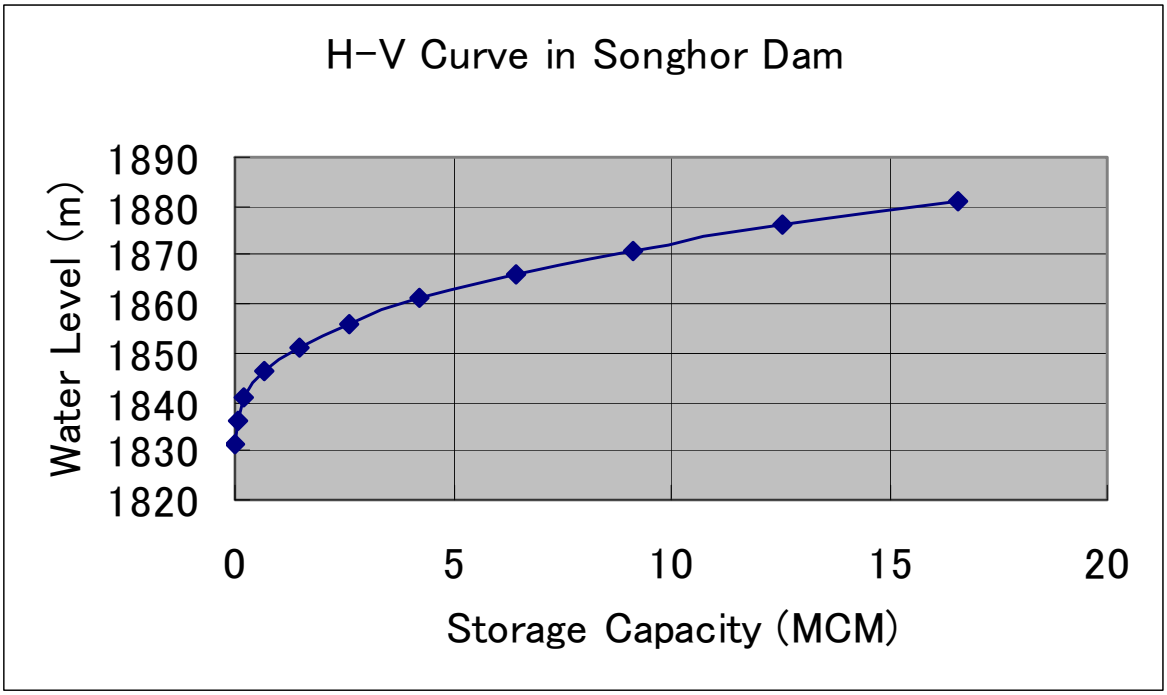
25) Mehtar Dam (Under Planning)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,632.70	0.000	0.000	
1,636.00	0.009	0.010	
1,640.00	0.033	0.085	
1,642.00	0.072	0.300	
1,647.00		0.400	L.W.L
1,648.00	0.112	0.659	
1,652.00	0.189	1.257	
1,656.00	0.288	2.198	
1,660.00	0.413	3.595	
1,664.00	0.564	5.543	
1,668.00	0.741	8.147	
1,672.00	0.905	11.430	
1,675.00		14.000	N.W.L
1,676.00	1.095	15.420	
1,680.00	1.316	20.230	
1,684.00	1.533	25.930	



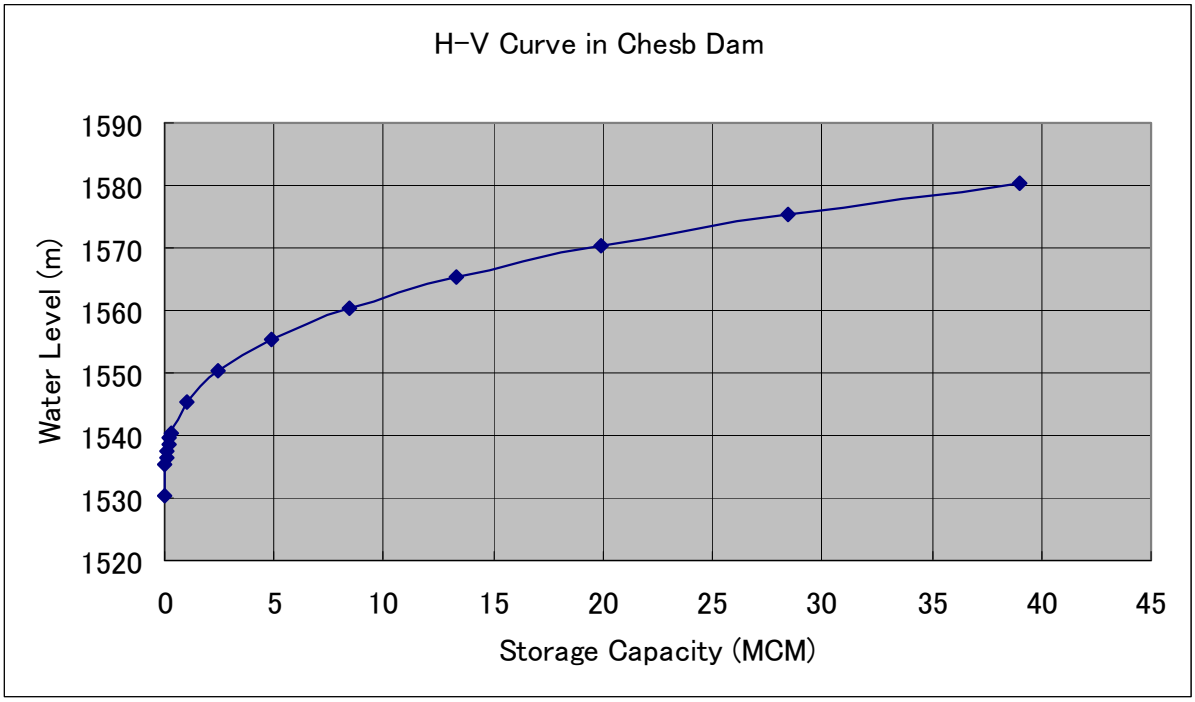
26) Songhor Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,831.15	0.00	0.000	0.000	
1,836.15	5.00	0.014	0.036	
1,841.15	10.00	0.049	0.229	
1,846.15	15.00	0.104	0.673	
1,850.00			1.350	L.W.L
1,851.15	20.00	0.176	1.448	
1,856.15	25.00	0.266	2.621	
1,861.15	30.00	0.372	4.257	
1,866.15	35.00	0.494	6.416	
1,871.15	40.00	0.632	9.153	
1,873.00			10.400	N.W.L
1,876.15	45.00	0.876	12.522	
1,881.15	50.00	0.954	16.574	



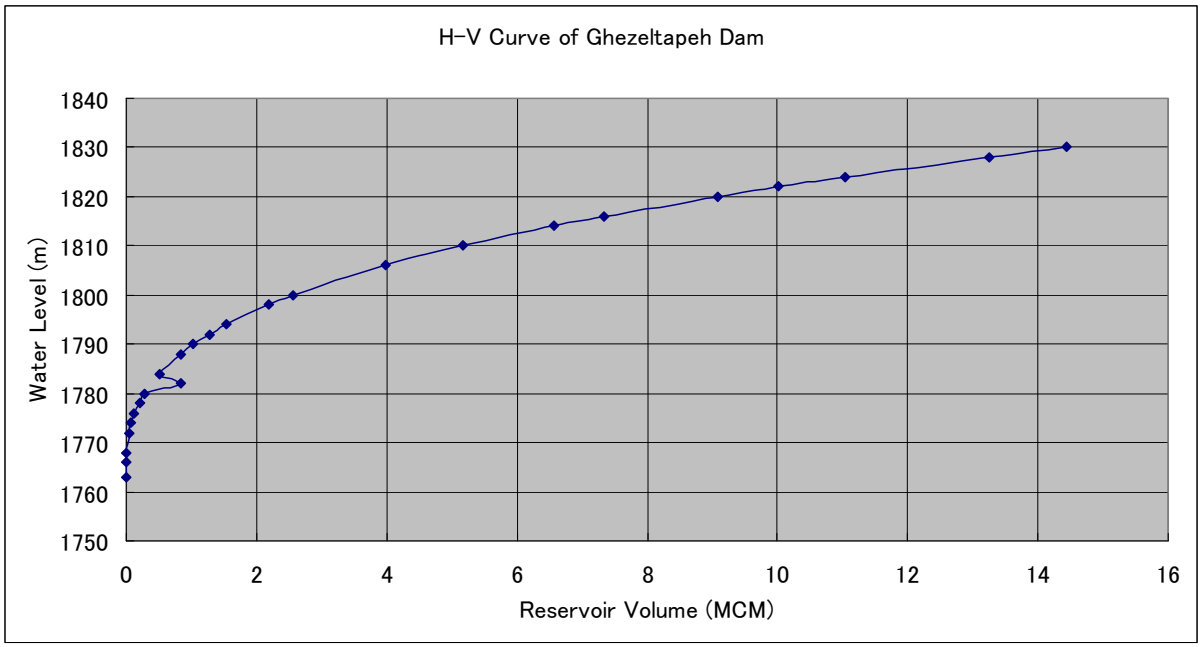
27) Chesb Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,530.48	0.00	0.000	0.000	
1,535.48	5.00	0.015	0.038	
1,536.48	6.00	0.023	0.066	
1,537.48	7.00	0.032	0.105	
1,538.48	8.00	0.044	0.157	
1,539.48	9.00	0.057	0.224	
1,540.48	10.00	0.072	0.307	
1,545.48	15.00	0.180	1.041	
1,547.00			1.800	L.W.L
1,550.48	20.00	0.344	2.474	
1,555.48	25.00	0.569	4.842	
1,560.48	30.00	0.858	8.383	
1,561.00			9.900	
1,565.48	35.00	1.215	13.333	
1,570.48	40.00	1.642	19.929	
1,575.48	45.00	2.141	28.409	
1,580.48	50.00	2.716	39.011	



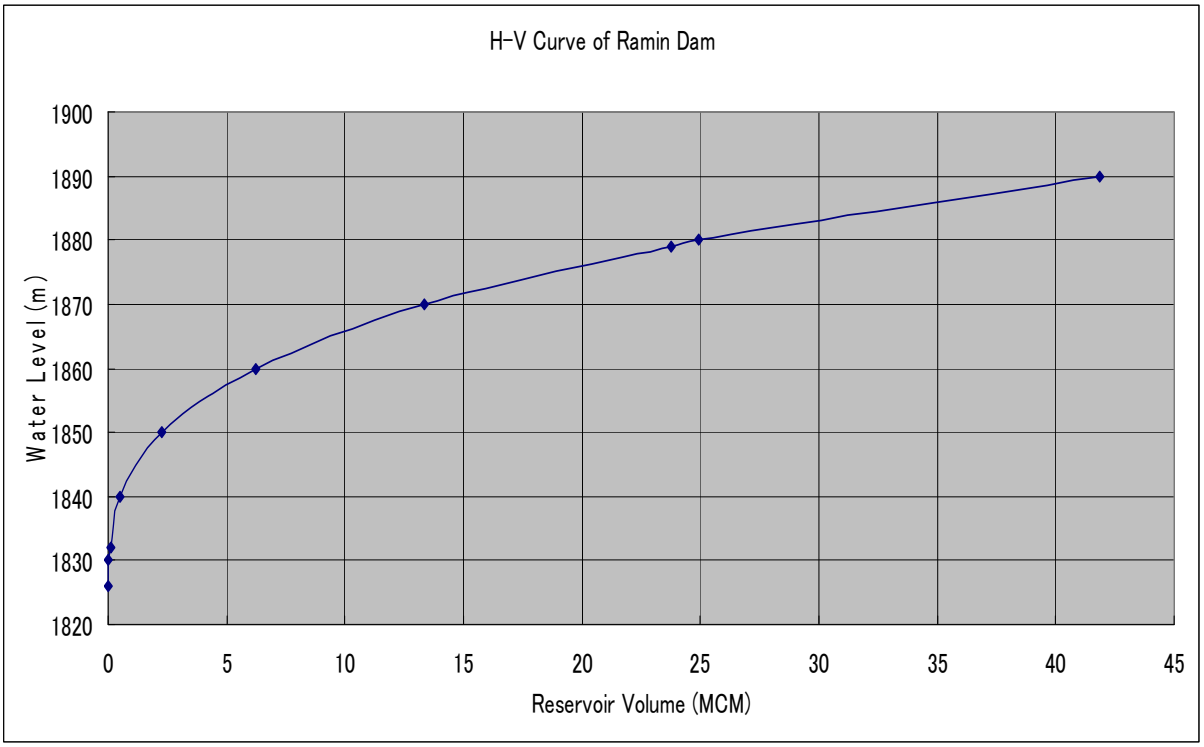
28) Ghezel Tapeh Dam (Under Planning)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,763.00	0.000	0.000	
1,766.00	0.002	0.002	
1,768.00	0.004	0.008	
1,772.00	0.014	0.044	
1,774.00	0.020	0.078	
1,776.00	0.029	0.127	
1,778.00	0.037	0.198	
1,780.00	0.046	0.276	
1,782.00	0.056	0.837	
1,784.00	0.068	0.502	
1,788.00	0.097	0.828	
1,790.00	0.111	1.034	
1,792.00	0.126	1.271	
1,794.00	0.142	1.539	
1,798.00	0.181	2.183	L.W.L
1,800.00	0.203	2.566	
1,806.00	0.271	3.984	
1,810.00	0.322	5.173	
1,812.40		6.000	N.W.L
1,814.00	0.375	6.567	
1,816.00	0.403	7.345	
1,820.00	0.461	9.072	
1,822.00	0.492	10.020	
1,824.00	0.523	11.040	
1,828.00	0.584	13.250	
1,830.00	0.614	14.450	



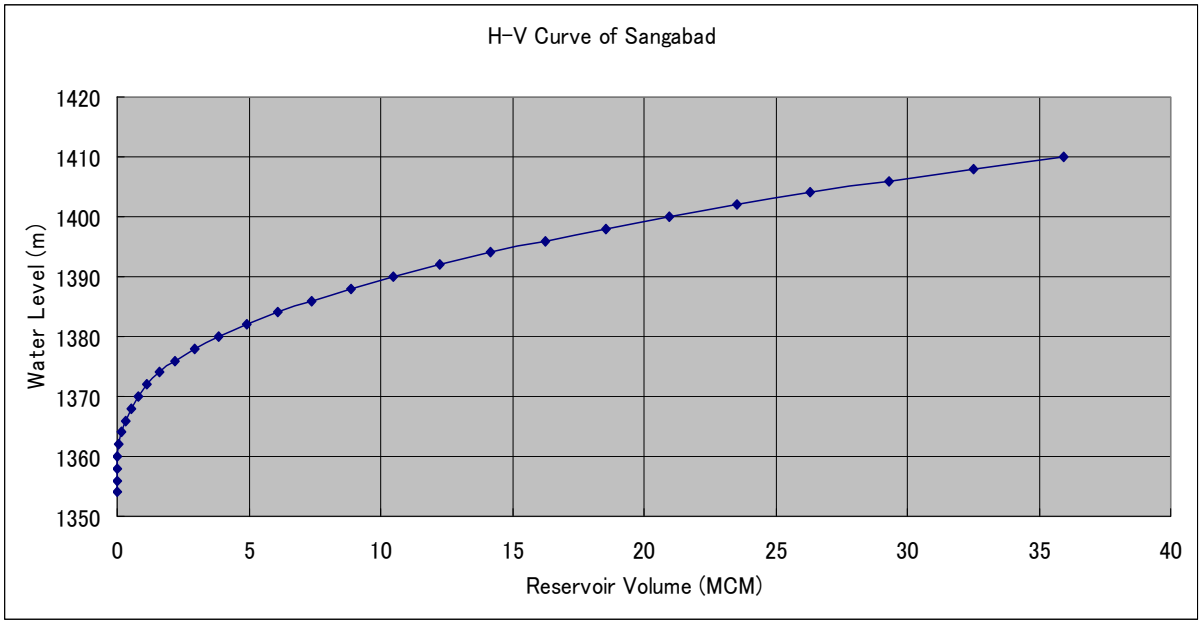
29) Ramin Tapeh Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,826.00	0.00	0.000	0.000	
1,830.00	4.00	0.014	0.027	
1,832.00	6.00	0.030	0.120	
1,838.00			0.400	L.W.L
1,840.00	14.00	0.091	0.493	
1,850.00	24.00	0.279	2.258	
1,860.00	34.00	0.526	6.217	
1,865.00			9.800	N.W.L
1,870.00	44.00	0.924	13.373	
1,879.00	53.00	1.359	23.785	
1,880.00	54.00	1.407	24.942	
1,890.00	64.00	1.996	41.868	



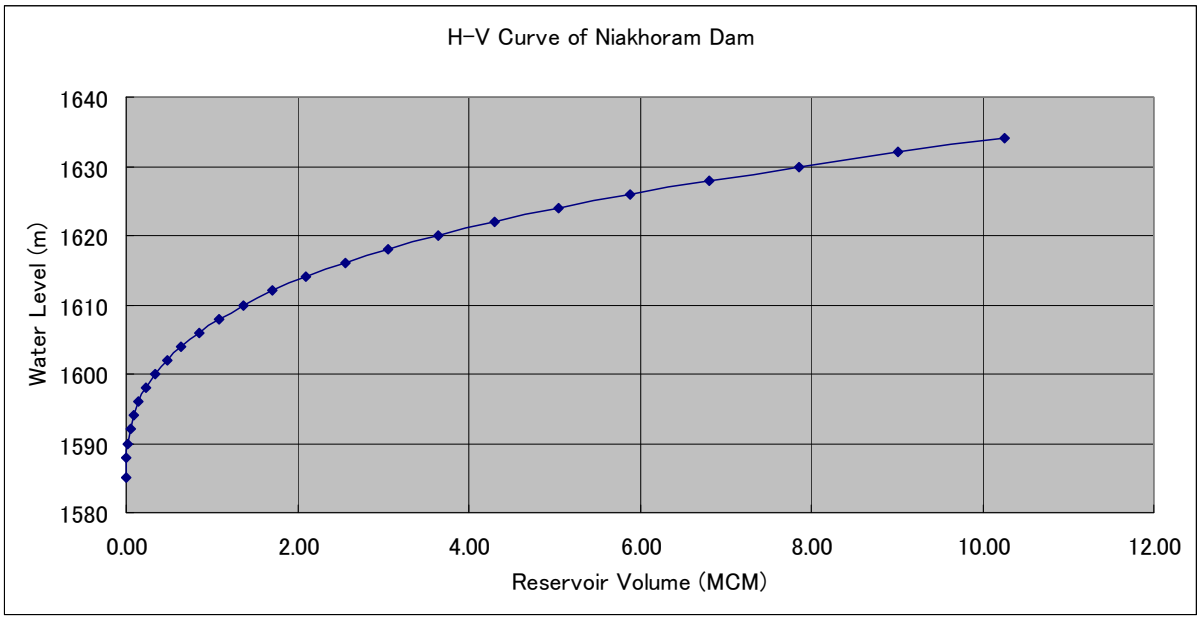
30) Sangabad Tapeh Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,354.00	0.00	0.000	0.000	
1,356.00	2.00	0.000	0.002	
1,358.00	4.00	0.006	0.005	
1,360.00	6.00	0.017	0.026	
1,362.00	8.00	0.035	0.077	
1,364.00	10.00	0.059	0.170	
1,366.00	12.00	0.085	0.313	
1,368.00	14.00	0.117	0.515	
1,370.00	16.00	0.153	0.784	
1,372.00	18.00	0.200	1.135	
1,373.00			1.320	L.W.L
1,374.00	20.00	0.259	1.592	
1,376.00	22.00	0.343	2.193	
1,378.00	24.00	0.418	2.953	
1,380.00	26.00	0.488	3.858	
1,382.00	28.00	0.553	4.898	
1,384.00	30.00	0.626	6.077	
1,386.00	32.00	0.701	7.403	
1,388.00	34.00	0.771	8.875	
1,390.00	36.00	0.846	10.491	
1,392.00	38.00	0.924	12.259	
1,394.00	40.00	1.006	14.188	
1,396.00	42.00	1.088	16.281	
1,398.00	44.00	1.169	18.537	
1,400.00	46.00	1.252	20.957	
1,402.00	48.00	1.342	23.550	
1,404.00	50.00	1.443	26.335	
1,406.00	52.00	1.546	29.323	N.W.L
1,408.00	54.00	1.648	32.516	
1,410.00	56.00	1.762	35.925	



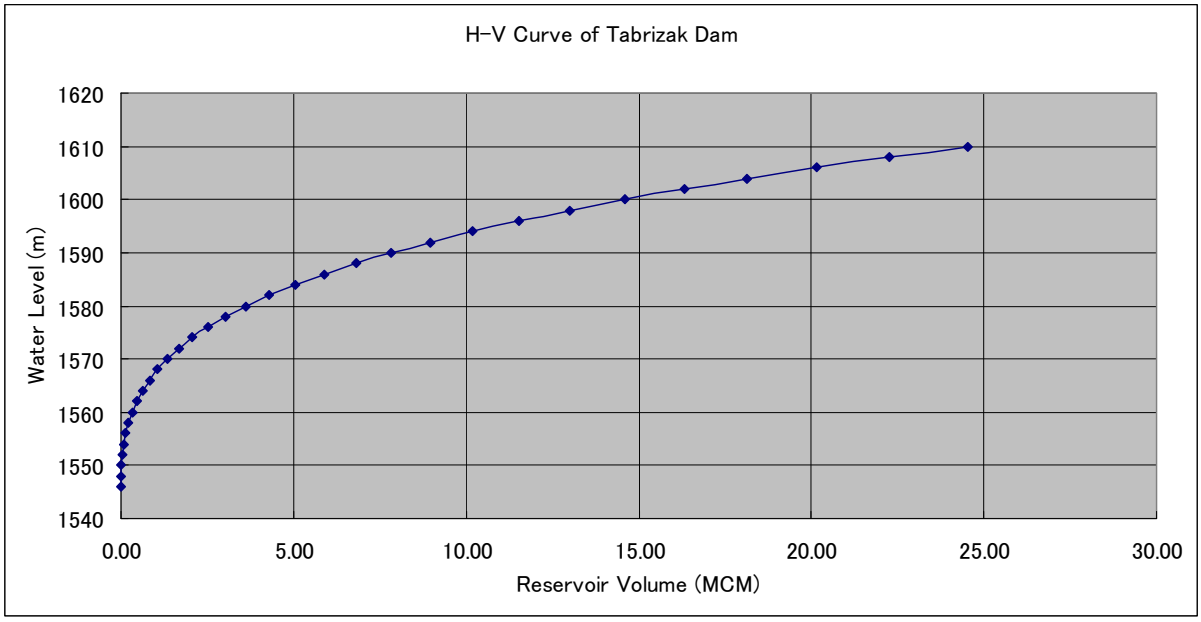
31) Niakhoram Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,585.00	0.00	0.000	0.00	
1,586.00	1.00	0.001	0.00	
1,588.00	3.00	0.004	0.00	
1,590.00	5.00	0.010	0.02	
1,592.00	7.00	0.018	0.05	
1,594.00	9.00	0.025	0.09	
1,596.00	11.00	0.034	0.15	
1,598.00	13.00	0.046	0.23	
1,600.00	15.00	0.061	0.33	
1,602.00	17.00	0.077	0.47	
1,604.00	19.00	0.093	0.64	
1,606.00	21.00	0.110	0.85	
1,608.00	23.00	0.131	1.09	
1,610.00	25.00	0.152	1.37	L.W.L
1,612.00	27.00	0.185	1.71	
1,614.00	29.00	0.211	2.10	
1,616.00	31.00	0.242	2.55	
1,618.00	33.00	0.272	3.07	
1,620.00	35.00	0.308	3.65	
1,622.00	37.00	0.348	4.30	
1,624.00	39.00	0.395	5.04	
1,626.00	41.00	0.441	5.88	
1,628.00	43.00	0.494	6.81	
1,630.00	45.00	0.551	7.86	
1,632.00	47.00	0.603	9.01	
1,634.00	49.00	0.650	10.26	
1,636.00	51.00		11.70	N.W.L



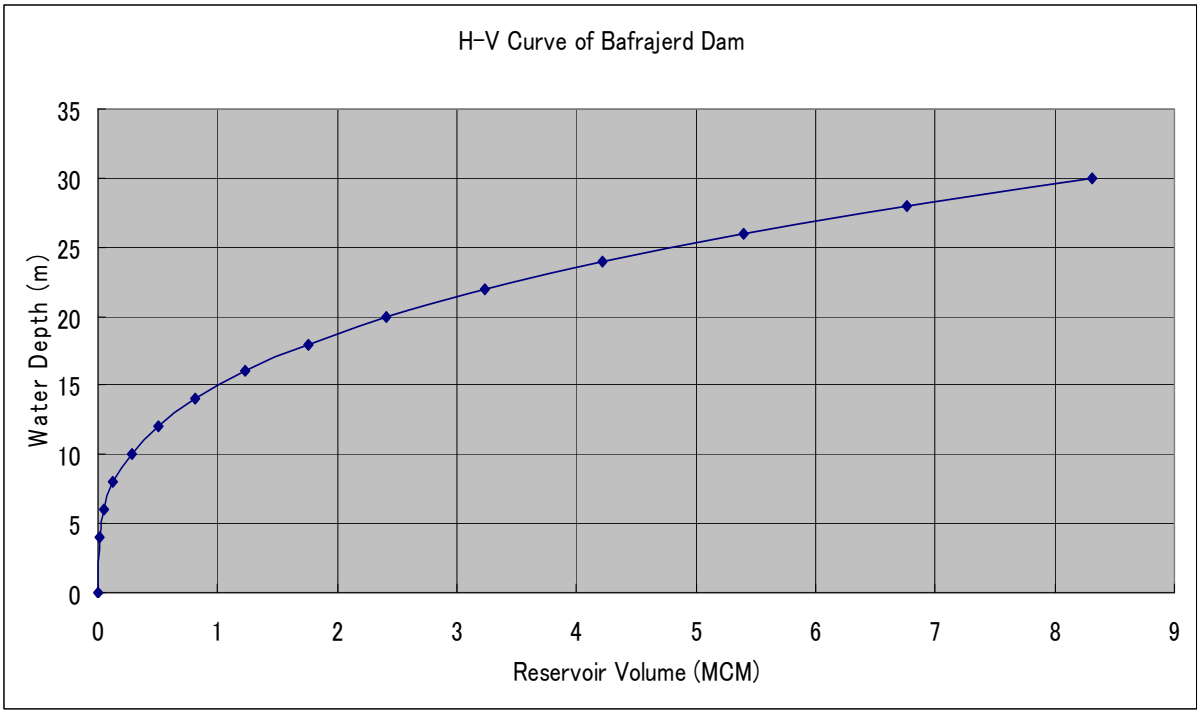
32) Tabrizak Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,546.00	0.00	0.000	0.00	
1,548.00	2.00	0.003	0.00	
1,550.00	4.00	0.008	0.01	
1,552.00	6.00	0.016	0.04	
1,554.00	8.00	0.028	0.08	
1,556.00	10.00	0.038	0.14	
1,558.00	12.00	0.048	0.23	
1,560.00	14.00	0.059	0.34	
1,562.00	16.00	0.072	0.47	
1,564.00	18.00	0.090	0.63	
1,566.00	20.00	0.107	0.82	
1,568.00	22.00	0.128	1.06	L.W.L
1,570.00	24.00	0.153	1.34	
1,572.00	26.00	0.181	1.67	
1,574.00	28.00	0.209	2.06	
1,576.00	30.00	0.238	2.51	
1,578.00	32.00	0.279	3.03	
1,580.00	34.00	0.312	3.62	
1,582.00	36.00	0.359	4.29	
1,584.00	38.00	0.398	5.04	
1,586.00	40.00	0.441	5.88	
1,588.00	42.00	0.488	6.81	
1,590.00	44.00	0.537	7.84	
1,592.00	46.00	0.590	8.96	N.W.L
1,594.00	48.00	0.645	10.20	
1,596.00	50.00	0.700	11.54	
1,598.00	52.00	0.760	13.00	
1,600.00	54.00	0.825	14.59	
1,602.00	56.00	0.892	16.31	
1,604.00	58.00	0.959	18.16	
1,606.00	60.00	1.026	20.14	
1,608.00	62.00	1.099	22.27	
1,610.00	64.00	1.176	24.54	



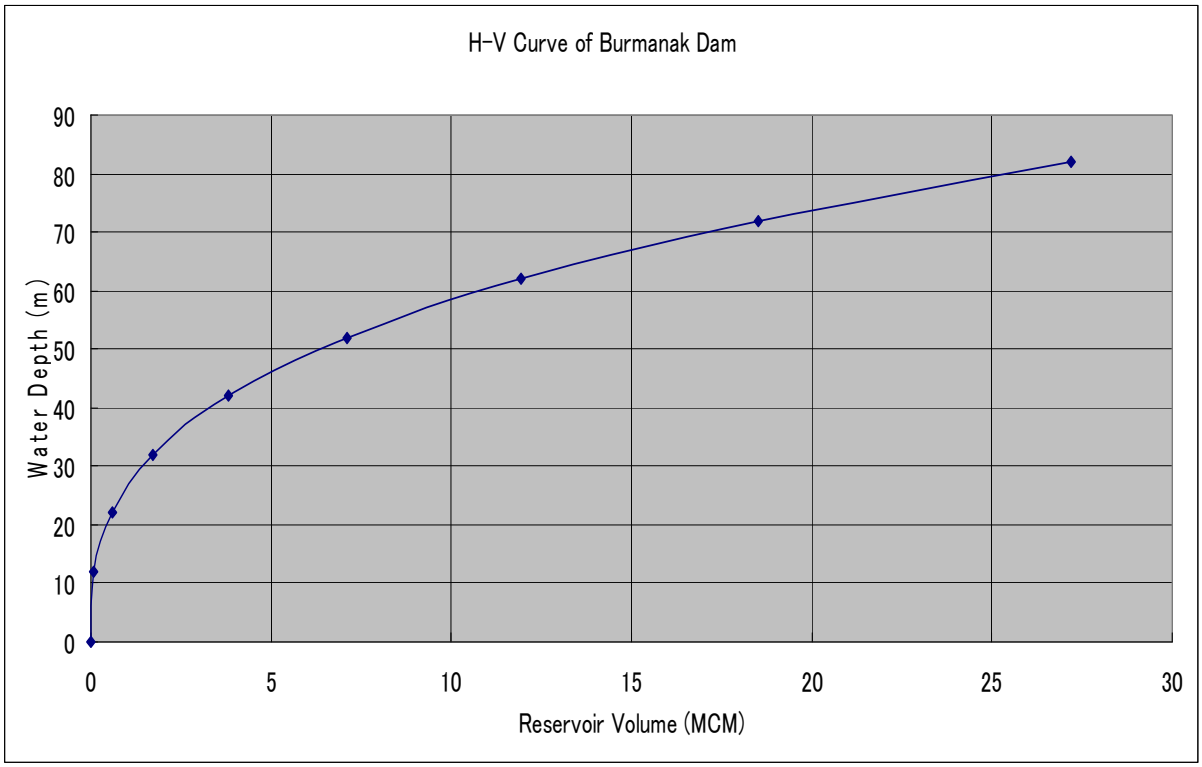
33) Befrajerd Dam (Under Planning)

Water Level (m)	Height (m)	Area (ha)	Volume (MCM)	Note
80.00	0.00	0.000	0.000	
82.00	2.00	0.042	0.000	
84.00	4.00	0.923	0.008	
86.00	6.00	2.844	0.044	
88.00	8.00	5.829	0.129	
90.00	10.00	9.391	0.280	
92.00	12.00	13.009	0.503	L.W.L
94.00	14.00	17.937	0.811	
96.00	16.00	23.436	1.223	
98.00	18.00	29.558	1.752	
100.00	20.00	36.687	2.413	
102.00	22.00	44.907	3.228	
104.00	24.00	53.711	4.213	
106.00	26.00	64.425	5.392	
108.00	28.00	72.126	6.757	N.W.L
110.00	30.00	82.929	8.306	



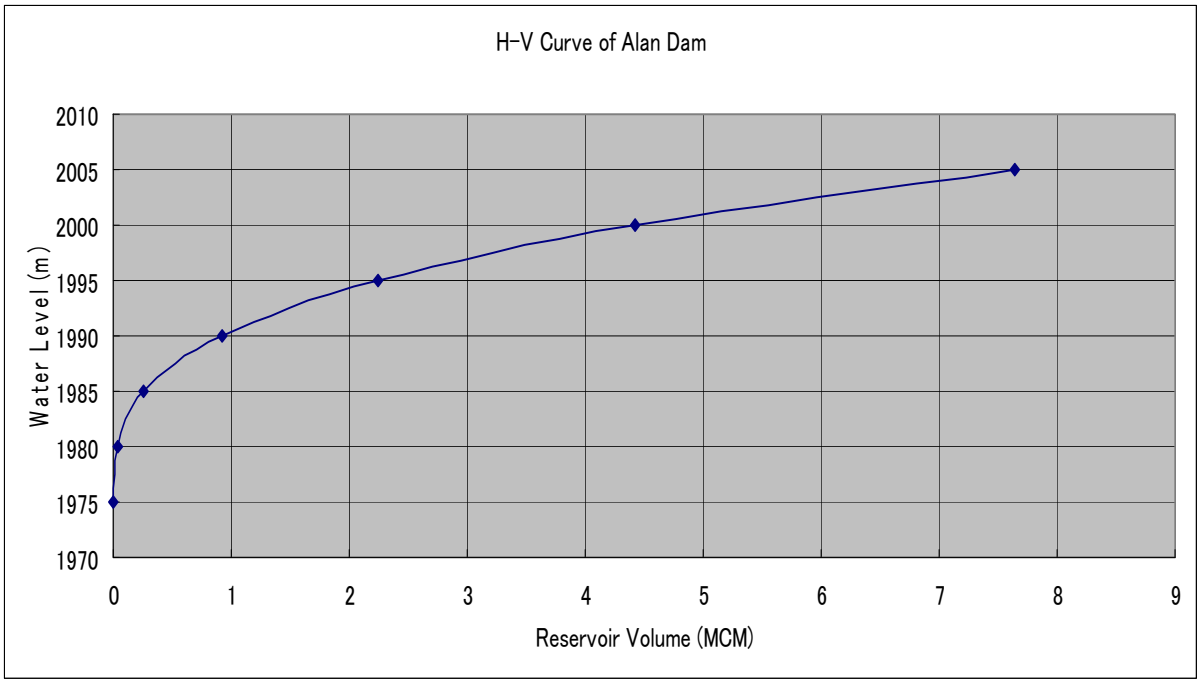
34) Burmanak Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
518.00	0.00	0.000	0.000	
520.00	2.00	0.000	0.000	
530.00	12.00	0.027	0.090	
532.00			0.190	L.W.L
540.00	22.00	0.076	0.580	
550.00	32.00	0.160	1.720	
560.00	42.00	0.264	3.800	
570.00	52.00	0.402	7.110	
580.00	62.00	0.569	11.940	
590.00	72.00	0.752	18.520	N.W.L
600.00	82.00	0.990	27.210	



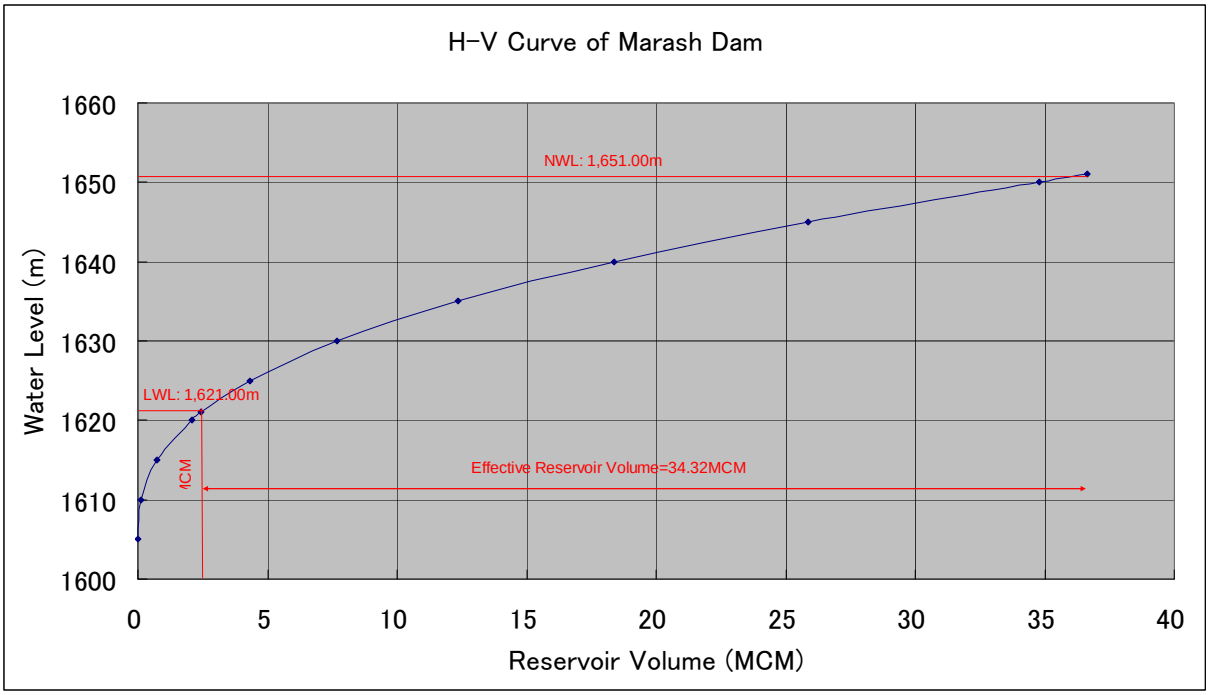
35) Alan Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1,975.00	0.00	0.000	0.000	
1,980.00	5.00	0.015	0.038	
1,985.00	10.00	0.080	0.255	
1,986.80			0.500	L.W.L
1,990.00	15.00	0.195	0.919	
1,995.00	20.00	0.344	2.248	
2,000.00	25.00	0.531	4.419	
2,003.00			6.350	N.W.L
2,005.00	30.00	0.766	7.644	



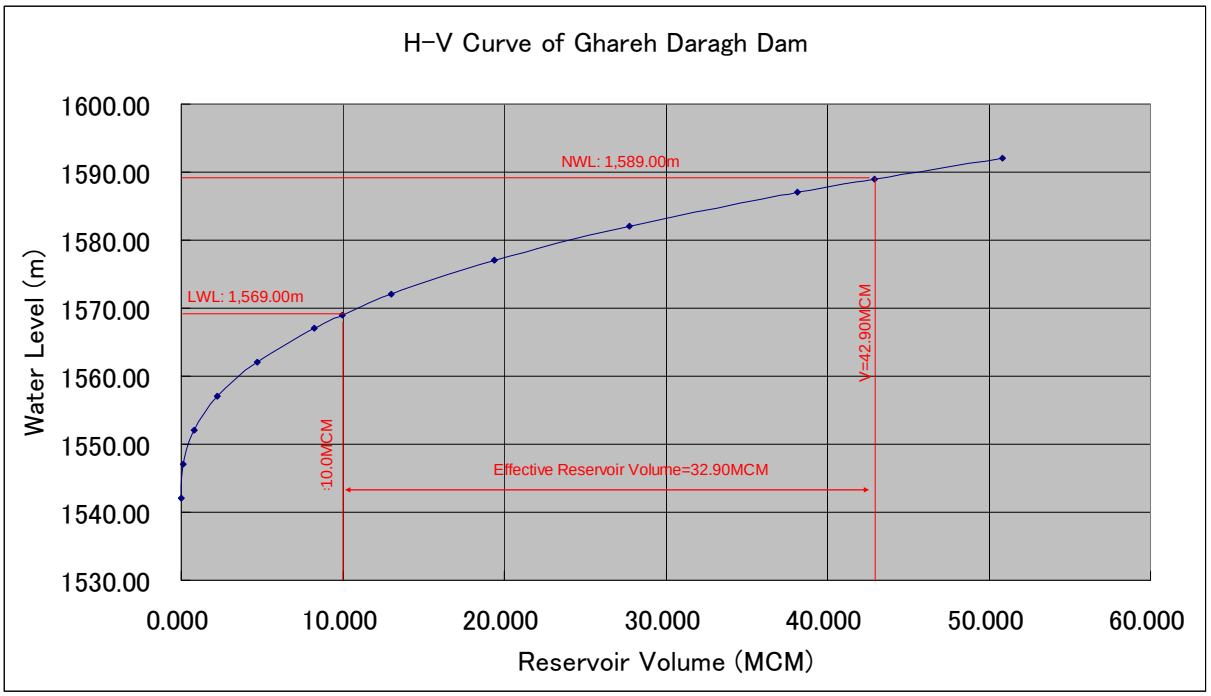
36) Marash Dam (Under Planning)

Water Level (m)	Area (ha)	Volume (MCM)	Note
1,605.00	0.00	0.00	
1,610.00	6.85	0.10	
1,615.00	18.72	0.73	
1,620.00	36.15	2.07	
1,621.00	39.78	2.45	L.W.L
1,625.00	55.59	4.34	
1,630.00	79.32	7.70	
1,635.00	107.30	12.35	
1,640.00	134.82	18.39	
1,645.00	163.82	25.85	
1,650.00	194.35	34.80	
1,651.00	200.02	36.66	N.W.L



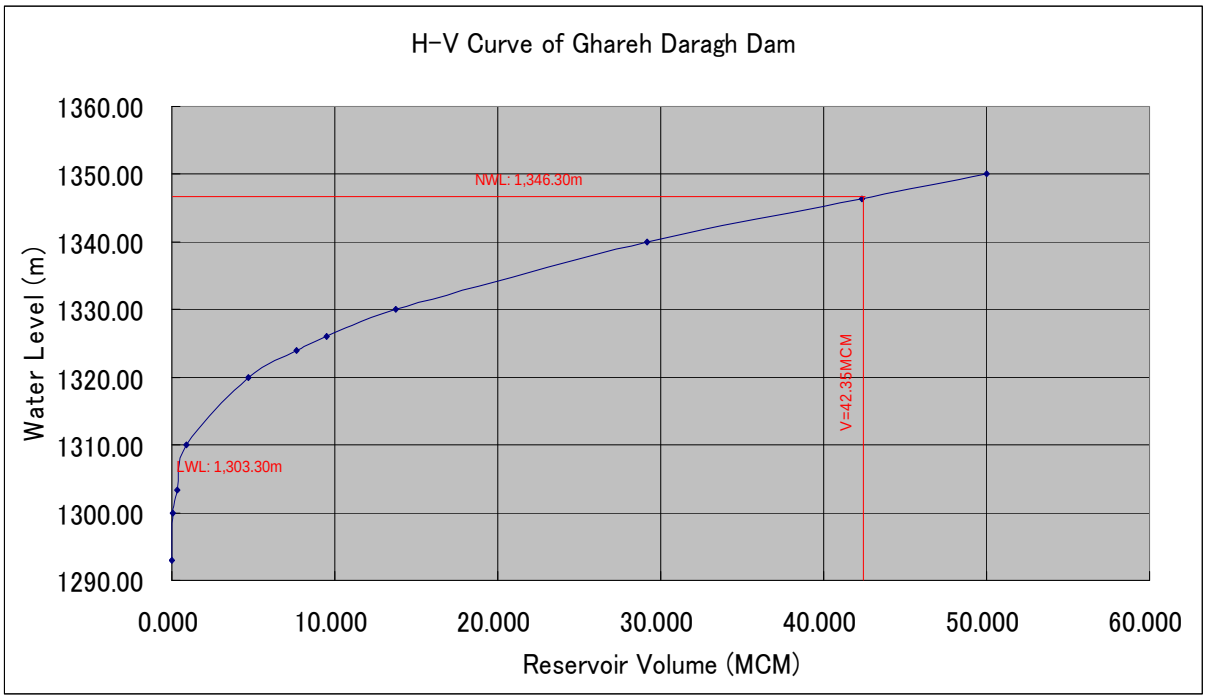
37) Ghareh Daragh Dam (Under Planning)

Water Level (m)	Area (km^2)	Volume (MCM)	Note
1,542.00	0.000	0.000	
1,547.00	0.082	0.114	
1,552.00	0.206	0.814	
1,557.00	0.388	2.252	
1,562.00	0.612	4.709	
1,567.00	0.836	8.230	
1,569.00	0.950	9.977	L.W.L
1,572.00	1.134	13.021	
1,577.00	1.499	19.392	
1,582.00	1.942	27.729	
1,587.00	2.370	38.138	
1,589.00	2.577	42.910	N.W.L
1,592.00	2.953	50.862	



38) Khoresh Rostam Dam (Under Planning)

Water Level (m)	Height (m)	Area (km^2)	Volume (MCM)	Note
1293.0	0.00	0.000	0.00	
1300.0	7.00	0.022	0.08	
1303.3			0.35	L.W.L
1310.0	17.00	0.163	0.89	
1320.0	27.00	0.647	4.67	
1324.0	31.00	0.860	7.68	
1326.0	33.00	0.961	9.50	
1330.0	37.00	1.179	13.77	
1340.0	47.00	1.931	29.17	
1346.3			42.35	N.W.L
1350.0	57.00	2.236	49.98	



2.2.4 Outflow from Manjil Dam

Monthly outflow from the Manjil Dam are shown in Table 2.2.6.

Table 2.2.6 Monthly Outflow from Manjil Dam

Month		Monthly Outflow (MCM)									
		1377/78 1998/99	1378/79 1999/00	1379/80 2000/01	1380/81 2001/02	1381/82 2002/03	1382/83 2003/04	1383/84 2004/05	1384/85 2005/06	1385/86 2006/07	Average
Oct	Meh	0.0	0.1	0.0	0.5	-	77.0	167.7	39.4	20.5	38.1
Nov	Aba.	-	4.4	0.0	1.1	-	81.1	52.6	43.4	28.6	30.2
Dec	Aza	146.6	5.6	0.0	0.2	-	84.4	99.0	72.6	13.1	52.7
Jan	Dey	68.9	4.4	0.0	0.0	-	155.5	9.7	20.4	59.3	39.8
Feb	Bah	10.9	2.7	0.0	0.0	-	54.5	39.2	25.4	133.5	33.3
Mar	Esf	5.8	0.0	0.0	0.0	-	0.0	353.1	18.2	60.6	54.7
Apr	Far	75.9	124.7	12.3	8.0	600.2	280.0	358.8	143.8	317.1	213.4
May	Ord.	292.1	405.9	415.8	336.9	371.0	356.3	387.9	306.1	409.7	364.6
Jun	Kho.	242.2	437.5	264.0	374.4	383.8	457.2	438.8	508.9	394.3	389.0
Jul	Tir	15.1	318.7	168.5	401.9	401.2	406.0	481.7	437.4	405.5	337.3
Aug	Mor.	33.0	50.4	2.5	171.3	222.8	355.7	310.3	180.4	309.9	181.8
Sep	Sha.	16.9	1.0	1.0	12.8	71.0	149.1	122.3	60.6	177.8	68.1
Total		907.4	1,355.3	864.1	1,307.0	2,050.1	2,456.8	2,821.2	1,856.5	2,329.9	1,803.0

Source: WRMC

2.2.5 Comparison between Outflow from Manjil Dam and Intake Water Volume at Tarik, Galerud & Sangar Weirs

The outflow discharge from the Manjil dam and the intake volume at three weirs located at the downstream of Manjil dam are shown in Table 2.2.7.

Table 2.2.7 Comparison between Manjil Outflow and Weir's Intake Water Volume

Year	Guaging Station Record at Gilvan and Loshan (MCM)	Discharge Record at Manjil Dam		② Intake Volume at Tarik, Galerud and Sangar (MCM)	Balance (MCM)	Note
		Annual Inflow (MCM)	①Annual Outflow (MCM)			
1988	3,474.0			1,636.7		
1989	3,067.6			1,702.0		
1990	3,122.9			1,645.6		
1991	6,736.4			1,756.8		
1992	4,558.4			1,918.7		
1993	7,432.4			1,972.6		
1994	6,431.9			2,390.0		
1995	5,331.2			2,168.4		
1996	2,606.9			1,549.7		
1997	4,265.5			2,193.0		
1998	1,174.0	1,009.5	907.4	759.1	148.3	Drought Year
1999	1,546.5	1,502.8	1,355.3	1,496.7	-141.4	
2000	1,000.8	961.6	864.1	1,651.8	-787.7	
2001	1,916.6	1,836.6	1,307.0	1,459.7	-152.7	
2002	4,207.4	3,291.2	2,050.0	1,651.8	398.2	
2003	2,567.4	2,629.9	2,456.8	1,485.3	971.5	
2004	2,837.8	2,981.3	2,821.2	1,683.1	1,138.1	
2005		2,212.0	1,856.5	1,808.0	48.5	
2006		3,208.0	2,329.9	1,659.0	670.9	
Average	3,663.4	2,181.4	1,772.0	1,679.0	93.0	

Source: WRMC

2.2.6 Monthly Water Level and Discharge in Manjil Dam

The monthly water level and the discharge from the Manjil dam are shown in Table 2.2.8 and Table 2.2.9.

Table 2.2.8 Monthly Water Level and Discharge in Manjil Dam (1/2)

Year	Month	Reservoir volume (MCM)	Water Level (m)	Outflow from start of water year (MCM)	Total outflow (MCM)	Outflow (MCM)									Inflow Volume (MM)	Inflow from start of water year (MCM)
						Spillway	Evaporation	Leakage	Drainage	Intake	Pumping	Bottem outlet	Turbine	For Water Use		
1998	Oct	28.56	222.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dec		203.65	146.62	146.61	0.00	0.00	0.00	0.00	146.61	0.00	0.00	0.00	146.61	132.88	132.89
1999	Jan	92.20	231.66	215.54	68.91	0.00	0.00	0.00	0.00	68.91	0.00	0.00	0.00	68.91	138.15	271.04
	Feb	244.31	242.70	226.47	10.94	0.00	0.00	0.00	0.00	10.94	0.00	0.00	0.00	10.94	166.32	437.36
	Mar	389.48	249.60	232.30	5.83	0.00	0.00	0.00	0.00	5.83	0.00	0.00	0.00	5.83	163.21	600.57
	Apr	540.36	255.05	308.15	75.85	0.00	0.00	0.00	0.00	4.17	0.00	0.00	71.68	75.85	219.11	819.68
	May	343.04	247.63	600.26	292.11	0.00	0.00	0.00	0.00	5.40	0.00	0.00	286.71	292.11	120.05	939.74
	Jun	87.19	231.17	842.46	242.20	0.00	0.00	0.00	0.00	31.25	0.00	0.00	210.95	242.20	18.82	958.55
	Jul	35.74	224.61	857.54	15.08	0.00	0.00	0.00	0.00	15.08	0.00	0.00	0.00	15.08	15.92	974.47
	Aug	20.10	220.55	890.52	32.98	0.00	0.00	0.00	0.00	32.98	0.00	0.00	0.00	32.98	20.74	995.20
	Sep	14.94	218.63	907.44	16.92	0.00	0.00	0.00	0.00	16.92	0.00	0.00	0.00	16.92	14.28	1,009.48
	Oct	36.80	224.83	0.13	0.13	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.13	21.44	21.44
	Nov	101.52	232.54	4.53	4.40	0.00	0.00	0.00	0.00	4.40	0.00	0.00	0.00	4.40	74.38	95.83
	Dec	192.97	239.56	10.12	5.60	0.00	0.00	0.00	0.00	5.60	0.00	0.00	0.00	5.60	94.83	190.66
2000	Jan	295.10	245.40	15.43	5.32	0.00	0.95	0.00	0.00	4.37	0.00	0.00	0.00	4.37	97.65	288.31
	Feb	407.14	250.31	18.74	3.31	0.00	0.61	0.00	0.00	2.70	0.00	0.00	0.00	2.70	113.45	405.89
	Mar	567.50	255.92	20.37	1.63	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	155.36	561.25
	Apr	1,108.52	269.48	149.04	128.67	0.00	3.96	0.00	0.00	41.86	0.00	0.00	82.85	124.71	621.47	1,182.72
	May	935.80	265.77	562.47	413.43	0.00	7.54	0.00	0.00	58.26	0.00	0.00	347.63	405.90	262.70	1,445.42
	Jun	476.70	252.90	1,011.29	448.81	0.00	11.33	0.00	0.00	56.29	0.00	0.00	381.19	437.48	36.73	1,482.15
	Jul	132.02	235.15	1,336.79	325.50	0.00	6.85	0.00	0.00	11.19	0.00	0.00	307.47	318.65	9.53	1,491.68
	Aug	21.71	221.07	1,389.07	52.29	0.00	1.94	0.00	0.00	50.35	0.00	0.00	0.00	50.35	6.12	1,497.80
	Sep	32.54	223.94	1,390.95	1.88	0.00	0.87	0.00	0.00	1.01	0.00	0.00	0.00	1.01	9.10	1,506.89
	Oct	62.06	228.43	0.45	0.46	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.32	21.81
	Nov	115.13	233.75	0.60	0.15	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.87	75.68
	Dec	198.94	239.95	0.83	0.23	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.87	162.07
2001	Jan	307.75	246.03	1.36	0.53	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	114.23	276.30
	Feb	422.75	250.92	2.19	0.84	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	117.28	393.58
	Mar	596.73	256.83	4.19	1.99	0.00	1.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	174.86	572.10
	Apr	831.91	263.30	21.02	16.83	0.00	4.50	0.00	0.00	0.80	0.00	0.00	11.53	12.33	239.13	811.23
	May	505.40	253.89	441.72	420.70	0.00	4.90	0.00	0.00	58.35	0.00	0.00	357.45	415.80	120.49	931.71
	Jun	223.57	241.48	712.18	270.46	0.00	6.43	0.00	0.00	6.46	0.00	0.00	257.58	264.03	24.99	956.70
	Jul	33.37	224.12	881.93	169.75	0.00	1.28	0.00	0.00	88.56	0.00	0.00	79.90	168.47	6.36	963.06
	Aug	19.10	220.22	885.06	3.13	0.00	0.60	0.00	0.00	2.53	0.00	0.00	0.00	2.53	2.97	966.03
	Sep	22.78	221.39	886.51	1.45	0.00	0.47	0.00	0.00	0.98	0.00	0.00	0.00	0.98	4.23	970.25
	Oct	40.13	225.42	0.69	0.69	0.00	0.24	0.00	0.00	0.46	0.00	0.00	0.00	0.46	20.31	20.31
	Nov	56.95	227.81	1.99	1.30	0.00	0.18	0.00	0.00	1.12	0.00	0.00	0.00	1.12	28.48	48.79
	Dec	147.05	236.31	2.56	0.56	0.00	0.39	0.00	0.00	0.17	0.00	0.00	0.00	0.17	95.86	144.65
2002	Jan	271.08	244.17	2.76	0.20	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	137.10	281.75
	Feb	390.94	249.66	3.81	1.05	0.00	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	137.31	419.07
	Mar	563.45	255.79	5.39	1.58	0.00	1.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	168.60	587.67
	Apr	1,061.48	268.51	14.04	8.65	0.00	0.69	0.00	0.00	0.89	0.00	0.00	7.07	7.96	465.56	1,053.22
	May	1,221.81	271.94	354.26	340.22	0.00	3.28	0.00	0.00	9.21	0.00	0.00	327.74	336.95	554.57	1,607.79
	Jun	890.44	265.22	732.35	378.08	0.00	3.66	0.00	0.00	20.96	0.00	0.00	353.47	374.42	159.45	1,767.24
	Jul	496.73	253.79	1,138.98	406.63	0.00	4.78	0.00	0.00	28.01	0.00	0.00	373.84	401.85	33.26	
	Aug	317.83	246.87	1,312.66	173.68	0.00	2.41	0.00	0.00	0.30	0.00	0.00	170.97	171.27	21.93	1,822.43
	Sep	296.94	246.04	1,326.90	14.24	0.00	1.41	0.00	0.00	0.08	0.00	0.00	12.75	12.82	14.11	1,836.54
	Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	Jan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Apr	1,276.41	272.84	1,006.57	602.26	2.05	0.00	0.00	0.00	271.25	0.00	0.00	328.96	600.21	1,334.62	2,209.77
	May	1,252.03	272.41	1,386.90	380.33	9.31	0.00	0.00	0.00	15.62	0.00	0.00	355.40	371.02	1,326.24	3,536.01
	Jun	1,115.91	269.82	1,772.84	385.93	0.00	2.09	0.00	0.00	39.13	0.00	0.00	344.72	383.85	469.62	4,005.63
	Jul	694.30	259.95	2,174.00	401.16	0.00	0.00	0.00	0.00	37.35	0.00	0.00	363.81	401.16	97.13	4,102.76
	Aug	466.07	252.85	2,397.81	223.81	0.00	0.98	0.00	0.00	0.24	0.00	0.00	222.59	222.83	33.75	4,136.50
	Sep	402.28	250.49	2,468.85	71.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	71.04	71.04	29.79	4,166.29
	Oct	350.82	248.45	77.01	77.01	0.00	0.00	0.00	0.00	0.73	0.00	0.00	76.28	77.01	37.01	37.01
	Nov	324.74	247.44	158.11	81.10	0.00	0.01	0.00	0.00	3.17	0.00	0.00	77.92	81.09	77.67	114.67
	Dec	381.96	249.87	242.51	84.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	84.40	84.40	143.45	258.12
2004	Jan	395.01	250.40	398.05	155.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	155.54	155.54	179.26	437.38
	Feb	527.87	255.39	452.90	54.85	0.00	0.29	0.00	0.00	0.30	0.01	0.00	54.25	54.55	191.56	628.94
	Mar	914.04	266.20	453.51	0.61	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	390.09	1,019.03
	Apr	1,194.41	272.06	754.96	301.45	20.65	0.83	0.00	0.00	5.88	0.00	0.00	274.09	279.97	476.58	1,495.61
	May	1,196.77	272.15	1,485.02	730.06	371.46	2.32	0.00	0.00	0.00	0.00	0.00	356.29	356.29	697.75	2,213.22
	Jun	1,011.43	268.25	1,972.87	487.86	28.96	1.70	0.00	0.00	96.58	0.00	0.00	360.61	457.19	277.46	2,522.59
	Jul	637.40	258.54	2,381.57	408.70	0.00	2.74	0.00	0.00	77.42	0.00	0.00	328.53	405.96	111.23	2,633.82
	Aug	306.46	245.09	2,743.00	361.43	0.00	5.74	0.00	0.00	21.62	0.00	0.00	334.06	355.68	30.06	2,665.11
	Sep	172.25	236.56	2,894.59	151.60	0.00	2.49	0.00	0.00	12.58	0.02	0.62	135.89	149.09	17.79	2,684.60

Source: WRMC

Table 2.2.9 Monthly Water Level and Discharge in Manjil Dam (2/2)

Year	Month	Reservoir volume (MCM)	Water Level (m)	Outflow from start of water year (MCM)	Total outflow (MCM)	Outflow (MCM)									Inflow Volume (MM)	Inflow from start of water year (MCM)
						Spillway	Evaporation	Leakage	Drainage	Intake	Pumping	Bottem outlet	Turbine	For Water Use		
2004	Oct	0.00	209.00	167.74	167.74	0.00	0.00	0.00	0.00	167.74	0.00	0.00	0.00	167.74	24.24	25.02
	Nov	0.00	209.00	220.33	52.59	0.00	0.00	0.00	0.00	52.59	0.00	0.00	0.00	52.59	52.59	77.62
	Dec	43.20	227.79	319.40	99.07	0.00	0.05	0.00	0.00	99.03	0.00	0.00	0.00	99.03	145.09	222.71
2005	Jan	162.35	239.91	329.21	9.81	0.00	0.14	0.00	0.00	9.67	0.00	0.00	0.00	9.67	126.13	348.84
	Feb	289.64	247.30	368.71	39.49	0.00	0.26	0.00	0.00	7.77	0.06	0.52	30.89	39.18	148.92	516.38
	Mar	678.47	261.17	722.85	354.14	0.00	1.09	0.00	0.00	93.05	0.00	0.00	260.00	353.05	726.66	1,243.04
	Apr	1,053.66	269.86	1,084.78	361.93	0.00	3.12	0.00	0.00	7.06	0.00	0.00	351.76	358.81	730.01	1,990.29
	May	1,182.26	272.32	1,525.95	441.17	49.61	3.58	0.00	0.00	69.06	0.08	5.00	313.84	387.90	630.44	2,620.73
	Jun	926.29	267.07	2,012.16	486.21	39.69	5.74	0.00	0.00	96.29	0.10	3.11	339.45	438.84	255.59	2,876.32
	Jul	479.19	255.54	2,498.98	486.82	0.00	4.97	0.00	0.00	90.69	0.15	0.00	391.01	481.70	44.12	2,920.44
	Aug	191.41	241.72	2,815.51	316.53	0.00	6.18	0.00	0.00	0.00	0.03	0.00	310.32	310.32	30.48	2,950.92
	Sep	129.35	237.18	2,899.68	126.19	0.00	3.85	0.00	0.00	0.00	0.00	53.18	69.16	122.34	66.98	2,973.85
	Oct	130.96	237.35	40.84	40.83	0.00	1.43	0.00	0.00	0.00	0.00	39.40	0.00	39.40	43.16	43.16
	Nov	170.92	240.80	85.07	44.24	0.00	0.77	0.00	0.00	0.00	0.04	31.33	12.10	43.43	84.21	127.37
	Dec	192.50	242.18	158.57	73.49	0.00	0.68	0.00	0.00	0.00	0.23	0.05	72.53	72.58	95.28	222.65
2006	Jan	297.80	247.79	179.51	20.95	0.00	0.47	0.00	0.00	0.00	0.05	14.21	6.22	20.43	126.77	349.41
	Feb	586.55	258.89	205.86	26.35	0.00	0.96	0.00	0.00	12.10	0.03	13.26	0.00	25.36	314.30	663.71
	Mar	895.69	267.12	227.03	21.17	0.00	2.94	0.00	0.00	0.00	0.03	18.20	0.00	18.20	331.93	995.63
	Apr	1,133.67	272.26	418.14	191.11	42.57	4.64	0.00	0.00	9.59	0.06	9.35	124.90	143.84	427.77	1,423.40
	May	1,109.85	271.80	993.26	575.12	263.49	5.48	0.00	0.00	16.55	0.09	0.86	288.64	306.05	559.70	1,983.10
	Jun	740.95	263.75	1,512.88	519.63	0.00	10.71	0.00	0.00	142.33	0.06	1.08	365.44	508.85	152.15	2,135.25
	Jul	348.24	250.88	1,959.78	446.90	0.00	9.46	0.00	0.00	30.80	0.05	25.53	381.05	437.39	49.50	2,184.75
	Aug	174.02	241.11	2,146.00	186.23	0.00	5.77	0.00	0.00	0.00	0.02	1.33	179.11	180.44	17.90	2,202.65
	Sep	116.76	236.62	2,209.62	63.62	0.00	3.04	0.00	0.00	0.00	0.00	5.05	55.53	60.58	9.38	2,212.03
	Oct	125.85	237.37	21.85	21.85	0.00	1.40	0.00	0.00	0.00	0.00	20.46	0.00	20.46	31.67	31.67
	Nov	206.23	242.90	51.50	29.65	0.00	1.06	0.00	0.00	0.00	0.00	16.47	12.13	28.59	111.44	143.10
	Dec	308.21	248.07	65.09	13.59	0.00	0.44	0.00	0.00	0.00	0.00	13.14	0.00	13.14	115.83	258.94
2007	Jan	338.24	249.41	127.90	59.98	0.00	0.65	0.00	0.00	0.00	0.01	5.32	54.01	59.32	87.65	349.87
	Feb	332.91	249.16	266.65	134.67	0.00	1.13	0.00	0.00	0.00	0.03	0.00	133.51	133.51	127.74	482.75
	Mar	487.86	255.42	328.40	61.75	0.00	1.13	0.00	0.00	0.00	0.02	5.58	55.02	60.60	221.65	704.40
	Apr	1,086.53	271.16	648.51	320.12	0.00	2.97	0.00	0.00	85.59	0.03	106.90	124.63	317.12	888.84	1,593.24
	May	1,144.52	272.38	1,686.44	1,037.93	621.92	6.26	0.00	0.00	0.00	0.08	51.95	357.72	409.67	1,104.17	2,697.41
	Jun	954.49	268.27	2,169.80	483.37	77.55	11.48	0.00	0.00	8.64	0.09	25.65	359.96	394.26	368.46	3,065.87
	Jul	607.28	259.33	2,584.27	414.48	0.00	8.90	0.00	0.00	15.68	0.06	22.19	367.64	405.52	91.71	3,157.58
	Aug	314.13	248.20	2,901.57	317.29	0.00	7.38	0.00	0.00	0.00	0.05	0.00	309.87	309.87	25.96	3,183.54
	Sep	163.87	239.51	3,083.56	182.00	0.00	4.15	0.00	0.00	0.00	0.03	11.53	166.29	177.82	32.86	3,216.40
	Oct	171.85	240.10	23.97	23.97	0.00	1.82	0.00	0.00	0.00	0.00	22.15	0.00	22.15	36.44	36.44
	Nov	206.65	242.30	50.60	26.63	0.00	1.09	0.00	0.00	0.00	0.00	25.54	0.00	25.54	62.35	98.79
	Dec	312.56	247.99	70.98	20.38	0.00	0.78	0.00	0.00	0.00	0.00	19.60	0.00	19.60	126.67	225.46
2008	Jan	395.24	251.72	84.24	13.27	0.00	0.29	0.00	0.00	0.00	0.00	12.97	0.00	12.97	96.56	322.02
	Feb	409.40	252.30	167.07	82.83	0.00	0.73	0.00	0.00	0.00	0.03	0.00	82.07	82.07	95.99	418.01

Source: WRMC

2.2.7 Discharge for Hydroelectric generation from Manjil Dam

The discharge for hydroelectric generation from Manjil dam is shown in Table 2.2.10.

Table 2.2.10 Discharge for Hydropower from Manjil Dam

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1998	0.000	0.000	0.000	0.000	71.681	286.708	210.947	0.000	0.000	0.000	0.000	0.000	569.336
1999	0.000	0.000	0.000	0.000	82.849	347.634	381.194	307.465	0.000	0.000	0.000	0.000	1,119.142
2000	0.000	0.000	0.000	0.000	11.532	357.451	257.579	79.904	0.000	0.000	0.000	0.000	706.466
2001	0.000	0.000	0.000	0.000	7.071	327.737	353.465	373.843	170.974	12.746	-	-	1,245.836
2002	-	-	-	-	328.962	355.398	344.715	363.806	222.594	71.040	76.284	77.918	1,840.717
2003	84.401	155.536	54.245	0.000	274.092	356.285	360.611	328.534	334.060	135.890	0.000	0.000	2,083.654
2004	0.000	0.000	30.887	260.002	351.756	313.837	339.450	391.011	310.321	69.163	0.000	12.095	2,078.522
2005	72.534	6.222	0.000	0.000	124.903	288.639	365.443	381.050	179.112	55.533	0.000	12.125	1,485.561
2006	0.000	54.005	133.505	55.024	124.629	357.717	359.964	367.643	309.868	166.290	0.000	0.000	1,928.645
Average	19.617	26.970	27.330	39.378	153.053	332.378	330.374	288.140	169.659	56.740	9.536	12.767	1,465.942

Source: WRMC

2.2.8 Comparison Between Outflow from Manjil and Outflow from Sangar Weir

The outflow discharge from the Manjil dam and the outflow discharge from Sangar weir are shown in Table 2.2.11.

Table 2.2.11 Comparison Between Manjil Outflow and Sangar Outflow

(Unit: MCM)

Year		Site	Non Irrigation Season							Irrigation Season							Total
			Oct.	Nov	Dec	Jan	Feb	Mar	Sub-total	Apr	May	Jun	Jul	Aug	Sep	Sub-total	
1989	1990	Sangar	103.8	175.1	154.6	253.7	191.5	287.7	1,166.4	322.7	414.1	85.0	91.9	292.8	270.7	1,477.2	2,643.7
		Manjil	156.6	194.1	233.5	196.7	6.2	114.8	901.9	214.3	701.7	554.4	479.4	396.4	203.6	2,549.8	3,451.7
		S-M	(52.8)	(19.0)	(78.9)	57.0	185.3	172.9	264.5	108.4	(287.6)	(469.4)	(387.5)	(103.6)	67.1	(1,072.6)	(808.0)
1990	1991	Sangar	290.7	193.1	199.9	232.3	252.8	294.1	1,463.0	870.3	192.8	40.7	36.0	34.2	45.2	1,219.1	2,682.1
		Manjil	77.9	43.7	140.0	170.7	163.3	46.1	641.7	735.7	496.7	472.3	354.8	223.1	82.7	2,365.3	3,007.0
		S-M	212.8	149.4	59.9	61.6	89.5	248.0	821.3	134.6	(303.9)	(431.6)	(318.8)	(188.9)	(37.5)	(1,146.2)	(324.9)
1991	1992	Sangar	152.9	181.9	265.6	245.0	178.4	258.2	1,282.1	956.9	1,544.8	861.4	333.3	295.2	335.9	4,327.5	5,609.5
		Manjil	180.4	127.5	228.5	187.4	78.7	122.0	924.5	659.2	2,129.3	1,293.8	670.1	546.5	329.4	5,628.3	6,552.8
		S-M	(27.5)	54.4	37.1	57.6	99.7	136.2	357.6	297.7	(584.5)	(432.4)	(336.8)	(251.3)	6.5	(1,300.8)	(943.3)
1992	1993	Sangar	324.1	160.2	368.6	361.3	316.5	345.1	1,875.8	379.0	789.0	356.8	285.7	105.8	455.1	2,371.5	4,247.3
		Manjil	76.7	198.8	340.9	324.5	163.2	89.4	1,193.5	525.4	1,066.3	671.0	582.9	402.6	105.7	3,353.9	4,547.4
		S-M	247.4	(38.6)	27.7	36.8	153.3	255.7	682.3	(146.4)	(277.3)	(314.2)	(297.2)	(296.8)	349.4	(982.4)	(300.1)
1993	1994	Sangar	666.3	636.1	1,107.6	1,122.5	432.1	839.2	4,803.9	1,355.3	1,135.6	185.1	270.5	146.5	300.8	3,393.8	8,197.7
		Manjil	263.4	339.9	714.8	888.3	306.1	636.0	3,148.5	1,404.1	1,402.6	680.8	483.9	392.9	255.4	4,619.7	7,768.2
		S-M	402.9	296.2	392.8	234.2	126.0	203.2	1,655.4	(48.8)	(267.0)	(495.7)	(213.4)	(246.4)	45.4	(1,225.9)	429.5
1994	1995	Sangar	142.5	1,024.3	1,288.8	301.1	508.2	367.1	3,632.1	273.9	1,040.9	327.7	146.2	199.3	210.5	2,198.5	5,830.5
		Manjil	150.8	725.5	1,081.8	177.6	391.4	134.8	2,661.9	535.4	1,432.1	822.6	597.0	421.3	188.6	3,997.0	6,658.9
		S-M	(8.3)	298.8	207.0	123.5	116.8	232.3	970.2	(261.5)	(391.2)	(494.9)	(450.8)	(222.0)	21.9	(1,798.5)	(828.4)
1995	1996	Sangar	406.6	266.8	332.4	333.8	442.7	328.5	2,110.7	1,261.2	1,207.1	258.2	70.3	99.9	113.7	3,010.4	5,121.1
		Manjil	171.8	277.8	280.1	234.0	151.7	120.8	1,236.2	968.6	1,583.1	691.0	560.9	347.6	186.5	4,337.7	5,573.9
		S-M	234.8	(11.0)	52.3	99.8	291.0	207.7	874.5	292.6	(376.0)	(432.8)	(490.6)	(247.7)	(72.8)	(1,327.3)	(452.8)
1996	1997	Sangar	306.7	365.7	263.7	263.8	168.7	261.1	1,629.6	155.3	50.4	49.8	100.1	55.6	510.3	921.5	2,551.1
		Manjil	192.6	265.8	228.8	219.2	133.1	74.1	1,113.6	199.9	514.3	448.8	243.0	173.2	37.0	1,616.2	2,729.8
		S-M	114.1	99.9	34.9	44.6	35.6	187.0	516.0	(44.6)	(463.9)	(399.0)	(142.9)	(117.6)	473.3	(694.7)	(178.7)
1997	1998	Sangar	148.8	335.9	363.9	238.8	307.0	473.4	1,867.8	760.8	391.4	116.4	73.5	118.9	254.2	1,715.2	3,583.0
		Manjil	57.9	195.6	164.6	70.6	140.1	252.9	881.7	1,028.0	855.1	602.7	517.7	274.4	149.6	3,427.5	4,309.2
		S-M	90.9	140.3	199.3	168.2	166.9	220.5	986.1	(267.2)	(463.7)	(486.3)	(444.2)	(155.5)	104.6	(1,712.3)	(726.2)
1998	1999	Sangar	293.2	215.6	252.1	124.6	51.4	33.2	970.2	45.3	56.5	26.4	18.1	9.9	60.1	216.2	1,186.4
		Manjil	188.9	143.1	146.6	70.9	11.1	5.9	566.5	59.6	308.6	288.6	66.6	36.2	18.9	778.5	1,345.0
		S-M	104.3	72.5	105.5	53.7	40.3	27.3	403.7	(14.3)	(252.1)	(262.2)	(48.5)	(26.3)	41.2	(562.3)	(158.6)
平均		Sangar	283.6	355.5	459.7	347.7	284.9	348.8	2,080.2	638.1	682.3	230.7	142.6	135.8	255.6	2,085.1	4,165.2
		Manjil	151.7	251.2	356.0	254.0	154.5	159.7	1,327.0	633.0	1,049.0	652.6	455.6	321.4	155.7	3,267.4	4,594.4
		S-M	131.9	104.3	103.8	93.7	130.4	189.1	753.2	5.0	(366.7)	(421.9)	(313.1)	(185.6)	99.9	(1,182.3)	(429.1)

Source: Sangar Weir: Astaneh Gauging Station (17-057)、 Manjil Dam: Pandam Study Report (Vol.4)

2.2.9 Monthly Water Level and Discharge in Taleghan Dam

Monthly water level and the discharge from the Taleghan Dam is shown in Table 2.2.12.

Table 2.2.12 Monthly Water Level and Discharge in Taleghan Dam

No.	Date	Reservoir volume (MCM)	Reservoir elevation (m)	Outflow from start of water year (MCM)	Total outflow (MCM)	Outflow (MCM)									Inflow from start of water year (MCM)	Inflow		Iranian Date
						Spillway	Evaporation	Leakage	Drainage	Intake	Pumping	Bottem outlet	Turbine	For Water Use (MCM)		Volume (MCM)	Inflow Discharge (m3/s)	
2006	Apr	136.90	1,748.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.35	80.35	80.35	47.60	850131
	May	240.75	1,762.61	43.46	43.46	0.00	0.00	0.00	0.00	43.46	0.00	0.00	0.00	152.30	232.64	152.30	50.40	850230
	Jun	273.15	1,766.17	99.87	56.41	0.00	0.00	0.00	0.00	56.41	0.00	0.00	0.00	87.60	320.25	87.60	22.10	850331
	Jul	263.23	1,765.08	142.26	43.51	0.00	0.00	0.00	0.00	43.51	0.00	0.00	0.00	36.11	355.72	36.11	7.50	850431
	Aug	245.94	1,763.18	172.97	30.72	0.00	0.00	0.00	0.00	30.72	0.00	0.00	0.00	15.90	372.54	15.90	4.50	850531
	Sep	229.47	1,761.37	198.86	25.88	0.00	0.00	0.00	0.00	25.88	0.00	0.00	0.00	11.16	383.69	11.16	4.00	850631
	Oct	225.92	1,760.98	13.84	13.84	0.00	0.00	0.00	0.00	13.84	0.00	0.00	0.00	11.72	11.71	11.72	12.00	850730
	Nov	253.95	1,764.06	27.10	13.26	0.00	0.00	0.00	0.00	13.26	0.00	0.00	0.00	40.29	52.00	40.29	9.40	850830
	Dec	252.04	1,763.85	44.01	16.92	0.00	0.00	0.00	0.00	16.92	0.00	0.00	0.00	14.56	66.55	14.56	4.95	850930
2007	Jan	256.86	1,764.38	49.48	5.47	0.00	0.00	0.00	0.00	5.47	0.00	0.00	0.00	10.66	77.22	10.66	3.29	851030
	Feb	264.23	1,765.19	54.87	5.38	0.00	0.00	0.00	0.00	5.38	0.00	0.00	0.00	13.43	90.64	13.43	5.38	851130
	Mar	283.25	1,767.28	57.28	2.42	0.00	0.00	0.00	0.00	2.42	0.00	0.00	0.00	22.23	112.87	22.23	10.78	851229
	Apr	377.10	1,776.17	63.11	0.92	0.00	0.00	0.00	0.00	0.92	0.00	0.00	0.00	4.98	213.20	4.98	57.64	860131
	May	419.44	1,779.95	253.19	190.08	89.52	0.00	0.00	0.00	60.22	0.00	20.74	19.61	221.29	434.49	221.29	60.00	860231
	Jun	415.97	1,779.64	400.00	146.82	2.91	0.00	0.00	0.00	80.66	0.00	27.66	35.60	112.50	546.98	112.50	25.29	860331
	Jul	411.04	1,779.20	449.33	49.33	0.00	0.00	0.00	0.00	49.33	0.00	0.00	0.00	42.97	589.95	42.97	10.47	860431
	Aug	379.79	1,776.41	501.85	52.52	0.00	0.00	0.00	0.00	52.52	0.00	0.00	0.00	20.07	610.02	20.07	5.83	860531
	Sep	348.66	1,773.63	542.51	40.67	0.00	0.00	0.00	0.00	40.67	0.00	0.00	0.00	11.53	621.55	11.53	3.70	860631
	Oct	334.54	1,772.37	21.37	21.36	0.00	0.00	0.00	0.00	21.36	0.00	0.00	0.00	11.17	11.16	11.17	4.60	860730
	Nov	307.18	1,769.91	51.41	30.04	0.00	0.00	0.00	0.00	30.04	0.00	0.00	0.00	8.25	19.42	8.25	3.78	860830
	Dec	307.00	1,769.89	63.53	12.11	0.00	0.00	0.00	0.00	12.11	0.00	0.00	0.00	14.68	33.48	14.68	7.10	860930
2008	Jan	311.92	1,770.35	67.68	4.15	0.00	0.00	0.00	0.00	4.15	0.00	0.00	0.00	11.53	45.01	11.53	3.30	861030

Source: WRMC

2.2.10 Development Stage and Construction Cost

According to the WRMC's information, development stage and construction cost for main dams are shown in Table 2.2.13.

Table 2.2.13 Development Stage and Construction Cost

No.	Dams/ Reservoirs	Phase	Province	Beneficial Reach	Purpose	Basin Area (km^2)	Dam Type	Dam Height (m)	Irigation Area (ha)			Project Cost (million Rls.)		
									Development	Improvement	Total	Dam	Irrigation (Main and Secondary)	Estimated Year
1	Manjil	4	Gilan	-	Multi-purpose	56,200	Concrete	86.0	-	-	0	4,500	3,400	1961
2	Golblakh	4	Kordestan	44	Irrigation	250	Earth	24.0	800	0	800	17,000	25,000	1998
3	Aydughmush	4	East Azarbyjan	11	Irrigation	1,625	Rockfill	67.0	13,700	1,300	15,000	350,000	1,125,000	2005
4	Sahand	4	East Azarbyjan	60	Irrigation	820	Rockfill	46.0	10,300	600	10,900	400,000	672,000	2005
5	Taleghan	4	Tehran	out of basin	Multi-purpose	828	Rockfill	103.0	-	-	0	1,751,000	-	2006
6	Taham	4	Zanjan	20	Multi-purpose	161	Earth	118.0	0	400	400	53,393	-	unknown
7	Golabar	3	Zanjan	30	Irrigation	1,131	Rockfill	82.0	7,900	1,400	9,300	302,326	324,000	2007
8	Garmichay	3	East Azarbyjan	6	Irrigation	344	Earth	60.0	2,300	1,200	3,500	570,400	324,000	2007
9	Kalghan	3	East Azarbyjan	60	Irrigation	203	Earth	65.0	1,500	1,090	2,590	264,500	100,000	2007
10	Ostor	3	East Azarbyjan	61	Multi-purpose	42,600	Concrete	135.0	6,500	0	6,500	1,434,510	850,000	2007
11	Talvar	3	Zanjan	66	Irrigation	6,441	Rockfill	85.0	29,500	0	29,500	1,136,461	887,000	2007
18	Befrajerd	3	Ardebil	61	Domestic	39	Earth	45.4	0	0	0	100,000	-	2007
12	Siazakh	3	Kordestan	41	Irrigation	1,058	Rockfill	84.0	21,246	754	22,000	615,000	1,390,000	2007
13	Sange Siah	3	Kordestan	47	Irrigation	255	Earth	41.0	3,400	0	3,400	200,000	200,000	2007
14	Sural	3	Kordestan	47	Irrigation	48	Rockfill	45.0	1,008	192	1,200	95,000	68,000	2007
15	Givi	3	Ardebil	3	Irrigation	600	Earth	79.0	6,300	927	7,227	539,965	528,000	unknown
16	Shafreh Bijar	3	Gilan	-	Domestic	242	Rockfill	94.5	0	0	0	406,783	-	2003
17	Mushampa	2	Zanjan	17	Multi-purpose	24,860	Earth	124.0	26,000	4,000	30,000	1,639,193	2,600,000	2006
19	Ramin	2	Zanjan	27	Multi-purpose	67	Rockfill	63.0	0	196	196	160,000	5,000	2007
20	Babakhan	2	Kordestan	35	Irrigation	924	Rockfill	59.0	5,950	50	6,000	300,000	225,882	2007
21	Sheikh Besharat	2	Kordestan	35	Irrigation	451	Earth	39.0	0	1,500	1,500	213,101	100,000	2007
22	Alehdare	2	Kordestan	41	Irrigation	96	Rockfill	44.5	0	2,100	2,100	52,000	97,552	2007
23	Mehtar	2	Zanjan	20	Irrigation	128	Earth	40.0	900	100	1,000	85,000	6,696	2007
24	Ghezel Tapeh	2	Zanjan	20	Irrigation	75	Earth	57.0	450	108	558	52,000	4,000	2007
25	Alan	2	Hamedan	66	Irrigation	67	Earth	33.0	90	310	400	60,000	1,700	2007
26	Sir	1	Kordestan	37	Irrigation	444	Earth	58.0	6,000	0	6,000	122,612	200,000	2007
27	Zardekamar	1	Kordestan	37	Irrigation	2,075	Earth	40.0	5,000	2,500	7,500	400,000	200,000	2007
28	Hasankhan	1	Kordestan	44	Domestic	2,485			0	0	0	90,000	-	2007
29	Mendagh	1	Zanjan	66	Irrigation	33	Earth	40.0	9,000	0	9,000	110,724	263,411	2002
30	Songhor	1	Zanjan	30	Irrigation	102	Earth	42.0	900	900	1,800	120,000	90,000	2005
31	Chesb	1	Zanjan	66	Irrigation	135	Earth	45.5	912	270	1,182	100,000	19,290	2005
32	Sangabad	1	Ardebil	3	Irrigation	61	Earth	57.0	1,625	600	2,225	77,153	80,000	2007
33	Niakhoram	1	Ardebil	61	Irrigation	76	Earth	57.0	675	225	900	71,200	22,500	2007
34	Tabrizak	1	Ardebil	3	Irrigation	600	Earth	51.0	450	150	600	26,800	15,000	2007
35	Hashtjin	1	Ardebil	61	Irrigation	49	Earth	38.0	600	150	750	42,000	18,000	2007
36	Burmanak	1	Qazvin	21	Irrigation	282	Earth		1,079	1,201	2,280	497,000	80,000	2007
37	Almout Weir and Tunnel	1			Irrigation		Concrete	10.0	out of reach	out of reach	out of reach	988,800	332,000	2000

Source: WRMC

2.2.11 Average Monthly River Discharge in Gilan Province

Monthly average river discharge in Gilan province is shown in pandam Report. This is shown in Table 2.2.14.

Table 2.2.14 Average Monthly River Discharge in Gilan

River	Observation Period	Unit	Average Monthly Discharge												Annual	Note
			Apr.	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		
Sefidrud (Rudbar)	1949-2000	m^3/s	281.89	368.25	216.68	137.29	99.79	61.26	48.64	76.07	90.46	81.18	71.58	118.27		
		MCM	755.01	986.32	580.36	367.72	267.28	164.08	126.07	197.17	234.47	210.42	185.54	296.34	4,370.78	
Tutkaban	1969-2000	m^3/s	10.80	6.00	2.22	1.43	1.20	2.07	2.36	3.13	3.16	2.83	4.15	6.45		
		MCM	28.93	16.07	5.95	3.83	3.21	5.54	6.12	8.11	8.19	7.34	10.76	16.16	120.21	
Siyahrud	1974-1989	m^3/s	4.48	2.52	1.77	1.50	1.39	3.10	4.40	3.72	4.03	2.98	3.80	5.01		
		MCM	12.00	6.75	4.74	4.02	3.72	8.30	11.40	9.64	10.45	7.72	9.85	12.55	101.15	
Firerud	1969-1987	m^3/s	1.72	0.76	0.41	0.41	0.61	1.39	1.67	1.83	1.58	1.13	1.52	2.00		
		MCM	4.61	2.04	1.10	1.10	1.63	3.72	4.33	4.74	4.10	2.93	3.94	5.01	39.24	
Zilkirud	1974-2000	m^3/s	9.36	4.89	2.64	3.16	2.45	6.57	9.49	9.54	7.83	6.39	7.47	10.25		Shahr Bijar dam
		MCM	25.07	13.10	7.07	8.46	6.56	17.60	24.60	24.73	20.30	16.56	19.36	25.68	209.09	
Disam	1973-2000	m^3/s	4.72	2.10	1.11	1.20	1.43	4.05	5.50	6.69	6.56	5.15	6.16	6.63		Ghavam weir
		MCM	12.64	5.62	2.97	3.21	3.83	10.85	14.26	17.34	17.00	13.35	15.97	16.61	133.66	
Sefidrud (Astaneh)	1956-2000	m^3/s	248.21	253.42	98.27	41.05	57.86	87.93	100.94	118.79	132.86	108.55	102.10	153.17		Downstream of Sangar weir
		MCM	664.81	678.76	263.21	109.95	154.97	235.51	261.64	307.90	344.37	281.36	264.64	383.78	3,950.91	

Source: The Project of Study on Irrigation and Drainage System Improvement in Gilan Sefidrud River, 2004, Pandam Consulting Engineer

2.2.12 Flow Capacity of Main Canals in SIDN

Pandam Study Report shows the flow capacity of the main canals in SIDN (Sefidrud Irrigation and Drainage Network). Those are shown as in Table Table 2.2.15.

Table 2.2.15 Flow Capacity of Main Canals in SIDN

Canal	Capacity of Canal (m^3/s)	Maximum Monthly Discharge (MCM)						Note
		Apr	May	Jun	Jul	Aug	Sep	
Tarik/Fumanat	32	85.7	85.7	85.7	85.7	85.7	85.7	
Gelerud	25	67.0	67.0	67.0	67.0	67.0	67.0	Plan
	15	40.2	40.2	40.2	40.2	40.2	40.2	Actual
Sangar Left	114	305.3	305.3	305.3	305.3	305.3	305.3	
Sangar Right	67	179.5	179.5	179.5	179.5	179.5	179.5	

Source: The Project of Study on Irrigation and Drainage System Improvement in Gilan Sefidrud River, 2004, Pandam Consulting Engineer

2.2.13 Water Resources Development Projects in Upper Basin of Manjil Dam

In the Mahab Ghodss Study Report, water resources development projects in the upper basin of Manjil dam are summarized as shown in Table 2.2.16. Water resources development projects in each province are shown in Table 2.2.17.to Table 2.2.22.

Table 2.2.16 Water Resources Development Projects in Upper Basin of Manjil Dam

Province	Target Irrigation Area (ha)			Number of Projects			
	Development	Improvement	Total	Operation	Under Consruction	Under Planning	Total
Kurdestan	38,004	8,096	46,100	36	3	6	45
Hamadan	180	620	800	0	0	2	2
Zanjan	80,812	9,570	90,382	22	13	27	62
East Azerbaijan	9,922	47,623	57,545	20	6	8	34
Ardebil	15,021	3,976	18,997	12	1	12	25
Qazvin	1,079	1,201	2,280	0	0	1	1
Tehran	0	0	0	1	0	0	1
Total	145,018	71,086	216,104	91	23	56	170

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

Table 2.2.17 Water Resources Development Projects in Kordestan Province

Reach code	Name of Project	Target Irrigation Area (ha)			Irrigation Efficiency
		Improvement	Development	Total	
34	Sheikh Besharat	1,500	0	1,500	62%
40	Siazakh	754	21,246	22,000	76%
41	Aleh dareh	2,100	0	2,100	70%
42	Zardeh kamar	2,500	5,000	7,500	76%
43	Golbolagh	0	800	800	62%
47	Hasan khan	Drinking Water			
50	Sural	192	1,008	1,200	73%
64	Babakhan	50	5,950	6,000	62%
65	Sir	No information			
	35 diversion weir	1,000	600	1,600	62%
Total		8,096	38,004	46,100	

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

Table 2.2.18 Water Resources Development Projects in East Azerbaijan Province

Name of Project	Target Irrigation Area (ha)			Irrigation Efficiency
	Improvement	Development	Total	
Kalghan	1,090	1,500	2,590	60%
Ashnar		150	150	50%
Aidamir		63	63	50%
Someh Kaboodin	152		152	45%
Kazarj	68	100	168	50%
Kandovan Mianeh		150	150	50%
Lands replaced with Ostur	0	12,000	12,000	65%
Aidughmoosh	1,240	12,630	13,870	64%
Sahand	600	10,300	10,900	66%
Someh Oliya	200	400	600	60%
Yalghoooz Aghaj	170	330	500	60%
Jair - Noruz abad		7,000	7,000	64%
Avin		100	100	45%
Khoramdargh	300		300	64%
Ishlandeh			0	45%
Avanligh	300		300	45%
Baranligh Hoseinkhan		200	200	45%
Baranligh Madad khan		120	120	45%
Turkmanchai	87		87	45%
Toshmanlu	120	120	240	45%
Zarankesh	50		50	45%
Songhor abad	50		50	45%
Someh Sofla	75		75	45%
Farahieh	60		60	45%
Qara Bulagh	20		20	45%
Kah	60		60	45%
Mahi abad	80	60	140	45%
Munegh		100	100	45%
Germi Chai	1,200	2,300	3,500	45%
9 Small scale development pla	4,000		4,000	45%
Total	9,922	47,623	57,545	

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

Table 2.2.19 Water Resources Development Projects in Hamedan Province

Reach Code	Name of Project	Target Irrigation Area			Irrigation Efficiency
		Improvement	Development	Total	
49	Alan	310	90	400	62%
49	Ghahvard	310	90	400	60%
Total		620	180	800	

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

Table 2.2.20 Water Resources Development Projects in Qazvin Province

Reach Code	Name of Project	Target Irrigation Area			Irrigation Efficiency
		Improvement	Development	Total	
32	Burmanak	1201	1079	2280	52%

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

Table 2.2.21 Water Resources Development Projects in Zanjan Province

Reach Code	Name of Project	Target Irrigation Area			Irrigation Efficiency
		Improvement	Development	Total	
31	Mehtar	100	900	1,000	64%
28	Qezel tapeh	108	450	558	64%
	Bolook & sar-dahat Sheikhlu	0	150	150	69%
22	Mushampa	4,000	26,000	30,000	62%
63	Galabar	1,400	7,900	9,300	67%
24	Taham	Drinking water supply			
	Khandaghlu	Drinking water supply			
	Ramin	Drinking water supply			
66	Talvar	0	23,092	23,092	62%
66	Mandagh	0	9,000	9,000	65%
66	Chesb	270	912	1,182	67%
66	Bizineh rud	92	2,408	2,500	54%
66	Qooi	0	4,000	4,000	71%
	49 small scale plan	3,600	6,000	9,600	50%
Total		9,570	80,812	90,382	

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

Table 2.2.22 Water Resources Development Projects in Ardebil Province

Reach Code	Name of Project	Target Irrigation Area			Irrigation Efficiency
		Improvement	Development	Total	
1	Zavieh Kord	250	170	420	65%
61	Khalkhal Zarj abad	200	200	400	65%
14	Bafrajerd	lack of information (Drinking water supply)			
59	Andebil	30	120	150	57%
7	tabrizak	150	450	600	57%
3	Sakar abad	0	200	200	57%
1	Sang abad	600	1,625	2,225	57%
1	Marasht	94	281	375	57%
12	Nia khoram	225	675	900	57%
15	Hashtjin 1	150	600	750	57%
16	Hashtjin 2	150	600	750	57%
61	Khoresh Rostam water conveyance	0	3,800	3,800	57%
	Ilakhchi	70			35%
	Sakar abad & Peruch Diversion weir	70			57%
	Susahab weir	40			35%
	Finarood weir	70			35%
	Kazaz weir	60			35%
	Mojareh	50			35%
	Pordastlu	70			35%
	Qara Qeshlagh	70			35%
	Garmab	lack of information			
	Likvan	lack of information			
	Kelur Pump station	100		100	35%
	Mazraeh pump station	100		100	35%
	Nahmil Pump station	110		110	35%
	Gazaz weir	60		60	35%
	Gharmkhaneh	120		120	35%
	Nilagh	70		70	35%
	Ganjgah & diversion dam	70		70	35%
	Heris	70		70	35%
59	Givi	927	6,300	7,227	66%
Total		3,976	15,021	18,997	

Source: Initial Phase of the Study for Integrated Water Resources Management in Sefidrud Qezel-Ozan, 2007, Mahab Gohdss

2.2.14 Evaporation in Manjil Dam Reservoir

According to the information submited by WRMC, the evaporation in Manjil Dam reservoir is as shown in Table 2.2.23.

Table 2.2.23 Evaporation in Manjil Reservoir (MCM)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1999-00	0.00	0.00	0.00	0.95	0.61	1.63	3.96	7.54	11.33	6.85	1.94	0.87	35.68
2000-01	0.46	0.15	0.23	0.53	0.84	1.99	4.50	4.90	6.43	1.28	0.60	0.47	22.38
2001-02	0.24	0.18	0.39	0.20	1.05	1.58	0.69	3.28	3.66	4.78	2.41	1.41	19.87
2002-03	-	-	-	-	-	-	0.00	0.00	2.09	0.00	0.98	0.00	3.07
2003-04	0.00	0.01	0.00	0.00	0.29	0.61	0.83	2.32	1.70	2.74	5.74	2.49	16.73
2004-05	0.00	0.00	0.05	0.14	0.26	1.09	3.12	3.58	5.74	4.97	6.18	3.85	28.98
2005-06	1.43	0.77	0.68	0.47	0.96	2.94	4.64	5.48	10.71	9.46	5.77	3.04	46.35
2006-07	1.40	1.06	0.44	0.65	1.13	1.13	2.97	6.26	11.48	8.90	7.38	4.15	46.95
2007-08	1.82	1.09	0.78	0.29	0.73								
Average	0.67	0.41	0.32	0.40	0.73	1.57	2.59	4.17	6.64	4.87	3.88	2.04	28.29

Source: WRMC

2.2.15 Water Level of Manjil Reservoir in Spring Season

According to the information submited by WRMC, water level of Manjil Dam reservoir in spring season is shown in Table 2.2.24.

Table 2.2.24 Water Level of Manjil Dam Reservoir in Spring Season

Date		1378/79 1999/00	1379/80 2000/01	1380/81 2001/02	1381/82 2002/03	1382/83 2003/04	1383/84 2004/05	1384/85 2005/06	1385/86 2006/07	1386/87 2007/08
April	1	252.75	265.13	260.01	260.86	265.59	269.33	265.32	270.23	259.93
	2	253.06	265.53	260.25	261.25	265.95	269.75	265.71	270.50	260.33
	3	253.43	265.92	260.47	261.72	266.26	270.10	266.12	270.81	260.77
	4	253.81	266.28	260.67	262.34	266.75	270.30	266.50	271.08	261.33
	5	254.13	266.36	260.86	262.89	267.40	270.57	266.78	271.33	260.86
	6	254.40	267.06	261.05	263.35	268.15	270.95	267.00	271.55	262.35
	7	254.63	267.44	261.25	263.78	268.87	271.20	267.20	271.71	262.84
	8	254.89	267.76	261.47	264.24	269.43	271.50	267.36	271.81	263.33
	9	255.13	268.06	261.75	264.70	269.88	271.77	267.48	271.88	263.96
	10	255.35	268.44	262.01	265.07	270.18	271.84	267.58	271.93	264.93
	11	255.56	268.82	262.26	265.39	270.46	271.91	267.69	271.99	265.91
	12	255.60	269.10	262.49	265.79	270.81	271.94	267.81	272.02	266.78
	13	255.61	269.21	262.67	266.13	271.16	271.94	267.94	272.04	267.63
	14	255.59	269.30	262.84	266.43	271.53	271.93	268.08	272.02	268.12
	15	255.57	269.35	262.99	266.72	272.01	271.92	268.28	272.00	268.68
	16	255.55	269.39	263.13	267.01	272.50	271.91	268.66	271.97	269.08
	17	255.46	269.45	263.26	267.35	272.74	271.93	269.20	271.99	269.53
	18	255.27	269.47	263.38	267.78	272.79	272.00	269.58	272.12	270.09
	19	255.05	269.48	263.30	268.51	272.84	272.06	269.86	272.26	270.61
	20	255.78	269.50	263.07	269.18	272.93	272.07	270.06	272.32	271.16
	21	254.58	269.45	262.80	269.61	273.04	272.08	270.25	272.35	271.70
	22	254.43	269.50	262.54	270.10	273.11	272.13	270.42	272.35	272.10
	23	254.38	269.63	262.23	270.50	273.12	272.24	270.57	272.33	272.42
	24	254.33	269.73	261.85	270.77	273.05	272.34	270.68	272.32	272.55
	25	254.26	269.80	261.51	270.97	273.01	272.62	270.79	272.32	272.64
	26	254.06	269.81	261.11	271.23	273.07	272.73	270.95	272.40	272.71
	27	253.85	269.76	260.70	271.41	273.17	272.71	271.15	272.48	272.76
	28	253.60	269.67	260.25	271.51	273.34	272.64	271.35	272.49	272.78
	29	253.34	269.55	259.85	271.62	273.43	272.57	271.50	272.40	272.77
	30	253.05	269.39	259.42	271.73	273.30	272.51	271.56	272.40	272.77
May	1	252.73	269.16	259.05	271.83	273.17	272.47	271.58	272.35	272.90
	2	252.41	268.96	258.75	271.87	273.02	272.44	271.60	272.29	272.94
	3	252.09	268.73	258.52	271.90	272.97	272.56	271.66	272.25	272.94
	4	251.75	268.51	258.39	271.97	272.91	272.60	271.75	272.22	272.90
	5	251.41	268.33	258.17	272.02	272.85	272.58	271.85	272.23	272.88
	6	251.06	268.22	257.94	272.05	272.80	272.55	271.96	272.30	272.85
	7	250.71	268.19	257.69	272.04	272.77	272.52	272.04	272.36	272.84
	8	250.39	268.12	257.39	272.03	272.74	272.49	272.06	272.38	272.80
	9	250.23	268.02	257.09	272.02	272.71	272.49	272.07	272.37	272.74
	10	250.37	267.94	256.71	272.02	272.63	272.42	272.07	272.35	272.69
	11	250.24	267.86	256.37	272.05	272.58	272.40	272.03	272.33	272.68
	12	249.98	267.79	256.01	272.04	272.54	272.37	271.98	272.30	272.65
	13	249.65	267.68	255.56	272.03	272.52	272.28	271.95	272.26	272.63
	14	249.33	267.47	255.22	272.02	272.50	272.22	271.97	272.21	272.62
	15	249.11	267.17	254.85	272.01	272.48	272.19	271.96	272.16	272.63

Source: WRMC

2.2.16 General Specification of Major Dams

1) Manjil Dam

Manjil Dam is at 200 km of Tehran northwestern and 100 km Caspian Sea lower than Manjil confluence of Ghezelozan and Shahrud rivers. The water source of Qezel Ozan is from Azerbaijan and Kordestan mountains with 2,000 m^3/s of maximum discharge and 50 L/s of minimum. Length of Ghezelozan river is about 500 km. The water source of Shahrud is located at Almout-Taleghan Mountains with 800 m^3/s of maximum discharge and 4.2 L/s of minimum. The type of Manjil Dam is buttress concrete, with 1.8 billion m^3 capacity designed and performed by Saser French Company and from year of 1962 exploit for irrigation and flood control.

Table 2.2.25 General Specification of Manjil Dam

No.	Item	Specification
1	Dam type	Buttress concrete gravity
2	Spillway type	Uncontrolled morning glory
3	Dam crest elevation	277.06 m
4	Reservoir surface area in max figures	56 km^2
5	Dam crest length	425 m
6	Dam height	106 m
7	River bed elevation	86 m
8	Dam width in foundation	106 m
9	Reservoir primary volume	1,765 MCM
10	Lake transgression in branch of Qezel Ozan	25 km
11	Lake transgression in branch of Shahrud	13 km
12	Power plant's nominal power generation	87.5 MWH
13	Number of turbines	5 Unit
14	Discharge from two left bottom gate	272 m3/s x 2gates
15	Discharge from three right bottom gate	142 m3/s x 3gates
16	Discharge from two middle bottom gate	1,000 m3/s x 2gates
17	Discharge from two uncontrolled spillway	1,500 m3/s x 2unit
18	Maximum discharge from spillway	6,200 m^3/s
19	Contractor	Saser
20	Counselor	Otko and Afar
21	Supervision	Oshtoki

2) Taleghan Dam

The construction of the Taleghan Dam is begun in 2002 at the upstream of the Shahrud River and has been completed in 2006. The general specifications of dam are shown in Table 2.2.26 and Table 2.2.27.

Table 2.2.26 General Specification of Taleghan Dam (1/2)

Item	Description	Specification
Hydrology and meteorology	Catchment area	960 km^2
	Average annual precipitation	478.30 mm
	Average annual evaporation	1,837.20 mm
	Average discharge at dam site	15.81 m^3/s
	Average annual discharge at dam site	499 MCM
	Probable maximum flood	3,700 m^3/s
	1/10,000 year flood discharge	1,791 m^3/s
	1/1,000 year flood discharge	971 m^3/s
	1/500 year flood discharge	803 m^3/s
	1/100 year flood discharge	512 m^3/s
	1/50 year flood discharge	415 m^3/s
	1/20 year flood discharge	313 m^3/s
	Maximum observed flood	345 m^3/s
	Mean carryover temperature	10.80 ℃
	Mean carryover maximum temperature	17.20 ℃
	Mean carryover minimum temperature	2.85 ℃
	1/100 year design wind speed	44.60 m/s
	1/50 year design wind speed	40.90 m/s
Reservoir and Water management	Maximum probable flood level (2,040 m3/s)	1,787.35 m
	1/10,000 year flood level (774 m3/s)	1,784.50 m
	1/1,000 year flood level (442 m3/s)	1,782,80 m
	Normal water storage level	1,780.00 m
	Minimum water level	1,742.00 m
	Average carryover inflow sediment	1.25 MCM
	Estimate elevation for 50 year sedimentation	1,708.30 m
	Estimate elevation for 100 year sedimentation	1,712.00 m
	Reservoir area at N.W.L	12.20 km^2
	Total storage capacity	516 MCM
	Corresponding storage capacity at N.W.L	420 MCM
	Active storage capacity	320 MCM
	Dead storage capacity	100 MCM
	Average total water supply	460 MCM
	Water consumption for Irrigation	278 MCM
	Water consumption for Municipal living	150 MCM
	Water for artificial recharge to groundwater	20 MCM
	Water rights	12 MCM

Table 2.2.27 General Specification of Taleghan Dam (2/2)

Item	Description	Specification
Dam and foundation	Foundation characteristics	Sedimentary rock
	Crest elevation	1,789.00 m
	Crest length	1,111.00 m
	Crest width	12.00 m
	Maximum height from river bed	109.00 m
	Maximum bottom width	636.90 m
	Upstream and downstream dam slope	1: 2.0-1:2 .5 (V/H)
	Crest elevation of clay core	1,788.00 m
	Crest width of clay core	4.00 m
	Maximum bottom width of clay core	55.00 m
	Upstream and downstream slope of core	1:0.25 (V/H)
	Crest elevation of concrete cut-off wall	1,693.50 m
	Depth of concrete cut-off wall	50.00 m
	Width of concrete cut-off wall	1.00 m
	Maximum depth of curtain grouting	80.00 m
Diversion tunnel & bottom outlet	Inlet elevation of diversion tunnel	1,690.00 m
	Internal section diameter (horse-shoe type)	6.00 m
	Total length of diversion tunnel	828.40 m
	Cavern length	649.40 m
	Bottom slope	1.55%
	Inlet elevation of bottom outlet	1,720.00 m
	Maximum discharge of water release	244.50 m^3/s
	Inlet bulkhead gate	5.2x5.2 m
	Internal section diameter of inclined shaft	5.20 m
	Total length of bottom outlet	707.09 m
	Cavern length	633.09 m
	Emergency bulkhead gate	2.8x3.0 m
Ungated spillway	Release discharge of PMF flood	2,040.00 m^3/s
	Corresponding downstream water level	1,687.40 m
	Release discharge at 1/1,000 year flood	410.00 m^3/s
	Corresponding downstream water level	1,681.70 m
	Elevation of approach channel	1,774.00 m
	Net width of approach channel	51.00 m
	Overflow weir crest elevation	1,780 m
	Net length of overflow weir crest	3 x 16.00 m
	Total length of spillway	921.07 m
	Length of chute	300.86 m
	Bottom elevation of stilling basin	1,670.00 m
	Dimensions of stilling basin (length x width)	64.55x40.00 m

3) Ostor Dam

Ostor (Shahryar) Dam has been under construction since 2001 on the Qezel Ozan River. The general specifications of dam are shown in Table 2.2.28.

Table 2.2.28 General Specification of Ostor Dam

No.	Item	Specification
1	Dam type	Double curvature concrete dam
2	Dam crest elevation	1,045.0 m
3	Normal operation water level	1,035.0 m
4	Minimum operation water level	1,020.0 m
5	Exceptional operation water level	1,037.0 m
6	Maximum flood water level (PMF)	1,044.8 m
7	Reservoir volume at N.W.L	700 MCM
8	Active reservoir storage	451 MCM
9	Reservoir volume at L.W.L	249 MCM
10	Dam height	106 m
11	Dam crest length	180 m
12	Crest width	5 m
13	Volume of concrete	240,000 m^3
Crest spillway		
14	Location	on the central part of crest
15	Number of bay	6
16	Width of bay	15.0 m
17	Elevation of ogee crest	1,035.0 m
Gated spillway		
18	Location	Right bank
19	Number of bay	3
20	Width of bay	15.0 m
21	Elevation of ogee crest	1,024.0 m
22	Type of gate	Radial
23	Dimension of gates	13.50 x 15.0 m (h x w)
24	Elevation of gate crest	1,037.5 m

4) Bijar Dam

Bijar Dam is located 8 km from Shahreh Bijar and about 35 km from Rasht. Main purpose of Bijar dam is drinking water supply for Rasht, Astaneh, Lahijan, Langerud and Anzali. The general specifications of dam are shown in Table 2.2.29.

Table 2.2.29 General Specification of Bijar Dam

Item	Description	Specification
Reservoir	River name	Zilki
	Elevation of riverbed	140.0 m
	Total reservoir volume	104.63 MCM
	Annual supply water volume	165.00 MCM
	Catchment area	242.0 km^2
	Reservoir surface area at N.W.L	3.44 km^2
	Annual average inflow	207.5 MCM
	Annual sedimentation volume	400,000 m^3/year
	Probable maximum flood (PMF)	1,700 m^3/s
	Maximum observed flood	162.8 m^3/s
	50 year sedment volume	1.25 MCM
Dam	Dam type	Rockfill with concrete facing
	Dam height from river bed	79.5 m
	Dam height from foundation	94.5 m
	Crest length	434.0 m
	Crest width	10.0 m
	Road width on crest	6.45 m
	Elevation of crest	219.5 m
	Cofferdam volume	178,500 m^3
	Total dam volume	3,955,100 m^3
Spillway	Spillway type	Uncontrolled (Free spillway)
	Design discharge	844.0 m^3/s
	Location	Right bank
	Crest elevation	212.6 m
	Spillway width	40.0 m
	Chute type	Stair type
	Chute length	200.0 m
	Stilling basin type	USBR III
	Elevation of stilling basin	134.6 m
Diversion tunnel	Tunnel location	Left bank
	Total length	611.7 m
	Inner diameter of tunnel (horse shoe)	3.8 m
	Inlet elevation	143.5 m
	Outlet elevation	139.2 m
	Maximum design discharge (25 year probable)	110.0 m^3/s
Intake facilities	Intake type	Shaft in 3 level
	Intake shaft height	61.0 m
	Maximum discharge of urban penstock	6.4 m^3/s
	Length of penstock for power plant	280.0 m
	Diameter of penstock for power plant	1.90 m
	Maximum discharge of power plant	9.9 m^3/s
	Intake level	187.0, 169.5 and 156.5 m
Bottom outlet	Inlet elevation	150.0 m
	Maximum discharge	48.0 m^3/s

5) Golabar Dam

Golabar Dam is located in 55 km southwestern Zanjan and is currently under construction on Sojas River. According to the Tehran Times (Apr. 2009), construction of dam was 70% completed, and construction of irrigation and drainage networks was in 25% progress. Approximately, 320 billion rials has been spent for the construction presently. The general specifications of dam are shown in Table 2.2.30.

Table 2.2.30 General Specification of Golabar Dam

Item	Description	Specification
Reservoir	River name	Sojas
	Total reservoir volume	116 MCM
	Active reservoir volume	82 MCM
	Dead reservoir volume	46 MCM
	Catchment area	1,131 km^2
	Reservoir surface area at N.W.L	10.1 km^2
	Annual average inflow	75 MCM
	Annual rainfall	313 mm
	Average river discharge	2.39 m^3/s
Dam	Dam type	Earthfill
	Dam height from river bed	55 m
	Dam height from foundation	82 m
	Crest length	247 m
	Crest width	12 m
Spillway	Spillway type	Free spillway
	Design discharge	308 m^3/s
	Location	Right bank
	Crest elevation	1,704.5 m
	Spillway width	30 m
	Chute length	150 m
	Width of chute	30-20 m
	Stilling basin length	85 m
	Width of stilling basin	20 m
	Elevation of stilling basin	1,641.0 m
Diversion tunnel	Tunnel location	Right bank
	Total length	304 m
	Inner diameter of tunnel	4.5 m
	Maximum design discharge	72 m^3/s
Intake facilities	Intake type	Lower Shaft
	Intake shaft height	20 m
	Diameter of shaft	4.5 m
	Maximum discharge of power plant	77 m^3/s

6) Mushampa Dam

Mushampa reservoir dam is located in 116km west of Zanjan city and 5 km is currently under tendering stage. The main purposes of the dam are irrigation, domestic water supply and hydropower generation. The general specifications of dam are shown in Table 2.2.31.

Table 2.2.31 General Specification of Mushampa Dam

Item	Description	Specification
Reservoir	River name	Qezel Ozan
	Total reservoir volume	700.0 MCM
	Active reservoir volume	328.0 MCM
	Dead reservoir volume	372.0 MCM
	Normal water level (N.W.L)	1,267.0 m
	Low water level (L.W.L)	1,250.0 m
	Catchment area	24,860 km^2
	Annual rainfall	337.6 mm
	Average river discharge	28.46 m^3/s
Dam	Dam type	Rockfill
	Dam height from river bed	100 m
	Dam height from foundation	124 m
	Dam crest elevation	1273.0 m
	Crest length	400 m
	Crest width	10 m
Spillway	Spillway type	Gate type with 4 gates
	PMF glood	9,076.8 m^3/s
	1/10,000 years flood	6,844.4 m^3/s
	1/1,000 years flood	4,358.6 $m^{3/}s$
	1/100 years flood	2,528.3 m^3/s
Diversion tunnel	Location	Right bank
	Diversion system	2 tunnels
	Inner diameter of tunnel	8.0 m
Construction Cost (million Rial)	Reservoir dam	1,005,254
	Irrigation network	2,398,400
	Reservoir damege	61,459
	Hydropower plant	342,100
	Pipeline for drinking water supply	747,322
	Diversion dam	405,726
	Total	4,960,261

7) Talvar Dam

Talvar Dam is located in 25km away from Khanabad village in Talvar Dam. The purposes of dam/reservoir are irrigation and domestic water supply. The general specifications of dam are shown in Table 2.2.32.

Table 2.2.32 General Specification of Talvar Dam

Item	Description	Specification
Reservoir	River name	Talvar
	Total reservoir volume	500.0 MCM
	Active reservoir volume	403.4 MCM
	Dead reservoir volume	96.6 MCM
	Normal water level (N.W.L)	1,642.0 m
	Low water level (L.W.L)	1,618.0 m
	Catchment area	6,441 km^2
	Annual rainfall	347.4 mm
	Average river discharge	9.60 m^3/s
Dam	Dam type	Rockfill
	Dam height from river bed	78 m
	Dam height from foundation	85 m
	Dam crest elevation	1,655.0 m
	Crest length	529 m
	Crest width	12 m
Spillway	Spillway type	Free spillway
	Design flood discharge	737 m^3/s
	Return period of design flood	10,000 year
	Location	Left bank
	Width of spillway	25 m
	Length of chute canal	315 m
Diversion tunnel	Location	Left bank
	Diversion system	2 tunnels
	Inner diameter of tunnel	5.0 m
	Length of tunnel	T-1=650m, T-2=657m
	Design discharge	350 m^3/s (1/50years)

SUPPORTING REPORT

PAPER 3

GROUNDWATER

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

SUPPORTING REPORT

PAPER 3 GROUNDWATER

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Note: The Contents without any reference source were prepared by JICA Study Team.

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CHAPTER 1. TOPOGRAPHY AND GEOLOGY

1.1 TOPOLOGY

The Albultz and Zaglos Mountains are located along the Caspian Sea from east to west and along the Persian Gulf from southeast to northwest respectively. The two mountain ranges meet at the northwestern part of Iran or in East Azerbaijan Province. Damavand Mountain of the Albultz Mountains possesses the highest peak with an elevation of 5,780 meters, and peaks of 3,000 to 4,000 meters continue to the Zaglos Mountains.

The country is divided into six major river basins: Urmia Lake Basin, Caspian Sea Basin, Markazi Basin, Gara Gom Basin, Hamoon Basin, and the Persian Gulf Basin. The Study Area is located in the northwestern part of Iran. The Sefidrud River Basin is classified as a sub-basin of the Caspian Sea Basin.

Table 1.1.1 Major Basins in Iran

Basin	Area (%)	Average Precipitation (mm/year)	Precipitation (%)	Surface Resource (%)	Discharge Resource (%)
Urmia Lake	3.2	370	5.0	7.0	3.3
The Caspian Sea	10.7	430	20.5	20.4	10.6
Markazi	50.9	165	31.8	12.7	44.9
Gara Gom	2.7	142	2.8	1.3	3.4
Hamoon	6.5		3.2	0.8	1.6
Persian Gulf	26.0	366	36.7	57.8	36.0
Total	100	252	100	100	99.8
Total in Iran	1,648,195km^2	-	415km^3/year	-	-

The Study Area extends to 59,090 km^2 and most of it is located between the Albultz Mountains and the Zaglos Mountains. Only Gilan Province is located north of the Albultz Mountains, facing the Caspian Sea. Topographic classifications are shown in Figure 1.1.1. Mountains and hills (hills, plateaus and upper terraces) are dominant in the Study Area. Alluvial layers of Alluvial plains, River Alluvial plains, that may be the most suitable aquifer, distributes only in the river mouth of Sefidrud River. Secondary good aquifer will be terrace deposits that are composed of sand and gravel with clay.

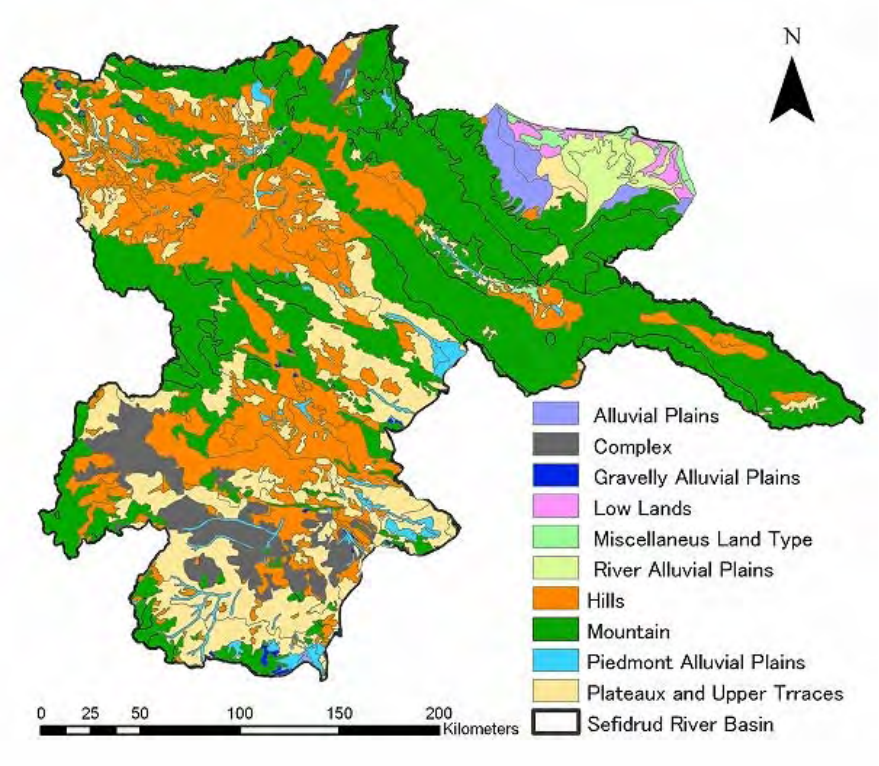


Figure 1.1.1 Topographic map

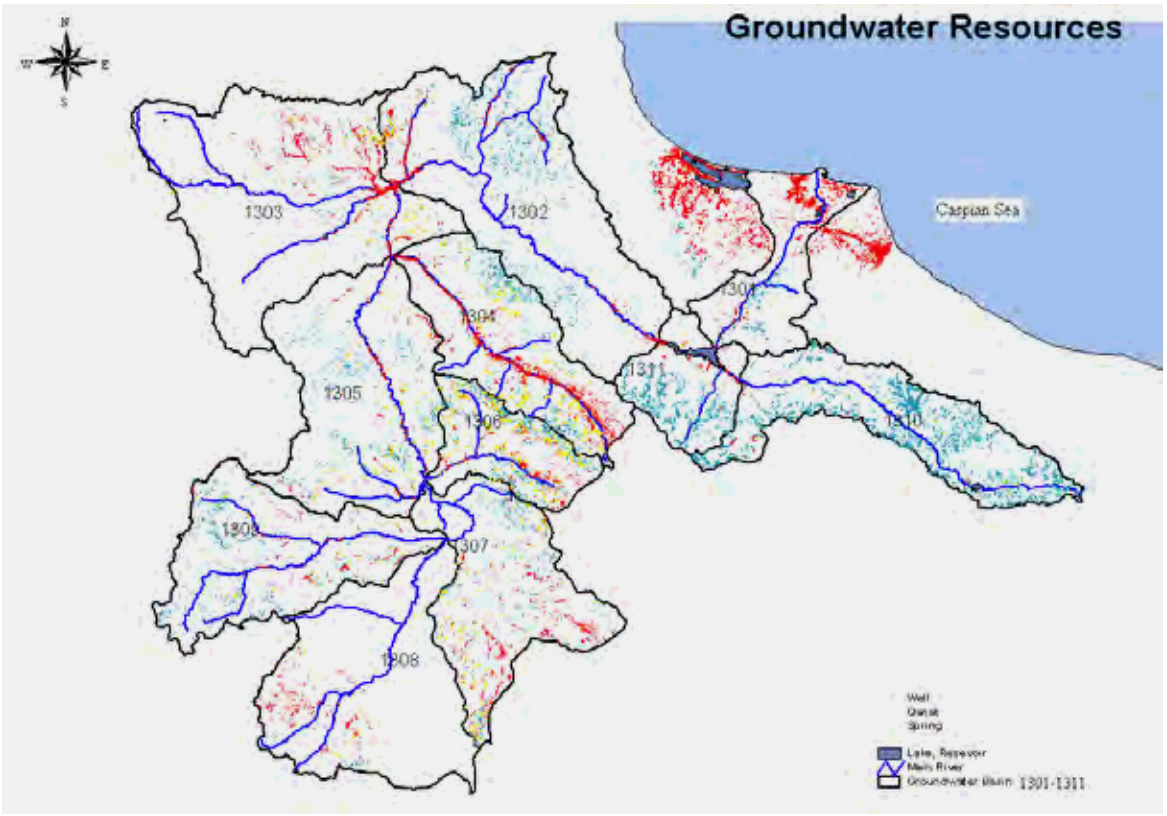


Figure 1.1.2 Classification Map of Groundwater Basin

The Sefidrud River Basin is divided into eleven groundwater basins as shown in Figure 1.1.2. The characteristics of topography in the groundwater basins are summarized in the following table in each basin.

Table 1.1.2 Outline of Topography in the Groundwater Basin

No.	Groundwater Basin		Province	Area (km^2)			Topographic Characteristics
	Name	Code		Total	Plain, Hilly	Mount-ainous	
1	Astaneh-Kuchesfahan	1301	Gilan	1,923	991	932	Highest peak: 2705m & lowest point: -25m. It is facing the Caspian Sea. 39% of the basin is covered by alluvial plains and 52% including fan and hill. Other is mountain topography covering 48% located in the upper part of the basin.
2	Tarum-Khakhal	1302	Ardabil	8,604	1,085	7,519	Mountainous topography. Alluvial topography is limited along the rivers.
3	Miyane	1303	East Azerbaijan	9,226	1,607	7,619	Gentle mountain topography is predominant and mountain is distributed in southwest and northeast in the basin.
4	Zanjan	1304	Zanjan	4,672	2,368	2,304	It is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Mountainous topography is dominant in the basin of 1305.
5	Mahneshan-Anguran	1305	Zanjan	7,172	2,598	4,574	
6	Sujas	1306	Zanjan	2,497	1,715	782	
7	Goltapeh-Zarinabad	1307	Kordestan	5,131	2,093	3,038	It is composed of hilly region and gentle mountain regions.
8	Ghorveh-Dehgulan	1308	Kordestan	7,284	2,807	4,477	It is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Mountainous topography is dominant.
9	Divandareh-Bijar	1309	Kordestan	5,385	2,225	3,160	
10	Taleghan-Alamut	1310	Qazvin	4,864	358	4,506	Mountainous region in Qezel Ozen River with Talegan Dam. Alluvial topography is narrow. Alluvial plain; 7.4%
11	Manjil	1311	Gilan	2,261	192	2,069	Mountainous region with Manjil Dam. Alluvial plain; 8.5%
Others: including of a part of provincial border of Kermansher, West Azerbaijan and Mazandaran				71	0	71	Mountainous topography is dominant
Total Area of the Sefidrud River Basin				**59,090**	**18,039**	**41,051**	
12	Fumanat	1202	Gilan	3,593	1,653	1,940	46% of the basin is covered by alluvial plains facing Caspian Sea with the lowest point of -26m. Other is mountain topography covering 48% with highest peak of 3,100m in Alborz Mountains.
13	Lahijan-Chabuksr	1401	Gilan	3,536	884	2,652	25% of the basin is covered by alluvial plains facing Caspian Sea with the lowest point of -26m. Other is mountain topography covering 75% with the highest peak of 3,900m in Alborz Mountains.
Total of out of Sefidrud River Basin				7,129	2,537	4,592	Adjoin of downstream area
Total of Sefid River Basin & downstream adjoin area				66,219	20,576	45,643	

Source: MG Study Report Vol. 2, with modification by the JICA Study Team

1.2 GEOLOGY

Iran is located on the Eurasian Plate and the border of the Arabian Plate. Zagros Mountains are the Thrust Mountains formed on its border, and this condition may be the cause of earthquake activities in Iran.

The Study Area consists of the plain facing the Caspian Sea and the plateau between the Alborz Mountains and the Zagros Mountains. Pre-Cambrian to present Quaternary deposits is

distributed in the Sefidrud River Basin without the geology of Ordovician period, Silurian period of Palaeozoic era and Paleocene epoch of Cenozoic. General geology in the Sefidrud River Basin is summarized in the following table.

Table 1.2.1 Outline of General Geology in the Sefidrud River Basin

Era	Period/Epoch	Formation/Group	Symbol	Lithology
Cenozoic	**Quaternary**			
	Alluvium	Recent alluvial	Qal	Coastal/Deltaic/levee/Flood plain deposit clay, sand with clay, gravel
0.01*		Terrace & Fan	Qt	sand and gravel with clay
		Loess	Ql	loess
	Pleistocene	High terrace,	-	sand and gravel with clay
2				
	Tertiary	Plio-Pleistcene	Pl	sandstone, conglomerate, marl, tuff
	Pliocene			
	Miocene	Upper red	M	conglomerate, red clay stone, tuff, mudstone with gypsum
		(thickness <100m)	-	marl, conglomerate, coral
	Oligocene	Qom	OMq	Marl, shale, limestone
		Lower red	O	Conglomerate, sandstone, shale, tuff, volcanic
	Eocene	Karaj	Ek	Andesitic lava, tuff, shale
		Limestone	En,	*Nummulitic* limestone
		Ziarat	Ez	Limestone with sandstone & conglomerate
65*		Fajan	Ef	Conglomerate, sandstone,
	Palaeocene	-	-	-
Mesozoic	**Cretaceous**	- (partly Tiz)	K	Sandstone, shale, marly limestone, volcanics
	Jurassic	Lar limestone	J_l	Limestone, partly Dalichai layer
		Shemshak,	Js	Conglomerate, sandstone, shale, quartzite
247*	**Triassic**	Elikah	Trc	Dolomitic limestone, dolomite, sandstone, shale, conglomerate
Palaeozoic	**Permian**	Dorud, Ruteh	Pdr	Sandstone, shale, limestone, dolomite, quartzite
	Carboniferous	Mobarak	Cm	Limestone, sandstone, shale, Phyllite (Rasht area)
	Devonian	-	D	Shale, quartzite, conglomerate, diabase, basic volcanics, limestone
	Silurian	-	-	-
	Ordovician	-	-	-
	Cambrian	Mila	ε m	Shale, limestone, dolomite
575*		Lavan	ε l	Sandstone, partly quartzite
Pre-Cambrian		Zaigun,Barut	P ε z	Red sandstone, red slate
		Saltanieh	P ε s	dolomite
		Kahar	P ε k	Green &grey sandstone and shale
		Others		Phyllite, quartzite, biotite schist
Igneous rocks	**Unknown**	Lava	-	rhyorite (r)、andesite (a), basalt (b)
	Tertiary	-	g	Granite, granodiorite
		-	qd	quartzdiorite
		-	p	Intrusive rocks: porphyrite, diorite porphyrite
		-	d	Gabbro, diorite
	Pre-cambrian	-	gd	Doran granite

Source: Geological Quadrangle Map of Iran, 1/250,000. Geological Survey of IRAN

** Geological age (x106)*

The outline of geology in the Study Area is divided into four in the table below, together with the topographic characteristics.

Table 1.2.2 Outline of Geology in the Study Area

Area	Main Distribution Provinces	Topography	Geology
Lower Reach (Caspian Sea side)	Gilan	1. Mountain 2. Along river: Fan, Alluvial plain	1. Mountain side: Sandstone, Conglomerate and Limestone in Mesozoic Era 2. Along river: Clay, sand, gravel in Quaternary
Middle Reach 1 (Alborz Mountains)	Ardabil, East Azerbaijan, Border between Gilan and Zanjan	Mountainous area. Alluvial topography is distributed only along rivers. Highest point is 2,750m.	Sandstone, Conglomerate, and Limestone in Mesozoic Era are mainly distributed in the Alborz Mountains.
Middle Reach 2, (between Alborz Mountains and Zagros Mountains)	Zanjan, Kordestan	This area is composed of the plateau with elevations of 1,500 to 2,000m, and the mountain region with elevations of 2,500 to 3,000m.	Plateau region: Fan, terrace, and alluvial deposits are mainly distributed. Mountainous region: Pyroclastic rocks of Karj Formation in Tertiary are distributed in Zanjan Province with a part of intrusive rocks of granites and porphyrite; Tertiary rocks are distributed in mountains in Kordestan.
Upper Reach (Zagros Mountains)	Southwestern part of Kordestan	Mountainous region with elevations of 3,000 to 4,000m.	Various limestone in Mesozoic Era is widely distributed.

1) Lower Reach

Geology is classified into two: in mountain areas and along the Sefidrud River side in the lower reach. The geology is composed of unconsolidated clay, sand and gravel of alluvium in the river side of the Sefidrud River. Conglomerate and limestone of Mesozoic Era are distributed in the mountain side.

2) Middle Stream Reach 1

In Middle Stream Reach 1, distributed are the sedimentary rock of sandstone, conglomerate and limestone of Mesozoic.

3) Middle Reach 2

In Middle Reach 2 located southeast of Middle Reach 1, are Pyroclastic rocks (tuff, lava) of Tertiary Eocene Karaji Formation, and granite and porphyrite formed the mountains. Fan and terrace deposits are widely distributed around the mountains from Zanjan Province to Kordestan Province. The Qom Formation composed of marls, shale and limestone is distributed on the gentle slope in Middle Reach 2. Old rocks of shale, limestone and dolomite of Precambrian and Paleozoic are also partly distributed in this area.

4) Upper Reach

Limestone of Mesozoic, Triassic and Cretaceous are distributed in the Upper Reach of the Study Area.

The distribution area of limestone and lava has high permeability and precipitation is easy to infiltrate into the ground compared with the other rocks. The same phenomenon exists in the distribution area of recent river deposits, terrace deposits and the fan deposit composed of sand and gravel with clay. These are reflected in the GIS database utilized for the analysis of water balance.

Geology of each groundwater basin is summarized in the following table.

Table 1.2.3 Outline of Geology in the Groundwater Basin

Groundwater basin		Zone*	Province	Area (Km^2)	Geology
Location	Code				
Astaneh-Kochesfahan	1301	E-1 E-2	Gilan (Downstream of Manjil dam)	1,923	Permian sediments to Alluvium deposits are distributed in the basin. Quaternary deposit of Alluvial deposits and fan deposits are distributed in the plain facing Caspian Sea and along the Sefidrud River. Sandstone and shale with coal of Permian to Cretaceous and volcanic rocks are partly distributed in the upper part of the basin. Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Lar limestone may have the possibility.
Tarom-Khalkhal	1302	C-1 C-2 C-3	Ardebil	8,604	Tertiary volcanic rocks are widely distributed in the basin and Tertiary intrusive rocks and sandstone, marl, conglomerate, tuff are distributed. Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Cretaceous limestone may have the possibility.
Miyane	1303	B-5 B-6 B-7	East Azarbaijan	9,226	Sandstone, conglomerate, and tuff etc of Tertiary sedimentary rock and andesitic volcanic rocks are distributed. Period unknown acidic (granite, rhyorite) to intermediate (andesite) intrusive rocks are distributed here and there. Layer to be aquifer Granular aquifer: Quaternary deposit.
Zanjan	1304	B-3	Zanjan	4,672	Following formations are distributed: - Quaternary sediments on the plain and hills. - Tertiary volcanic rocs of Karaj Formation; lava, tuff, shale in the northeastern mountains - Volcanic rocs and Palaeozoic sedimentary rocks with intrusive rocks Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Lar limestone may have the possibility.
Mahneshan-Anguran	1305	B-1 B-4	Zanjan	7,172	From Pre-Cambrian to Quaternary formation are distributed in this basin. Tertiary volcanic rocks are widely distributed in the western part of this basin with Tertiary sedimentary rocks and Quaternary sediments and old rocks. Layer to be aquifer Granular aquifer: Quaternary deposit.
Sojas	1306	B-2	Zanjan	2,497	Quaternary sediments are distributed on the plain to hill. Tertiary volcanics of Karaj Formation (lava, tuff, shale) are distributed in the mountain area and Palaeozoic sedimentary rocks are distributed with intrusive rocks in the part of central mountain. Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Lar limestone may have the possibility.
Goltapeh-Zarinabad	1307	A-3	Kordestan	5,131	Tertiary sedimentary rocks and Quaternary sediments are widely distributed in the basin and sedimentary rocks (sandstone, shale, limestone) of Cretaceous to Jurassic period are distributed in the central part of the basin. Salt domes are distributed partly. Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Lar limestone may have the possibility.
Ghorveh-Dehgulan	1308	A-1	Kordestan	7,284	Tertiary sedimentary rocks and Quaternary sediments are widely distributed on the plain and hill. Tertiary volcanic rocks are dotted like monadonock with NW-SE direction Mesozoic to Paplaeozoic volcanic are distributed in the southeastern part of mountain. Layer to be aquifer Granular aquifer: Quaternary deposit.

Divandareh-Bijar	1309	A-2	Kordestan	5,385	Tertiary sedimentary rocks and Quaternary sediments are widely distributed on the plain and hill. Mesozoic volcanic rocks are widely distributed in the western part of mountains. Layer to be aquifer Unknown
Taleghan-Alamut	1310	D-1 D-2	Qazvin	4,864	Palaeozoic Permian, Mesozoic Triassic-Jurassic-Cretaceous formations are distributed. Intrusive rocks are distributed here and there. Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Ruteh limestone may have the possibility.
Manjil	1311	C-4	Gilan	2,261	Tertiary volcanic rocks and intrusive rocks are predominant in the basin and Tertiary sedimentary rocks and Quaternary sediments are distributed in the downstream reach of this basin. Layer to be aquifer Granular aquifer: Quaternary deposit.
others	Including the provincial border of a part of Kermansher, West Azarbaijan, and Mazandaran			71	
Total in Sefidrud River Basin				59,090	
Fumanat	1202	-	Gilan	3,593	Limestone, conglomerate, sandstone, volcanic rocks of Palaeozoic to Mesozoic Era are distributed in the mountain areas and unconsolidated sea/delta/river deposits of Quaternary Period are distributed in the plain Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Ruteh/Elika limestone
Lahijan-Chabuksar	1401	-	Gilan	3,536	Various sedimentary rocks, plutonic rocks, volcanic rocks, metamorphic rocks of Palaeozoic to Mesozoic Era are distributed in the mountain areas and unconsolidated sea/delta/river deposits of Quaternary Period are distributed in the plain Layer to be aquifer Granular aquifer: Quaternary deposit. Karst aquifer: Rutehlimestone
Total in adjoin of downstream area of Sefidrud				7,129	

*: Zone: refer to Chapter 5 in Main Report

The detailed geology of each groundwater basin is described in Appendix 1.

CHAPTER 2. GROUNDWATER

2.1 OUTLINE OF HYDROGEOLOGY

The possible geological layers to be aquifer in the Sefidrud River Basin are river deposits, fan deposits, and terrace deposit of Quaternary deposits that consists of sand and gravel with clay. Other possible geology is limestone with hole and cavity. The former is called "Granular aquifer" and the latter is "Karst aquifer". According to the existing data, Almost aquifer is granular aquifer in the Quaternary deposits (so hereinafter called "Quaternary aquifer") in the Sefidrud River Basin. Limestone is distributed here and there but only Permian Ruteh limestone in the groundwater basin of Qazvin (Code: 1310) may have cavity and karst aquifer that details are unknown.

The hydologeological outline of each basin is summarized in Table2.1.1 from the data of existing study and monitoring results. Monitoring well were constructed 32 wells in 1301 basin, 17 wells in 1302 basin, 59 wells in 1304 basin, 18 wells in 1306 basin, 134 wells in 1308, 3 wells in 1310, and 8 wells in 1311 and total 271 wells. Pumping tests, groundwater level measuring, and water quality test have been conducting in all monitoring wells. But, Pumping tests, groundwater level measuring have not been conducting in monitoring well of 1308.

Table 2.1.1 Outline of Hydrogeology and Monitoring Systems in the Groundwater Basin

Name of Groundwater Basin	Basin code	Outline of basin*1	Pumping test (number)	Water level (number)	Water quality sampling (number)	Type of aquifer	Q*2 (l/s)	T*3	Qp*4 (l/s)
Astaneh-Kuchesfahan	1301	Area: 1000km^2 Depth: 100-250m. By electric resistivity survey(ES)	32	9	32	Unconfined Confined	45.1	2,025	5.7
Tarom-Khakhal	1302	Tarom:329km^2 , Depth:30-75m。 By well, ES 27 lines Khalkhal: 248km^2 , 20-50m. By ES: 42 lines	17	17	17	Unconfined Confined	19.8	1,545	15.7
Miyane	1303	Depth:50-250m. By ES 25 lines. But details are unknown.	0	0	0	Unconfined	-	-	8.7
Zanjan	1304	East, north-east part: depth 150m Central part: depth 100m Sahrin River: depth 100-200m By ES and wells	59	7	59	Unconfined Confined	78.7	742	11.1
Mahneshan-Anguran	1305	By well, but details are unknown.	0	0	0	Unconfined	-	-	5.3
Sujas	1306	By well, but details are unknown	18	6	18	Unconfined	55.9	1,560	6.2
Goltapeh-Zarinabad	1307	GIS database are found. But details are unknown.	0	0	0	Unconfined Confined			6.5
Ghorveh-Dehgulan	1308	Dehgulan: Area; 624km^2 , Depth; 56-140m By ES44 lines and wells	1	1	134	Unconfined	*58.0*	*2,850*	11.2
Divandareh-Bijar	1309	Details are unknown.	0	0	0	Unconfined	-	-	6.9
Taleghan-Alamut	1310	Area:243km^2 ,	3	0	3	Unconfined (karst aquifer)	*22.3*	*3,120*	15.9
Manjil	1311	Area:226km^2 , Depth: 5-50m By ES 19 lines, wells	8	8	8	Unconfined	38.0	903	16.0
Total		Notes: well means test well	138	48	271	-	-	-	-

Q*2: Yield, T*3: Transmissivity: m^3/day/m, Qp*4: yield of production well

Source: Groundwater data of WRMC(2001)。

*1, *4: MG Company "Report Vol 2, 2-3Groundwater"

Cord: 1308: Only one pumping test data is available in Arcata.

The summary of pumping test is attached in Appendix 2 and the results of each pumping test for each well are attached in Appendix 3.

Monitoring systems have been established in eight out of the eleven sub-basins as shown in Figure 2.1.1 Location of Observation Wells. Conducted were measurements of groundwater level, water quality and yield (by pumping test). Table 2.1.1 summarizes the characteristics of each groundwater basin. Monitoring wells are not established in the groundwater basin of 1303 (East Azerbayjan Province), 1305 (Western part of Zanjan Province), 1309 (Western part of Kordestan Province). Even in the provinces that monitoring wells are installed, it is not enough number and not enough monitoring system.

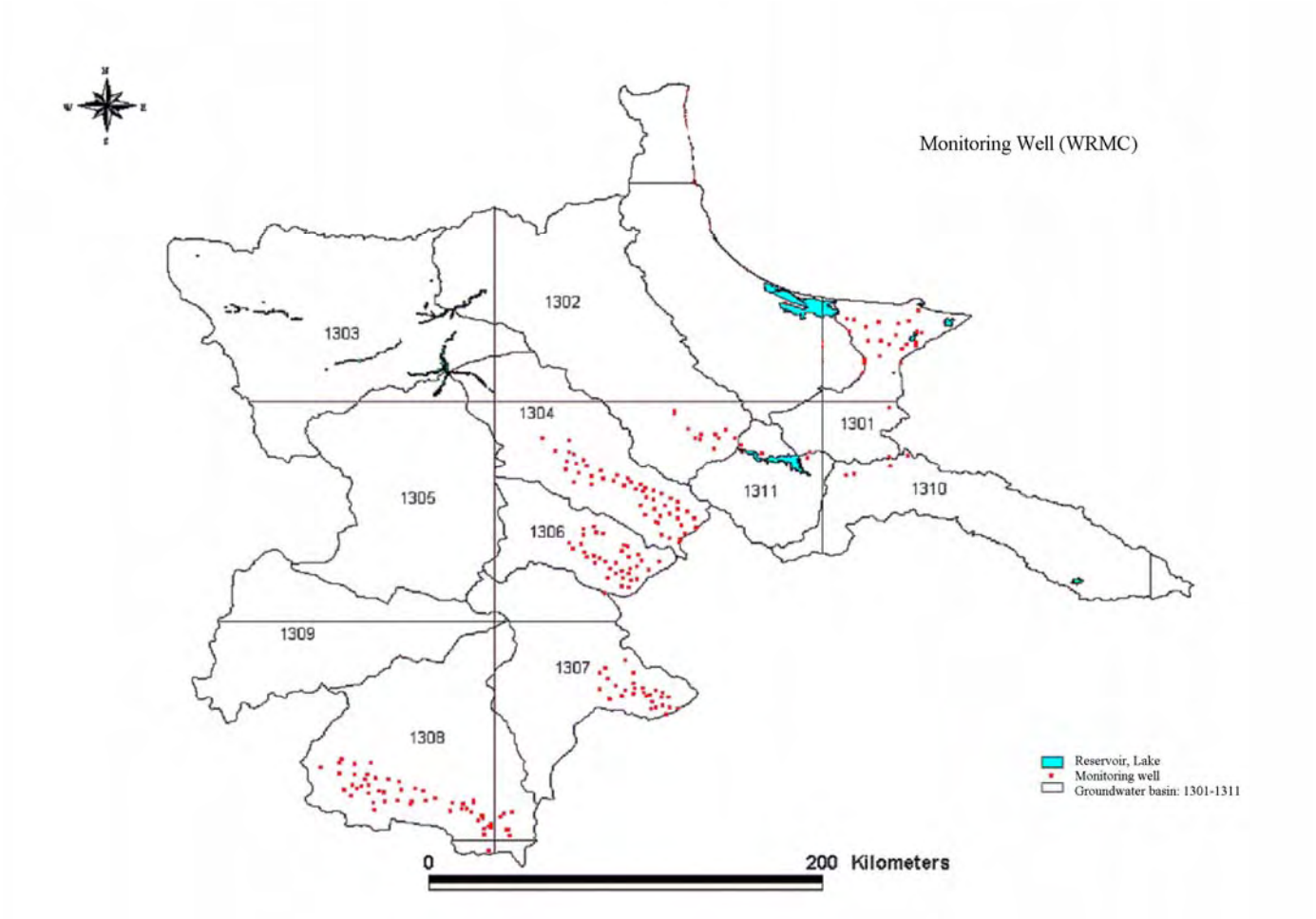


Figure 2.1.1 Location of Observation Wells in Eight Sub-Basins

It is required to clear the following three elements to know the groundwater basin (hereinafter, it means Quaternary aquifer).

- Stretch of aquifer: area, depth, shape of sand and grave layer
- Essential factor: material of aquifer, permeability, transmissivity, storativity etc
- External factor: meteorological and hydrological data (related with groundwater recharging)

The monitoring quantities shown in Table 2.1.1 are quite a few considering the stretch of its each basin area. The stretch of Quaternary layer that become Quaternary aquifer will be investigated by geological map and GIS. The meteorological and hydrological data are also mostly cleared by

hydrological analysis in each basin. But, the shapes of depth are not almost investigated because of insufficient test wells and electric resistivity surveys. It is also not almost investigated the essential factor (material of aquifer, permeability, transmissivity, storativity etc) because of insufficient pumping tests.

On the basis of a few existing survey results, unconfined aquifers are commonly used, and averaged values of pumping yield and transmissivity were high. For example, transmissivity of five out of eight aquifers are greater than 1,300 m^3/day/m and are considered to be "good" aquifers. Transmissivity in Zanjan (1304) and Manjil (1311) where mountainous areas are widely distributed are lower than 1300 m^3/day/m, so that they are "not good" aquifers. Transmissivity is 742 m^3/day/m in Zanjan (1304) and 903 m^3/day/m in Manjil (1311), but pumping yield is 11 l/s (950 m^3/day), 16 l/s (1382 m^3/day) respectively, so it is assumed that the aquifer has been over-pumped based on the low transmissivity and high pumping yield.

2.2 FACILITIES AND UTILIZATION OF GROUNDWATER

2.2.1 Facilities of Groundwater

Groundwater is utilized by a number of well, spring and qanat facilities as shown in the following table.

Table 2.2.1 Facilities for Groundwater Utilization (2001)

Groundwater Basin	Basin Code	Province	Well (number)	Spring (number)	Qanat (number)
Astaneh-Kuchesfahan	1301	Gilan	3,758	403	0
Tarum-Khakhal	1302	Aldebil	1,159	1,989	27
Miyane	1303	East Azerbaijan	1,973	419	69
Zanjan	1304	Zanjan	3,252	200	220
Mahneshan-Anguran	1305	Zanjan	1,164	1,628	60
Sujas	1306	Zanjan	905	1,373	251
Goltapeh-Zarinabad	1307	Kordestan	1,562	1,003	170
Ghorveh-Dehgulan	1308	Kordestan	3,167	824	73
Divandareh-Bijar	1309	Kordestan	817	2,151	79
Taleghan-Alamut	1310	Qazvin	607	12,066	13
Manjil	1311	Gilan	548	6,232	6
Total			18,912	28,288	968

Source: WRMC

1) Utilization of Groundwater

The total volume of groundwater utilization is 1,867 million m^3/year, as listed in the following table on the data of WRMC. But data year is scatted and even the latest data is 2001. So, it is unreasonable without reservation.

Table 2.2.2 Annual Groundwater Utilization Volume

Groundwater Basin	Basin Code	Province	Data year	Well (MCM)	Spring (MCM)	Qanat (MCM)	Total (MCM)
Astaneh-Kuchesfahan	1301	Gilan	1995	50.17	25.90	0	76.07
Tarum-Khakhal	1302	Aldebil	1999	31.93	227.14	27.94	287.01
Miyane	1303	E-Azerbaijan	2001	105.92	87.55	12.04	205.51
Zanjan	1304	Zanjan	1994	226.12	67.21	39.22	332.55
Mahneshan-Anguran	1305	Zanjan	1999	14.35	87.34	5.40	107.09
Sujas	1306	Zanjan	1994	39.87	100.24	38.81	178.92
Goltapeh-Zarinabad	1307	Kordestan	1994	55.04	88.56	26.16	169.76
Ghorveh-Dehgulan	1308	Kordestan	1991	298.19	80.94	23.05	402.18
Divandareh-Bijar	1309	Kordestan	1995	29.89	13.81	5.24	48.94
Taleghan-Alamut	1310	Qazvin	1994	2.58	28.36	1.04	31.98
Manjil	1311	Gilan	2001	5.23	19.97	2.08	27.28
Total			-	859.29	827.02	180.98	1867.29

Sources: WRMC, Mahab Ghodss (Vol. 2 2-3 Groundwater), JICA Study Team

The groundwater usage will be estimated increase in 2006 but there are not data. Mahab Ghodss Company updated the WRMC data and 2003 groundwater usage was investigated shown in Table 1.2.4. The usage of well and qanat have been decreased a few from WRMC data but spring water usage has slightly increased. The total groundwater usage has increased 204 million m^3/year from WRMC data to 2003.

Table 2.2.3 Annual Groundwater Utilization Volume in 2003

Groundwater Basin	Basin Code	Province	Well (MCM)	Spring (MCM)	Qanat (MCM)	Total (MCM)	Remarks
Astaneh-Kuchesfahan	1301	Gilan	24.57	25.13	0	49.70	It is said groundwater table (GW) has been decreasing.
Tarum-Khakhal	1302	Aldebil	52.50	96.67	2.50	151.67	
Miyane	1303	E-Azerbaijan	61.17	46.86	7.74	115.77	
Zanjan	1304	Zanjan	234.74	65.36	36.60	336.70	GW decreasing -5.2m (1997-2002)
Mahneshan-Anguran	1305	Zanjan	24.27	86.74	5.47	116.48	
Sujas	1306	Zanjan	48.20	97.52	37.23	182.95	GW decreasing -3.0m (1996-2001)
Goltapeh-Zarinabad	1307	Kordestan	56.58	91.06	25.02	172.66	
Ghorveh-Dehgulan	1308	Kordestan	294.59	43.80	9.01	347.40	GW decreasing Ghorveh: -5.0m Dehgulan: -9.0m (1997-2002)
Divandareh-Bijar	1309	Kordestan	2.43	70.30	5.18	77.91	
Taleghan-Alamut	1310	Qazvin	8.74	413.59	2.78	425.11	
Manjil	1311	Gilan	34.57	59.03	1.15	94.75	
Total in Sefidrud River Basin			**842.36**	**1096.06**	**132.68**	**2071.11**	
Fumanat	1202	Gilan	57.42	17.65	0	75.07	
Lahijan-Chabuksar	1401	Gilan	41.08	2.0	0	43.08	
		小計	98.50	19.65	0	118.15	
Total			842.36	1096.06	132.68	2071.11	

Sources: Mahab Ghodss (Vol.2, 2-3 Groundwater), JICA Study Team

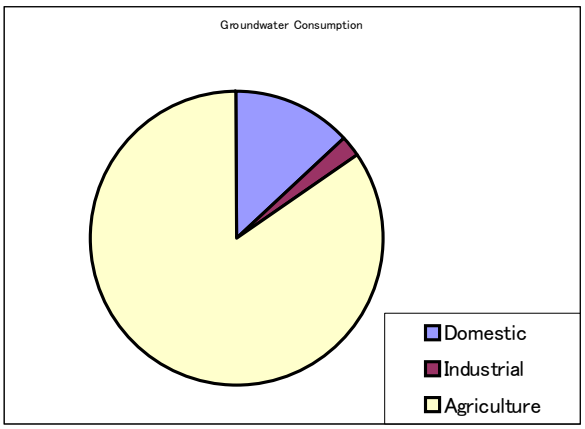
2) Groundwater Utilization for the Purpose-wise

Groundwater is utilized as agricultural water, domestic water and industrial water. The following table shows the purpose-wise utilization in each groundwater basin. Groundwater is utilized for agricultural water (84.5%), domestic water (13.3%) and industrial water (2.2%) in the Sefidrud River Basin. The Astaneh-Kuchesfahan Region (Code 1301) and the Manjil Region (1311) highly rely on the groundwater with 21.7% and 33.4% respectively for domestic water compared to the average. On the other hand, the Tarum-Khakhal Region (1302) in Ardabil Province, Sujas Region (1306) in Zanjan Province, and Goltapeh-Zarinabad (1307) in Kordestan Province highly rely on the groundwater for agriculture compared to the average.

Table 2.2.4 Groundwater Utilization Purpose-wise（2003)

Groundwater Basin		Province	Exploitation Volume (million m^3/year)			
Name	Code		Domestic	Industry	Agriculture	Total
Astaneh-Kuchesfahan	1301	Gilan	10.77	2.91	36.02	49.70
			21.7%	*5.9%*	*72.5%*	*100%*
Tarum-Khakhal	1302	Aldebil	8.75	1.84	141.08	151.67
			5.8%	*1.2%*	*93.0%*	*100%*
Miyane	1303	E-Azerbaijan	15.40	3.40	96.97	115.77
			13.3%	*2.9%*	*83.8%*	*100%*
Zanjan	1304	Zanjan	48.20	6.70	281.80	336.70
			14.3%	*2.0%*	*83.7%*	*100%*
Mahneshan-Anguran	1305	Zanjan	12.20	4.40	99.88	116.48
			10.5%	*3.8%*	*85.8%*	*100%*
Sujas	1306	Zanjan	6.80	1.00	175.15	182.95
			3.7%	*0.5%*	*95.7%*	*100%*
Goltapeh-Zarinabad	1307	Kordestan	7.46	1.30	163.90	172.66
			4.3%	*0.8%*	*94.9%*	*100%*
Ghorveh-Dehgulan	1308	Kordestan	55.60	6.10	285.70	347.40
			16.0%	*1.8%*	*82.2%*	*100%*
Divandareh-Bijar	1309	Kordestan	12.65	4.40	60.86	77.91
			16.2%	*5.6%*	*78.1%*	*100%*
Taleghan-Alamut	1310	Qazvin	65.90	10.56	348.65	425.11
			15.5%	*2.5%*	*82.0%*	*100%*
Manjil	1311	Gilan	31.60	2.20	60.95	94.75
			33.4%	*2.3%*	*64.3%*	*100%*
Total			275.33	44.81	1,750.96	2,071.10
Ratio			13.3%	2.2%	*84.5%*	*100%*

Sources: WRMC, Mahab Ghodss Report (Vol. 2 2-3 Groundwater), JICA Study Team



Sources: WRMC, Mahab Ghodss (Vol. 2, 2-3 Groundwater), JICA Study Team

Figure 2.2.1 Groundwater Utilization Purpose-wise（2003)

2.2.2 Groundwater Fluctuation

Monitoring results show that the groundwater table lowered by 5.2 meters from 1997 to 2002 in Zanjan (Code 1304), and by 3.0 meters from 1996 to 2001 in Sujas (1306) in Zanjan Province. The results also show that the groundwater table lowered by 5.0 meters from 1997 to 2002 in Ghorveh, and by 9.0 meters in Dehgulan (1308), Kordestan Province. The lowering is attributed to over-exploitation. The following table listed the area that groundwater table lowered.

Table 2.2.5 Annual Groundwater Table Lowering

Groundwater Basin	Basin Code	Province	Measuring year	Total amount of lowering	Annual amount of lowering
Zanjan	1304	Zanjan	1997-2002	5.2m	1.0m
Sujas	1306	Zanjan	1996-2001	3.0m	0.6m
Ghorveh	1308	Kordestan	1997-2002	5.0m	1.0m
Dehgulan	1308	Kordestan	1997-2002	9.0m	1.8m

The fluctuation graph of groundwater table is attached in Appendix 5.

These rapid lowering of groundwater table is caused by over pumping without reservation of groundwater recharge.

The precipitation is key factor for the groundwater recharging and the decrease of groundwater recharging means the decrease of precipitations. 20 years annual average precipitations from 1985 to 2005 is 346mm/year in spite of its 40 years from 1965 to 2005 is 402 mm/year as shown in Table 1.2.6. It is clear that precipitation after 1985 year has been decreasing and it is easy to estimate the decrease of groundwater recharging in recent. The result of water balance simulation by MIKE-SHE described in Section "1.4 Water Resources Potential", the groundwater recharging volume is 1,862million m^3/year and 2,388million m^3/year, respectively.

Table 2.2.6 Fluctuation of Precipitation and Groundwater Recharging Volume

Area	Observation year	Annual average precipitation (mm/year)	Groundwater recharging volume (MCM/year)	Remarks
Whole Sefidrud River Basin	1965-2005	402	2,388	Analyzed precipitation: 40 years
	1985-2005	346	1,862	Analyzed precipitation: 20 years
Upstream of Manjil Dam area	1969-2005	375	-	Analyzed precipitation 36 years
	2001-2003	289	-	Precipitation of average drought year (by Thiessen method)

On the other hand, for the abstraction of semi-dry area of most of Sefidrud River Basin, the precipitation of upstream of Manjil dam is analyzed. The annual average precipitation of 36 years from 1969 to 2005 was 375 mm/year, but recent precipitation of drought 3 years of 2001 to 2003 was only 289 mm/year by the Thiessen Method.

On the hydrological examination, it is clear slight rain in recent, and it may decrease the groundwater recharging volume in recent.

The reason of groundwater table lowering is over pumping and the decrease of groundwater recharging at the basin of 1304 (Zanjan), 1306 (Sujas), 1308 (Ghorveh), 1308 (Dehgulan). Consequently, safe yield of groundwater shall be determined severally on the average precipitation year and drought year for the prevention of over pumping and groundwater conservation. The groundwater conservation will be detailed in Section 3.2 "Groundwater Management Plan".

2.3 WATER QUALITY

2.3.1 Environmental Standards for Waters

General rules for setting standards are established by the Environmental Protection and Enhancement Act (1974). Standards are developed by Iranian Institution of Standards and Industrial Research (ISIRI), the Ministry of Energy and Department of Environment (DOE), and approved by the Environmental High Council (EHC). The DOE is responsible for enforcement.

In 2008, there are water quality standards for "drinking water", "sewage effluent" and "industrial discharge into sewage collection system" which is in force. There is no standard for classification of rivers, lakes and oceans.

The standard for drinking water were previously prepared and published by the Management and Planning Organization (1992, No 116). Iranian drinking water standard have been developed by the ISIRI. The drinking water standard of Iran and other organization is attached in Appendix 6.

2.3.2 Groundwater Quality

Quality of Groundwater is measured by WRMC. Location of measuring well is shown in Figure 1.2.1. There is some areas to control groundwater by monitoring well, which are divided from 1301 to 1311. Measurement of groundwater quality is done in all areas except for 1303, 1305 and 1309.

Water quality indexes for groundwater measured by WRMC are mostly anion and cation. Harmful materials which sometimes cause a problem in groundwater, like Cadmium (Cd) and Arsenic (As), are not measured here.

- Water quality index measured by WRMC: Potassium (K^+), Sodium (Na^+), Magnesium (Mg^{2+}), Calcium (Ca^{2+}), Sulfate ion (SO_4^{2-}), Chloride ion (Cl^-), Bicarbonate ion (HCO_3^-), Carbonate ion (CO_3^{2-}), pH, Electric conductivity (EC), Total dissolved solid (TDS).

Table 2.3.1 shows average in a year and in a groundwater basin duration 2001 to 2006.

Table 2.3.1 Groundwater Quality at Monitoring Well (2001-2006)

Basin code	Tested year	Samp-le No.	K	Na	Mg	Ca	SO_4	Cl	HCO_3	CO_3	PH	TDS	Electric Conduct -ivity
			(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	-	(mg/l)	m-S/cm
1301	2002	52	0.15	2.93	2.52	4.99	1.28	3.11	6.51	-	7.65	688.81	1093.29
	2003	55	0.16	2.68	2.47	5.33	1.10	2.98	6.44	-	7.51	680.65	1080.44
	2004	45	0.32	3.35	2.83	5.02	1.35	3.32	6.67	-	7.61	736.20	1168.47
	2005	25	0.11	3.81	2.43	5.06	1.25	3.57	6.58	-	7.56	734.74	1166.20
1302	2001	14	0.15	11.19	5.85	8.98	9.95	12.05	4.93	-	7.35	1647.54	2615.14
	2002	29	0.09	8.57	4.28	7.87	7.29	7.82	5.51	-	7.79	1225.96	1945.97
	2003	27	0.06	10.82	4.84	7.92	8.68	10.93	5.22	-	7.38	1524.67	2420.19
	2004	14	0.09	10.91	3.63	7.46	5.85	10.91	5.24	-	7.46	1458.21	2314.71
	2005	16	0.06	9.47	3.55	6.33	5.56	8.95	31.73	-	7.72	1223.94	1942.88
1304	2002	98	2.93	1.90	3.02	7.20	1.15	3.83	-	-	7.80	471.98	815.79
	2003	98	2.93	2.12	2.92	7.17	1.18	3.59	-	-	7.70	456.09	719.85
	2004	88	2.63	2.10	2.44	6.87	1.33	2.66	-	-	7.99	469.50	763.44
	2005	80	2.70	2.02	2.97	7.22	1.13	3.49	-	-	7.63	463.29	935.38
1306	2002	67	1.32	2.00	3.18	6.14	0.90	4.22	-	-	7.65	385.99	612.01
	2003	75	1.47	2.08	3.70	11.31	1.07	8.90	-	-	7.41	410.78	659.37
	2004	70	1.44	2.12	2.65	5.99	0.80	3.40	-	-	7.69	406.14	672.14
	2005	73	1.32	1.79	2.87	5.64	0.70	3.91	-	-	7.68	359.70	631.10
1307	2002	67	5.24	2.36	3.48	10.01	2.86	4.29	-	-	7.72	658.84	1029.39
	2003	68	4.97	2.40	4.27	10.54	2.82	4.56	-	-	7.53	709.50	1102.28
	2004	68	-	2.08	3.85	9.68	2.71	3.52	-	-	7.98	-	1074.50
	2005	67	4.45	2.54	3.68	9.88	2.32	3.72	-	-	7.59	682.96	1101.13
	2006	24	5.58	2.90	4.46	12.79	3.01	3.69	-	-	7.78	847.50	1399.83
1308	2004	73	0.06	1.67	1.82	3.77	1.47	0.64	4.75	0.07	7.82	414.33	637.08
	2005	151	0.04	1.38	1.42	3.43	2.98	0.59	4.01	0.07	7.92	531.58	560.13
	2006	38	0.05	1.95	1.96	3.86	1.79	0.86	4.48	0.01	7.70	460.76	707.66
1309	2004	13	2.45	2.33	1.36	5.02	3.60	0.93	3.68	0.05	7.99	518.23	795.23
	2005	20	0.05	2.34	1.39	4.89	3.61	0.96	153.74	0.03	7.93	518.65	797.15
	2006	12	0.05	4.07	2.13	6.60	5.72	2.94	3.39	0.08	8.00	779.00	1180.50
1310	2001-02	15	0.07	0.59	4.01	7.83	2.14	0.40	10.16	0.00	7.25	740.12	1174.80
	2003	9	0.05	0.60	3.86	8.88	1.98	0.45	10.98	0.00	7.23	706.44	1121.67
	2004-05	14	0.06	0.65	3.75	9.69	1.92	0.37	11.75	0.00	7.02	825.79	1310.86
1311	2002-05	12	0.04	0.43	1.32	2.61	0.81	0.32	3.26	0.00	7.67	275.91	438.25
Iran drinking water standard			10 (EC)	200	50	250	400	400	-	-	6.5-8.7	1500	400 (EC)

Source：WRMC. EC: EC guideline

Sampling number is listed in Appendix 7, test results are listed in Appendix 8.

Potassium (K^+), sodium (Na^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), sulphate ($SO4^{2-}$), chloride (Cl^-), pH, total dissolved solid (TDS) are below the Iranian Drinking Water Standard and it is judged that groundwater in the monitoring wells are soft and good. But 84.5 % of these good groundwater are utilized for irrigation water. Electric Conductivity is too high based on the other index of TDS and the value of cation. There are not reason it is so high.

The following is described in each cation and anion.

1) Potassium (K^+)

Most of groundwater basins show less than 0.2mg/l. It shows 2.6-2.9mg/l in groundwater basin 1304, 4.6-5.6 mg/l in 1307, and 1.3-1.5 mg/l in 1306. But all values in groundwater basins are less than the standard of 10mg/l of EC drinking water guidelines.

2) Sodium (Na^+)

Most of groundwater basin shows 2 to 4mg/l. It shows 8.6-11.2 mg/l in groundwater basin 1302. They are rare case of groundwater basin 1310 and 1311 that shows less than 1mg/l. All values in groundwater basins are remarkably lower than the standard of 200mg/l of Iranian drinking water standards.

3) Magnesium (Mg^{2+})

Most of groundwater basin shows less than 3mg/l. It shows 3.6-5.9mg/l in groundwater basin 1302, 3.7-4.5 mg/l in 1307, and 3.8-4.0 mg/l in 1310. But all values in groundwater basins are remarkably lower than the standard of 50mg/l of Iranian drinking water standard.

4) Calcium (Ca^{2+})

Most of groundwater basin shows less than 10mg/l. It shows little higher 9.7-12.8mg/l in groundwater basin 1307. But all values in groundwater basins are remarkably lower than the standard of 250mg/l of Iranian drinking water standard. It is judged the ground water of monitoring well in the study area will be soft water.

5) Chloride (Cl^-)

It shows 7.8-12.1mg/l in groundwater basin 1302, 3-4 mg/l in 1301, 1304, 1306, 1307, less than 1.0mg/l in 1308, 1309, 1310, and 1311. But all values in groundwater basins are remarkably lower than the standard of 400mg/l of Iranian drinking water standard.

2.4 WATER RESOURCES POTENTIAL

2.4.1 Water Resources Potential

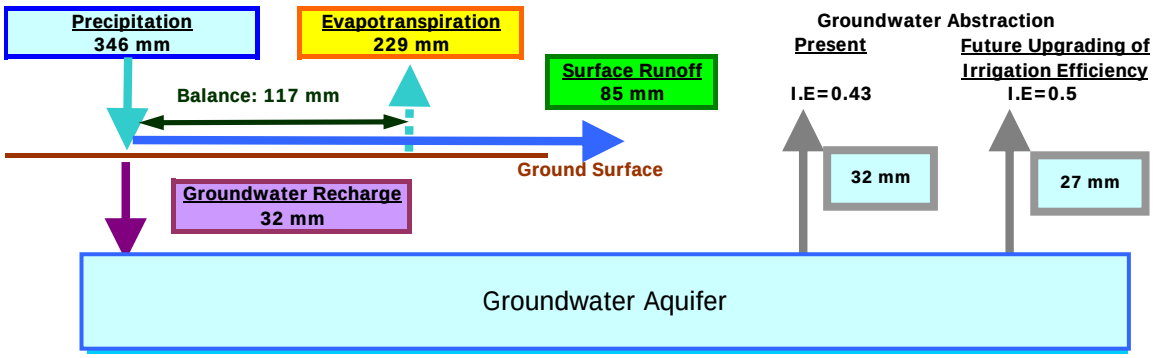
The water resources potential was computed through water balance simulation with MIKE-BASIN and MIKE-SHE. The result is summarized below.

Annual average precipitation is 346mm from 1985 to 2005 year, among of them 229mm is evapotranspiration, infiltration to the ground is 32mm and remaining 85mm is surface runoff. These precipitation or value converted into surface runoff and groundwater recharge volume in the whole Sefidrud River basin, 5.0 billion m^3 and 1.9 billion m^3. These value become the water resources potential in the basin.

Table 2.4.1 Water Resources Potential

Annual Precipitation	Evapotranspiration	Water Resources Potential		
		Surface Runoff	Groundwater Recharge	Total
346 mm (= 20.4 billion m^3)	229 mm (= 13.5 billion m^3)	85 mm (= 5.0 billion m^3)	32 mm (= 1.9 billion m^3)	117mm (= 6.9 billion m^3)
100 %	66.2 %	24.6 %	9.2 %	33.8 %

Note: Data from 1985 to 2005



Present: Deficit (water table lowering) may occur in 7 Aquifers out of 11 ones.
Future: Deficit (water table lowering) may occur in 5 Aquifers out of 11 ones.

Basic Concept: To conserve the groundwater aquifers over the basin through conversion of water source

Figure 2.4.1 Water Balance and Water Resources Potential

2.4.2 Groundwater Potential

The storage capacity and recharging volume shall be cleared for investigating the groundwater potential.

The storage capacity is the capacity of water volume that store in gap of sediment. The stored water can be used temporarily in a case of drought like this semi-dry to dry climate area. But, it is important to recharge water during the average to surcharge precipitation year for groundwater conservation. So, it is important to know the storage capacity of groundwater.

It is important to know the recharging volume of groundwater is to know the safety pumping volume for groundwater conservation. The groundwater is never dried up within the pumping up of recharging volume in every year.

To clear the storage capacity and recharging volume, the following three elements shall be investigated:

(i) Stretch of aquifer: area, depth, shape

(ii) Essential factor: material of aquifer, permeability, transmissivity, storativity etc

(iii) External factor: meteorology and hydrological data (related with groundwater recharging)

As stated "2.1 Outline of Hydrogeology", it should be cleared the progress of existing survey for three elements. It is compiled the following table.

Table 2.4.2 Survey of groundwater basin and Its Progress

Groundwater Code	Area of basin	Depth, shape	Essential element	External element	Utilized aquifer	Pumping test	Water measuring	Water quality test	T*1
1301	○	x△	x△	○	Unconfined Confined	30	9	32	2,025
1302	○	x△	x△	○	Unconfined Confined	16	17	17	1,545
1303	○	x△	x	○	Unconfined	x	x	x	
1304	○	x△	x△	○	Unconfined Confined	17 (59)	7	59	742
1305	○	x	x	○	Unconfined	x	x	x	
1306	○	x	x△	○	Unconfined	15	6	18	1,560
1307	○	x	x	○	Unconfined Confined	x	x	x	
1308	○	x△	x△	○	Unconfined	1	1	134	*2,850*
1309	○	x	x	○	Unconfined	x	x	x	
1310	○	x	○	○	Unconfined (karst)	3	x	3	*3,120*
1311	○	x△	x△	○	Unconfined	7	8	8	903
Total	-	-	-	-	-	131	48	271	-

Legend: ○; almost surveyed, △; partly surveyed, x△; very a few surveyed, x: not surveyed

Area of basin: Alluvial layer (become Quaternary aquifer) is classified by geological map and GIS
Depth/Shape of basin: partly surveyed by electric survey and test wells.
Essential factor: partly surveyed by pumping test and analyzed the permeability and transmissivity.
External factor: There is the data of 40 years precipitations and meteorlogic data.

Source：WRMC (2001)。Mahab Ghodss Company "Report Vol.2, 2-3 Groundwater, 2007"
T*1: m^3/day/m

The stretch of groundwater basin of Quaternary aquifer will be almost investigated by the geological map and satellite image analysis. On the other hand, the depth and shape of basin are almost not investigated because of a few survey numbers. Accordingly, it cannot be estimated the volume of basin. Furthermore, storativity is not investigated because of a few pumping test results and storage capacity of each groundwater basin cannot be computed at present.

It is not recommended not to use the storage groundwater as for groundwater resources at present, it shall be used later that more data will be collected and analyzed. So, groundwater shall be used the volume in annual as recharged volume from the annual precipitation for the groundwater conservation and it shall be called "Groundwater Potential" at present.

The recharged volume to groundwater in annual from precipitation, in other words groundwater potential, is estimated about 19 billion m^3/year simulated by MIKE-SHE.

The water balance of water consumption (2003 year) and recharged volume is shown in the following table.

Table 2.4.3 The Potential and the Water Balance of Groundwater

Zone	Sub-Zone	Area (km^2)	Groundwater Basin Code	Province	Annual Precipitation *1 (mm/y)	Annual Evaporation (mm/y)	Groundwater Recharge (MCM/y)	Pumping Discharge*2 (MCM/y)	Water Balance (MCM/y)	Remarks
A	A-1	6,445.5	1308	Kordestan	285	195	220.16	347.40	-127.24	*3
	A-2	5,072.9	1309	Kordestan	339	206	319.11	77.91	241.20	
	A-3	6,004.0	1307	Kordestan	251	177	162.75	172.66	-9.91	
	小計	17,522.4	-		289	192	702.01	597.97	104.04	
B	B-1	1,817.6	1305	Zanjan	262	194	35.25	116.48	56.25	
	B-2	2,395.4	1306	Zanjan	324	221	38.57	182.95	-1404.38	*3
	B-3	4,590.6	1304	Zanjan	324	228	72.89	336.70	-263.81	*3
	B-4	6,527.1	1305	Zanjan	268	196	128.08	—	—	
	B-5	1,628.5	1303	East Azerbaijan	399	237	42.22	115.77	84.98	
	B-6	3,540.0		East Azerbaijan	409	223	98.65			
	B-7	2,145.1		East Azerbaijan	334	213	59.88			
	小計	22,644.3			323	214	475.53	751.90	-276.37	
C	C-1	1,761.2	1302	Ardabil	378	247	29.38	151.67	-9.31	
	C-2	1,679.3		Ardabil	522	371	39.10			
	C-3	5,020.6		Ardabil	293	226	73.88			
	C-4	2,763.3	1311	Gilan (Upper reach of the Dam)	259	222	8.92	94.75	-85.83	
	小計	11,224.4			332	250	151.28	246.42	-95.14	
D	D-1	942.8	1310	Qazvin, Tehran	617	422	62.75	425.11	-106.30	
	D-2	3,909.3		(Talghan River)	409	252	256.06			
	小計	4,852.1			449	285	318.81	425.11	-106.30	
E	E-1	1,042.6	1301	Gilan (Caspian sea side)	1,105	486	136.36	49.70	164.49	
	E-2	1,805.0		Gilan (Lower reach of the Dam)	554	358	77.83			
	SubTotal	2,847.6			756	405	214.19	49.70	164.49	
Total		59,090.8			346	229	1861.82	2071.11	-209.29	

Note) *1: twenty years from 1985 to 2005, *2: MG Company Report 2006,
*3: Groundwater table lowering area, WRMC monitoring report (1996-2002)

It is supposed the over pumping of groundwater basin 1304 (Zanjan Province), 1306 (Zanjan Province), 1308 (Easter part of Kordestan Province) considering the annual groundwater recharged volume on the basis of the annual average precipitation of 20years from 1985 to 2005. The monitoring well recorded the facts that groundwater level of monitoring wells have lowered from 1996 to 2002. Other pumping yield of basin 1302, 1307, 1310, 1311 exceed the recharged volume, it is the same condition of over pumping. It is afford the groundwater potential in only the basin of 1309 (A-2 zone), 1305(B-1 & B-4 zones), 1303(B-5 zone). From the viewpoint of zone, over pumping is prominent in B, C, and D. The groundwater potential of A and E zone is afford. The groundwater balance is short about 209million m^3/year in Sefidrud River Basin, so groundwater utilization shall be restricted as soon as possible.

CHAPTER 3. OUTLINE OF MASTER PLAN

3.1 BASIC CONCEPT FOR THE INTEGRATED WATER RESOURCES MANAGEMENT

The conceptual relationship among the goals, main activities and planning components is schematized in the following figure.

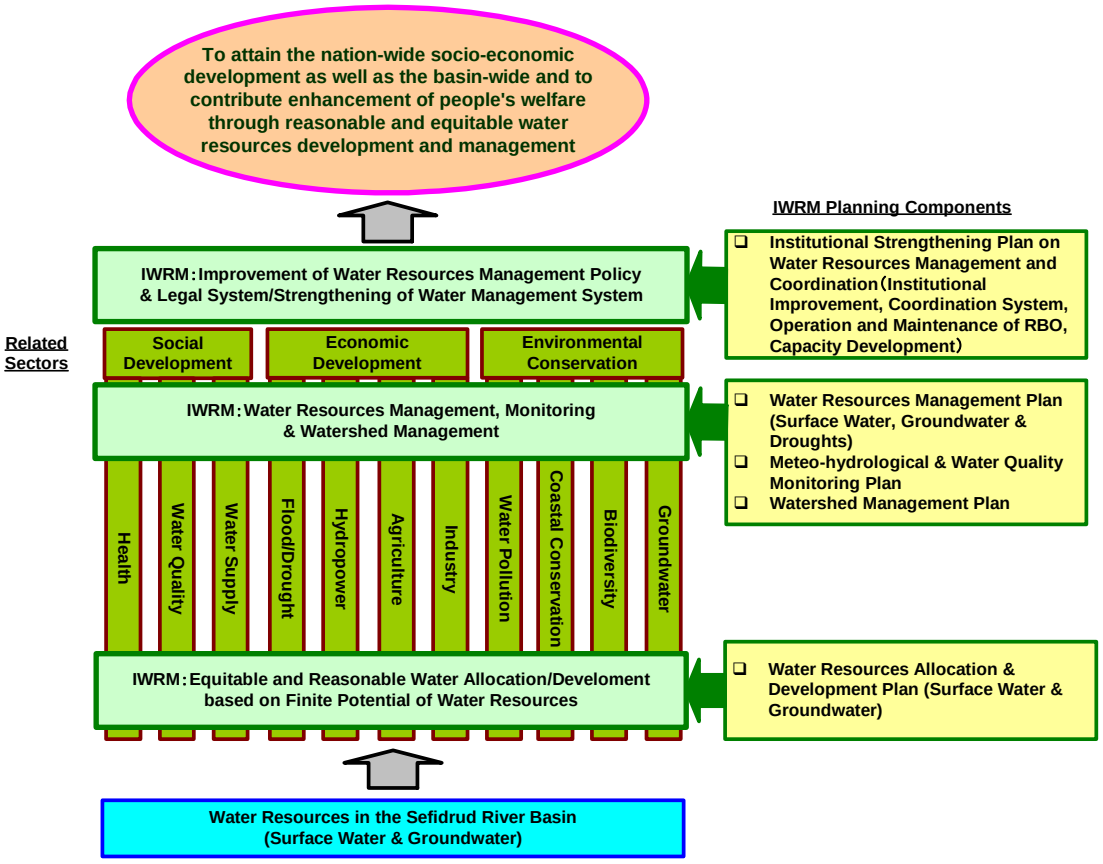


Figure 3.1.1 Integrated Water Resources Management Concept of the Sefidrud

In addition, relationship among the components (sub-plan), which are composed of engineering intervention level and policy coordination one, is illustrated in the following figure. Details of the components are described in the following section.

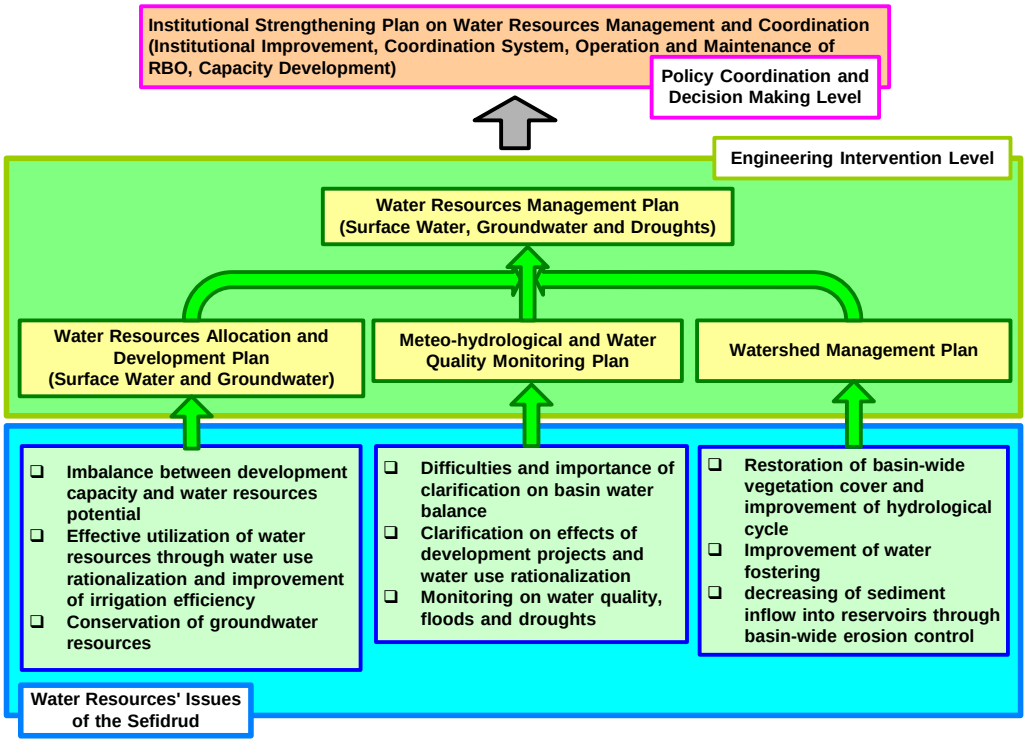


Figure 3.1.2 Structures of IWRM Components of the Sefidrud

The following are planning conditions of the Sefidrud IWRM, and each component shall follow those conditions.

3.1.1 Target Year of the IWRM

The phased plan shall be setup with target years of 2016 in the mid-term plan and 2031 in the long-term plan. Implementation period could be divided into two parts; namely phase I for 10 years from 2007 to 2016, and phase II for 15 years from 2016 to 2031. In accordance with the two periods, phased plan shall be proposed in each component.

3.1.2 Basic Directions of Water Resources Development

Groundwater resources are generally depending on the localities such as geological structures, precipitation, soil cover and so on. In some areas, groundwater resources are suffered from over-extraction resulting in declining the groundwater table. Meanwhile, in another areas development potential still exists, in which the groundwater resources are expected to utilize them for domestic and industrial purposes due to their suitable water quality for them.

The priority of water source should be given to surface water so that main sources to be utilized could be the water regulated by dam reservoirs. In the areas where the groundwater conservation is needed, irrigation water extracted from the groundwater aquifer shall be shifted to surface water. In general the irrigation water might be dominant water users in the most areas.

3.1.3 Prioritization of Water Supply and Their Safety Level

The priorities given to water usage in the long-term water resources development strategy of MOE, the 1st, 2nd and 3rd priorities shall be given to domestic, industrial and irrigation water uses, respectively. Furthermore, the safety level of water uses could be given by drought recurrence period; 10-yaer for domestic and industrial water and 5-year for irrigation water.

3.2 GROUNDWATER MANAGEMENT PLAN

It has been reported that groundwater tables have lowered in the Zanjan and Sujan areas of Zanjan Province and the Ghorveh-Dehgalan area of Kordestan Province. In the recent five years, these groundwater tables have lowered in a range of 3 m to 9 m. In addition to this report, the tables might have lowered in Ardebil City of Ardebil Province and Qazvin Plain of Qazvin Province. There are, however, no clear data available since groundwater aquifers extend widely and groundwater monitoring networks are not dense. Thus it is urgently necessary to establish the reliable groundwater monitoring system for formulating the groundwater management plan. Table 3.2.1 tabulates the management framework, in which priority means implementation order.

Table 3.2.1 Groundwater Management Framework

Management Process	1st Action (Urgent and 1st Priority)	2nd Action (2nd Priority)
1. Urgent measures The area of groundwater lowering area	- Restriction of new development - Control of pumping yield up to recovering water table Basin code: 1304, 1306, 1308 are applicable.	- Safety yield should be determined by pumping test and logical control of pumping yield should be done. - Alternative water resources should be examined: surface water, water conveyance, artificial recharge to groundwater - Investigation of Karst aquifer
2. Preparation of well inventory (Well specification, well log, water level, water quality, results of pumping test)	Subject to large-scale wells	- Subject to the other wells - Management of illegal well
3. Investigation of Aquifer		
(1) Stretch of aquifer	Already investigated	Already investigated
(2) Depth and shape of aquifer	- Geological structure by electric resistivity survey - Geology by well inventory - Investigation of karst aquifer	- Test well should be constructed in a data shortage area and these wells will be converted to monitoring well in future. - Karst aquifer also should be investigated.
(3) Essential factor (permeability, transmissivity etc)	Examination of the existing results for existing pumping test.	Investigation of pumping test for new test wells
(4) External factor (meteorological-hydrological data)	Almost collected 20 to 40 years periods	Almost collected 20 to 40 years periods
4. Installation of monitoring well	Diverting monitoring wells from existing production wells. Exiting monitoring well: 271 wells Diverting wells: 200	New installation: about 250 wells Arrangement: see Figure R 8.3.1
Parameters to be monitored / Monitoring schedule: Level: every month, other item: every dry and rainy seasons	Water level, water quality, pumping yield for each unconfined and confined aquifer	Water level, water quality, pumping yield for each unconfined and confined aquifer
5. Institutional strengthening	- Institution in each aquifer and capacity building. - monitoring and data collection	Basin-wide institution: monitoring system Activity in RBO (River Basin Organization)
6. Database construction	Database processing, analyzing for Aquifer: unconfined or confined water level, yield, quality, hydrogeological constant	Database processing, analyzing for Aquifer: unconfined or confined water level, yield, quality, hydrogeological constant
7. Groundwater simulation	- Computation of Groundwater storage capacity - Computation of recharged volume - Renewable every year based on the collected latest data	- Computation of Groundwater storage capacity - Computation of recharged volume - Renewable every year based on the collected latest data
8. Designation of regulative areas of groundwater pumping yield	Measures in the regulation areas for groundwater lowering area	Strengthening monitoring system in the areas where much groundwater is used
9. Setup of water use regulation order in groundwater lowering areas	Irrigation water	Irrigation and industrial water
10. Measures for drought year (1) Average annual precipitation year (2) Drought year: regulation1 (3) Severe drought year: regulation2	Regulation for well pumping yield (1) No pumping regulation (2) 25% for irrigation well (3) 50% for irrigation/industry well	Regulation for well pumping yield (1) No pumping regulation (2) No pumping regulation (3) 10% for domestic well
11. Revision of legal and penalty system	Revision of existing law	Strengthening of penalty system
12. Enhancement of water users' consciousness and saving water	Enhancement of consciousness on saving water, rationalization of industrial water use, and saving irrigation water	Recycling use of industrial water, reuse of treated wastewater

1) Urgent Measures

The groundwater tables have lowered from 3 to 9 meters in 1996 to 2002 in the groundwater basins of code 1304 Zanjan, 1306 Sajas in Zanjan Province, and 1308 Ghorveh and 1308 Dehgulan in Kordestan Province. Pumping yield should be regulated as soon as possible until to recover the groundwater table in these areas. But, there are not reliable data for total volume of pumping yield, aquifer data, so pumping yield should be regulated 20% and 40% until to recover the groundwater table in these areas in a one cycle of dry and rainy season in an urgent measure. It is also determined the safety yield in each basin on the basis of the urgent simulation for groundwater recharging volume and pumping test. But, these are only urgent measures and after the accumulation of monitoring data, safety yield of groundwater should be examined formally.

2) Preparation of Well Inventory

As for 271 monitoring wells, following items are described: drilling year, coordinates (UTM), elevation, specification of well (depth, diameter, casing diameter), existence of automatic water level meter, results of pumping test/analysis, aquifer type, water level, geology. But, other wells are not described sufficiently. For example, 67 wells in the basin 1301 (depth: up to 15 meters) and 87 well in the basin 1304 (depth: many of them are 50 to 100 meters) have been monitored the water level. But they have not data without coordinates (UTM), elevation, depth, water level in the well inventory. Accordingly, well inventory should be prepared all wells in the Sefidrud River Basin and it should be cleared the target aquifer (unconfined or confined) and pumping yield for the groundwater management.

3) Investigation of Aquifer

The stretch of aquifer is already investigated by the geological and GIS studies. But, geological survey for the geological structure to the direction of depth is not sufficient. So, electric resistivity survey should be conducted to investigate the large-scale geological structure and after that test well drilling will be conducted to clear the geology, hydologeological factor of permeability, porosity, transmissivity, and the distinction between unconfined and confined aquifer.

4) Installation of Monitoring Well

The monitoring well should be established and the following parameters should be monitored. The existing 271 monitoring wells will be continued to monitor and diverting monitoring wells from 200 existing production wells will be established urgently.

In future, the existing 271 monitoring wells and about 250 new monitoring wells should be established. The monitoring system is detailed in Section 3.3.

- Measuring parameters: water level, water quality, pumping yield
- Measuring aquifer: each unconfined aquifer and confined aquifer
- Measuring schedule: water level; every month, others; every dry and rainy seasons

5) Institutional Strengthening

The strengthening of institute and capacity building of personnel will be started in the unit of province for the water resources management and database management of monitoring wells in a short term target. In a long term target, river basin institute (hereinafter called as River Basin Organization) should be established and these personnel who trained above will play an important role in RBO.

6) Database Construction

Collected database should be compiled in each unconfined and confined aquifers. Database have to include the following items: drilling year, coordinates (UTM), elevation, specification of well (depth, diameter, casing diameter), existence of automatic water level meter, results of pumping

test/analysis, aquifer, water level, geology, precipitations, river discharge, land use. Database should be renewed every year.

7) Groundwater Simulation

The storage volume of groundwater and recharging volume to the groundwater will be computed in every year on the bases of every renewal database by MIKE-SHE. The pumping volume of each basin should be determined based on the result of this simulation. For example, the pumping volume will be regulated in the drought year based on the recharged volume.

8) Designation of Regulative Areas of Groundwater Pumping Volume

It is recommended the two regulative areas in an urgent or first priority area and second priority area. The urgent action area is the groundwater lowering area in present where are the basin of 1302, 1304, 1306, and 1308. In the second priority area, it is recommended to strengthen the monitoring system in the areas where much groundwater is used in the basin of 1305, 1307, and 1310.

9) Setup of Water Use Regulation Order in Groundwater Lowering Areas

Pumping of irrigation water should be urgently regulated at the present lowering area of groundwater in a basin of 1302, 1304, 1306, and 1308. If the groundwater table becomes lower, pumping of irrigation and industry water should be regulated.

10) Measures for Pumping Yield in a Drought Year

Measures for pumping yield in a drought year will be implemented on a basis of the database of precipitation. The precipitation data is one of the important elements of recharging volume of groundwater. In the case of normal precipitation of annual average year, there is not regulation of pumping yield because of normal recharging volume to groundwater. But, in the case of drought year, it is recommended two cases of measures as follows. However, it shall be reconsidered based on the further examination of hydrology and Hydrogeology.

- Average annual precipitation year: No pumping yield regulation
- Drought year: 25% for irrigation well from that year to following year
- Severe drought year: 50% for irrigation/industry well and 10% for domestic water well

11) Revision of Legal and Penalty System

The existing laws were almost established and should be revised. Next measures will be recommended to establish the penalty for the smooth and effective application of laws.

12) Enhancement of Water Users' Consciousness and Saving Water

It is recommended to conduct the campaigns of enhancement of users' consciousness for limited water resources. The RWC stuffs who are trained above shall become the trainer and they have to train the residents. After that, saving method of domestic water and irrigation water shall be examined. Furthermore, it shall be examined the recycling use of industrial water and reuse of treated wastewater.

13) Implementation Schedule

The draft implementation schedule of groundwater management is shown following Table 3.2.2.

Table 3.2.2 Implementation Schedule of Groundwater Management (Draft)

	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Urgent measures	―	―	―																	
2	Preparation of well inventory	―	―	―	―	―															
3	Investigation of aquifer				―	―	―	―	―	―	―										
4	Installation of monitoring well				△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△	△△
5	Institutional strengthening	―	―	―	―	―	―	―	―	―	―	―	―	―	―	―					
6	Database construction		―	―	―	―	―	―	―	―	―	―	―	―	―	―	―	―	―	―	―
7	Groundwater simulation			△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
8	Designation of regulative areas				―	―	―														
9	Setup of water use regulation							―	―	―											
10	Measures for drought year							―	―	―											
11	Revision of law and penalty				―	―	―														
12	Enhancement of water users' consciousness & saving water	-	-	-	-	-	-	-	Intermittent work				-	-	-	-	-	-	-	-	-

3.3 GROUNDWATER AND WATER QUALITY MONITORING PLAN

Groundwater and water quality monitoring plan aims at providing the basic data/information to support activities of the RBO (River Basin Organization), and providing reliable and prompt data enough to coordinate among the provinces concerned during drought time and emergency such as water pollution accident. The basic concept of the plan is (1) to select the representative monitoring stations located at important locations and (2) to improve their monitoring instruments. Hereinafter present conditions of monitoring system are summarized and the proposed plan will be presented afterwards.

3.3.1 Present Conditions of Groundwater Monitoring

The fluctuation of groundwater table have not measured enough in the past as explained before chapter, the establishment of monitoring system of groundwater play an important role of the groundwater management. The groundwater monitoring system was established in eight of eleven groundwater basin and groundwater levels have measured continuously, and water quality tests have been conducted periodically.

There are 271 monitoring wells in the groundwater basin of 1301, 1302, 1304, 1306, 1308, 1310, and 1311. WRMC did not investigate in the basin 1303, but, the electric resistivity survey was conducted in the basin 1303 by the other organization. Besides above, there is the WRMC data in GIS but not measuring data in the 1307 basin. Accordingly, it is supposed to be more monitoring wells in the basin including other organization and non-sorting data. No unified data are available in the basin at present.

3.3.2 Monitoring Plan

The number of monitoring wells is few considering the area of Sefidrud River Basin with an area of 59,090km^2. But, if the installation of monitoring was limited in only plain where

production wells are distributed, the area of plain is 18,039km^2 that is equivalent to about 31% of total basin area. The installation and number of monitoring wells are sometime encountered difficulty, but here it is recommended to refer to same scale plain and successful example of regulating pumping yield in Kanto Plain in Japan. The Kanto Plain has an area of about 17,000km^2 and has suffered from the land subsidence because of over pumping of groundwater. Total 450 monitoring wells have been installed during about 30 years from 1955 to 1986 and constructed database, conducted groundwater simulation, determined safety yield of groundwater and implemented and finally completed successfully. Referring this example, it is recommended that the number of monitoring will be about 450 in total and they are allocated in proportion to the area of each basin as shown in Table 3.3.1. It is installed one in each 40km^2, but the existing monitoring wells are too much in basin 1308, so finally total 254 new monitoring wells are recommended as shown in Table 3.3.1. These new monitoring wells shall be installed in the area shown in Figure 3.3.1 (Additional monitoring area) and if production wells could be used, it should be diverted as much as possible. But, it is required that there is the geological logs and the results of pumping test of diverted wells. It is also required that electric resistivity survey should be conducted and geological structure should be investigated around the new monitoring wells.

Monitoring Parameters

Monitoring parameters is as follows:

- Measuring parameters: water level, water quality, pumping yield
- Measuring aquifer: each unconfined aquifer and confined aquifer
- Measuring schedule: water level; every month, others; every dry and rainy seasons

Table 3.3.1 The Recommended Monitoring System of Groundwater

Name of groundwater basin	Basin code	Area (km^2)	Plain area (km^2)	**Existing monitoring well**	*Pumping test*	*Water level measuring*	*Water quality test*	Proper well in total in basin	**Additional new well**
Astaneh-Kuchesfahan	1301	1,923	991	**32**	32	9	32	25	**0**
Tarom-Khakhal	1302	8,604	1,085	**17**	17	17	17	27	**10**
Miyane	1303	9,226	1,607	**0**	0	0	0	40	**40**
Zanjan	1304	4,672	2,368	**59**	59	7	59	59	**0**
Mahneshan-Anguran	1305	7,172	2,598	**0**	0	0	0	65	**65**
Sujas	1306	2,497	1,715	**18**	18	6	18	43	**25**
Goltapeh-Zarinabad	1307	5,131	2,093	**0**	0	0	0	52	**52**
Ghorveh-Dehgulan	1308	7,284	2,807	**134**	1*	1*	134	*70*	***0***
Divandareh-Bijar	1309	5,385	2,225	**0**	0	0	0	56	**56**
Taleghan-Alamut	1310	4,864	358	**3**	3	0	3	*9*	***6***
Manjil	1311	2,261	192	**8**	8	8	8	5	**0**
その他	-	71	0	**0**	0	0	0	-	**-**
合計		59,090	18,039	**271**	138	48	271	450	**254**

Source: WRMC (2001)
*: Code 1308 There are only one data of the results of pumping test and water quality test

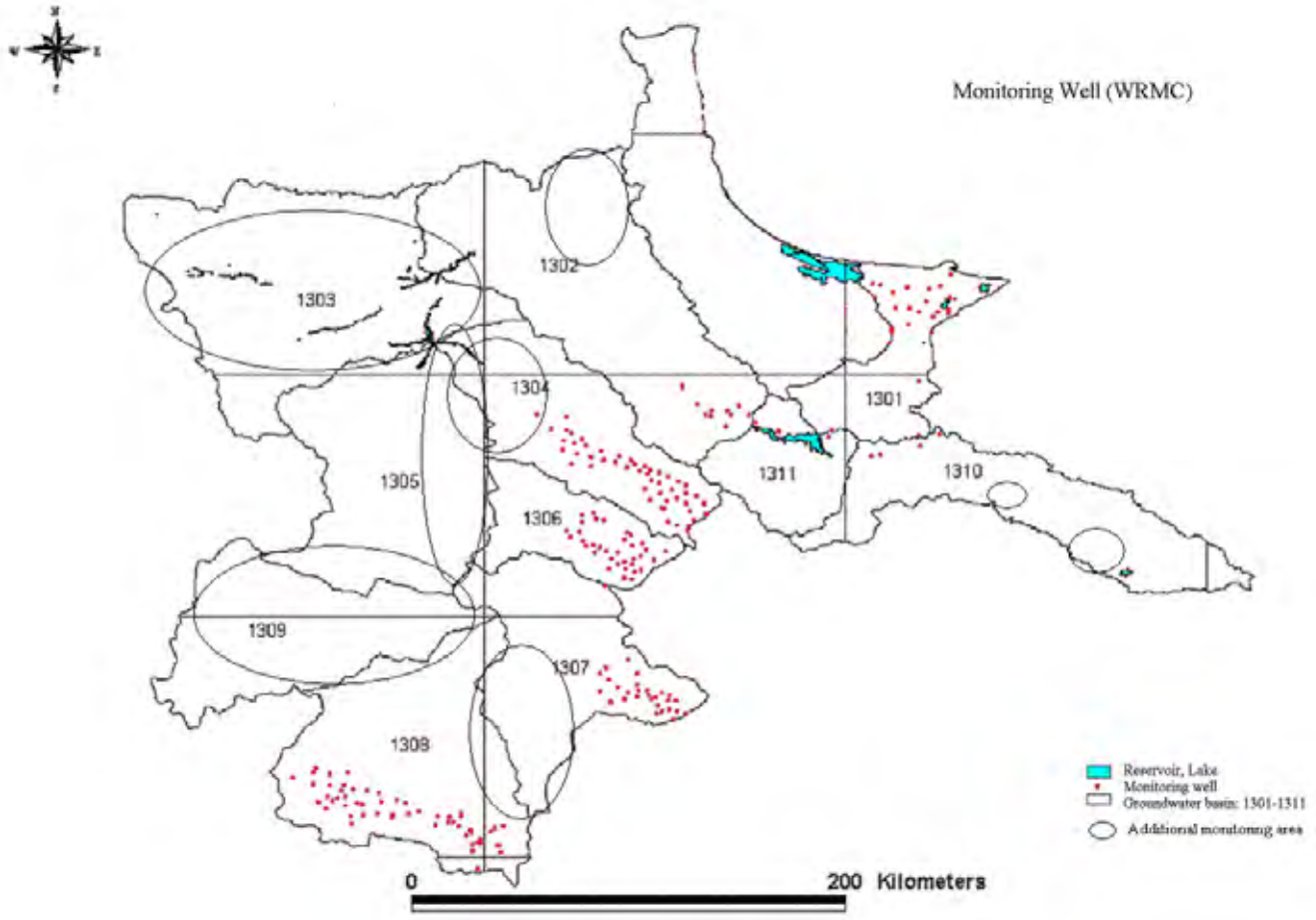


Figure 3.3.1 The Area of Additional Monitoring Well of Groundwater

Appendices

Appendix 1 Geology in Each Aquifer

Groundwater Basin	Basin Code	Zone	Province	Area (Km^2)	Geology
Astaneh-Kochesfahan	1301	E-1 E-2	Gilan	1,923	Highest peak: 2705m & lowest point: -25m. It is facing the Caspian Sea. 39% of the basin is covered by alluvial plains and 52% including fan and hill. Other is mountain topography covering 48% located in the upper part of the basin. Permian sediments to Alluvium deposits are distributed in the basin. Quaternary deposit of Alluvial deposits and fan deposits are distributed in the plain facing Caspian Sea and along the Sefidrud River. Sandstone and shale with coal of Permian to Cretaceous to Jurassic in Mesozoic and volcanic rocks of Tertiary are partly distributed in the upper part of the basin in the Alburzt Mountains.
Tarom-Khalkhal	1302	C-1,2,3	Ardebil	8,604	Mountain topography is dominant. Tarom: alluvial plain 9%: 329km^2, Khalkhal: alluvial plain 5%:248km^2。 Tertiary volcanic rocks are dominantly distributed and intrusive rocks, sandstone, marls, conglomerate, tuff are distributed.
Miyane	1303	B-5,6,7	E-Azerbaijan	9,226	Hilly topography is dominant. Tertiary sandstone, marls, conglomerate, tuff are distributed with unknown period acidic rocks of granite, rhyolite, andesite.
Zanjan	1304	B-3	Zanjan	4,672	It is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Quaternary deposits are distributed on the plain to hilly region and Karaj Formation (lava, tuff, shale) in north-east mountains, Karaj Formations and Pre-Cambrian to Paleozoic sedimentary rocks with intrusive rocks in the south-east mountains are distributed.
Mahneshan-Anguran	1305	B-1 B-4	Zanjan	7,172	It is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Mountainous topography is dominant in the basin of 1305. Highest peak is 3350m. Pre-Cambrian to Quaternary formations are distributed in this area. Tertiary volcanic rocks are widely distributed in the western part and Tertiary sedimentary rocks and quaternary sediments are widely distributed in other area. Old basement rocks are scattered here and there.
Sojas	1306	B-2	Zanjan	2,497	It is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Quaternary deposits are distributed on the plain to hilly region. and Karaj Formation (lava, tuff, shale) in the mountain area, Paleozoic sedimentary rocks with intrusive rocks in the central part of this area are distributed.
Goltapeh-Zarrinabad	1307	A-3	Zanjan	5,131	It is almost composed of plain and hilly region with an elevation of about 1500 to 2000m. Tertiary sedimentary rocks and Quaternary sediments are widely distributed and sedimentary rocks of Cretaceous to Jurassic Period in Mesozoic Era are distributed south-east direction in the central part of the area. Small-scale Salt-domes are found in this area.
Ghorveh-Dehgulan	1308	A-1	Kordestan	7,284	It is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Quaternary deposits, Tertiary sedimentary rocks and partly volcanic rocks are distributed on the plain to hilly region. Volcanic rocks of Mesozoic to Paleozoic Era are distributed in the south-eastern mountains.
Divandareh-Bijar	1309	A-2	Kordestan	5,385	t is composed of plain and hilly region with an elevation of about 1500 to 2000m and mountain area with 2500 to 3000m. Quaternary deposits, Tertiary sedimentary rocks are distributed on the plain to hilly region. Volcanic rocks of Mesozoic Era are distributed in the western mountains.
Taleghan-Alamut	1310	D-1 D-2	Qazvin	4,864	It is mountainous topography in Shafrud River Basin. Talegan Dam is located. Alluvial topography is narrow. Alluvial plain: 10%, 486km^2, Permian in Paleozoic Era, Jurassic and Cretaceous in Mesozoic Era, Tertiary sedimentary rocks and Tertiary volcanic rocks are distributed with intrusive rocks.
Manjil	1311	C-4	Gilan	2,261	This are is locate in upper part of Manjil Dam and mountainous region.: 10% 226km^2。 Tertiary volcanic rocs with intrusive rocks are widely distributed in this area and Tertiary sedimentary rocks and Quaternary sediments are partly distributed in the downstream part.
Others	border with Kermansher, W- Azarbaijan, Mazandaran.			71	Mountainous topography. Sedimentary rocks and igneous rocks of Paleozoic to Mesozoic Era are distributed.
Total				59,090	

Appendix 2 Summary of Pumping Test

	Basin		Province	Sampling number*	Transmissivity (m^2/day)			Yield (l/s)		
	Name	Code			Max.	Min.	Ave.	Max.	Min.	Ave.
1	Astaneh-Kuchesfahan	1301	Gilan	30 (32)	6,689	90	2,025	120.0	3.0	45.1
2	Tarum-Khakhal	1302	Ardebil	16 (17)	3,500	10	1,545	37.5	2.0	19.8
3	Miyane	1303	E.Azerbaijan	- -						
4	Zanjan	1304	Zanjan	17 (59)	1,700	28	742	184.0	4.0	78.7
5	Mahneshan-Anguran	1305	Zanjan	- -						
6	Sujas	1306	Zanjan	15 (18)	2,925	30	1,560	76.0	10.0	55.9
7	Goltapeh-Zarinabad	1307	Kordestan	- -						
8	Ghorveh-Dehgulan	1308	Kordestan	*1 (134)*			*2,850*			*58.0*
9	Divandareh-Bijar	1309	Kordestan	- -						
10	Taleghan-Alamut	1310	Qazvin	*3*	*3,370*	*2,700*	*3,120*	*25.8*	*17.0*	*22.3*
11	Manjil	1311	Gilan	7 (8)	1,800	127	903	56.0	15.1	38.0
	Total			86						

Data source: WRMC *: effective number, (total number)

Appendix 3 (1301) Result of Each Pumping Test (420-025) : کد فرم

Name of study area: Astane -Kochesfahan			Study area code:1301				Plain name: Astane -Kochesfahan			
					Result of pumping				Coefficient of storage percent	
No	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Kind of testing	Water yield L/S	Drawdown (m)	Coefficient of transmissibility m²/day		Note
1	391210 4120500	E Kochesfahan	55	1369/12/21	Continuous	55	1.64	6689		Exploitation
2	364500 4079750	Roudbar Charm CO	54	1368/11/13	Continuous	24.3	5.82	700		"
3	368500 4084250	Rostamabad	51	1369/6/8	Continuous	55	3.47	5400		"
4	403000 4133500	Bichah	84	1369/9/18	Continuous	17	1.83	3918		"
5	386750 4125600	Kiseh Gilan Rasht	59		Continuous	25.5	2.08	1009		"
6	366200 4084000	Tone cabon Roudbar	45	1369/3/23	Continuous	6	25.45	90		"
7	397750 4134000	Balajorshar Lashtenesha	84		Continuous	47	2.7	2123		"
8	396250 4123250	Rashtabad	39	1369/9/28	Continuous	17	1.74	1679		"
9	390500 4126350	Roudgol Kochesfahan	54	1368/12/14	Continuous	47	4.56	1769		"
10	394000 4111150	Tazeabad Jangah	57		Continuous	25	14.95	242		"
11	397000 4132500	Miyangashte Lashtenesha	66	1369/12/8	Continuous	22	2.3	644		"
12	382000 4110650	Gilanlavash	42		Continuous	17	0.09			"
13	406500 4126500	Kiyashahr	57	1379/02/27	Continuous	15	1.41	384		"
14	395200 4123630	Cachamahale	28	1977/7/16	Continuous	31	14	1200	0/0018	"
15	378500 4127750	Ajbishe	25		Continuous	3	2.08	127		"
16	397500 4101800	Kogeh Siyahkal	81		Continuous	25	0.62	1179		"

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Appendix 3 (1301) Result of Each Pumping Test

کد فرم : (420-025)

Name of study area: Astane -Kochesfahan			Study area code:1301			Plain name: Astane -Kochesfahan					
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
17	380900 4116900	Iran Kanaf	42	1367/5/15	Step-drawdown	31.9	8.46	1125		Exploitation
18	383400 4110700	Shaghaji	150	1357/3/1	Step-drawdown	101	4	2133		"
19	381800 4113400	Darposht	120	1363/6/29	Step-drawdown	73	5.21	4000		Exploitation
20	382550 4112800	Darposht	101	1364/6/15	Step-drawdown	76	5.85	3500		"
21	383200 4106800	Darposht	113	1364/6/22	Step-drawdown	73	4.49	2786		"
22	384600 4108300	ction Canal and Jades	80	1364/7/6	Step-drawdown	75	4.1	1952		"
23	383200 4109500	Shahrestan	180	1364/7/10	Step-drawdown	74	3.77	3078		Exploratory
24	383500 4133900	Dafchah	45	1371	Step-drawdown	36	2.8	1400		Exploitation
25	387500 4134600	Meshkasht	30	1366/11/5	Step-drawdown	13.5	2.95	390		Exploitation
26	382800 4105810	Ghaziyan(janali bala mahale	120	1364/4/2	Step-drawdown	120	6/72	2400	0.1	Exploratory
27	384270 4108700	Ghaziyan(janali bala	132	1361/8/26	Step-drawdown	71	0.27	3236	_	Exploratory
28	382050 4108310	Dehbone saravan	132	1361/12/5	Step-drawdown	65	3.24	2922		Exploratory
29	385250 4108450	Ghaziyan Paien mahale	108	1363/3/19	Step-drawdown	4100%	10	1450	0.26	Exploratory
30	385230 4108450	Ghaziyan Paien mahale	60	1363/3/21	Step-drawdown	71	8/62	2600	0/152	Exploratory
e an	393500 4121650	Shaikhali` Bast	26	1377/8/27	Step-drawdown		6/31	1200	0/102	Exploitation
32	397260 4124200	Kacha Paien mahale	27	1377/5/26	Step-drawdown	41	13/69	1450	0/00589	Exploitation

Appendix 3 (1302) Result of Each Pumping Test

کد فرم : (420-025)

Name of study areaTarom-Khalkhal			Study area code:1302			Plain name: Tarom-Khalkhal				
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
1	326750 4073800	Handi candi	48	1368/3/18	Step-drawdown	13.6	23.94	650	0.0205	Exploratory
2	330650 4074760	Charzeh	41	1368/12/3	Step-drawdown	2	9.11	14		"
3	330550 4077400	Someavar	33	1368/12/9	Step-drawdown	12.5	13	440		"
4	318000 4081400	Dast jerdeh	42	1369/2/27	Step-drawdown	17.5	9.98	297		"
5	314300 4084400	Vanisar	60	1369/2/27	Step-drawdown	6.5	11.61	540		"
6	301150 4100550	Deram	38	1368/11/28	Step-drawdown	12.5	11.63	1975		"
7	312250 4087750	Haron abad	20	1369/5/2	Continuous	13	4.57	1950	0.0015	"
8	330640 4074690	Someavar	58	1373/3/18	Step-drawdown	17.8	13	141	7	"
9	330900 4073640	Someavar	27	1373/4/19	Step-drawdown	27.5	0.2	1500 Average	20	"
10	325105 4073813	Ghargholicham	54	1373/4/16	Continuous	متغیر	28.4	10	12	"
11	324860 4073800	Ghargholicham	54	1373/4/16	Step-drawdown	15.55	4.15	700 Average	5	"
12	325780 4075650	Ghameshk	22	1373/3/27	Step-drawdown	28.61	2.92	1500 Average	1	"
13	327450 4075180	Ghargholicham	27	1373/4/3	Step-drawdown	36.94	1.96	3442	2	"
14	328750 4074400	Handi candi	24	1373/4/2	Step-drawdown	35.55	1.88	3000 Average	2	"
15	328300 4073680	Handi candi	22.5	1373/3/24	Step-drawdown	36.94	3.04	2000 Average	6	"
16	329835 4076450	Someavar	30	1373/6/21	Step-drawdown	37.5	1.4	3500 Average	10	"
17	330650 4074760	Jarze chai	50	1368/12/3	Step-drawdown	3	9.11			"
20										
21										
22										

Appendix 3 (1304) Result of Each Pumping Test (420-025) : کد فرم

Name of study areaTarom-Khalkhal				Study area code:1304			Plain name: Zanjan				
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
1	306900 4029600	Vir			Continuous	120	13.64	587		Exploitation
2	304900 4041800	Gharebolagh			Continuous	140	10.9	714		"
3	299000 4052750	Zaker	90	1369	Continuous	14	11.48	447		"
4	292100 4052200	Bonab			Continuous	100	18.3	600		"
5	291050 4056550	Kahnam			Continuous	184	18.47	1615		"
6	286150 4058900	Dizej abad			Continuous	184	1.25	1400		"
7	302850 4046300	Sorkh dizaj			Continuous	162	2.3	1500		"
8	297250 4037000	Sarijlo			Continuous	72.1	27.17	643		"
9	280100 4061350	Sayan			Continuous	165	7.8	1700		"
10	290250 4041500	Sarijlo			Continuous	9	23.41	74		"
11	285500 4055600	Dizej abad			Continuous	9	51.01	28		"
12	268850 4061700	Koshkan Agriculture faculty			Continuous	51	21.71	400		"
13	262300 4076550	Sahrin diba			Continuous	10	42.06	33		"
14	270300 4062800	Home zanjan			Continuous	4	8.87	982		"
15	277850 4059950	Home zanjan			Continuous	18	69.8	225		"
16	282250 4058250	Sayan			Continuous	55	10.21	359		"
17	281300 4060900	Chornab			Continuous	41	11.8	1311		"

Appendix 3 (1304) Result of Each Pumping Test (420-025) : کد فرم

Name of study area:Tarom-Khalkhal				Study area code:1304			Plain name: Zanjan			
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
18	299300 4051250	Morvarid			Continuous			940		Exploitation 19R-15D
19	296300 4040250	Sarijlo			Continuous			36		Exploitation 19T-5SD
20	298150 4036050	Abasabad Sarijlo			Continuous			218		Exploitation 19V-38Ar
21	299550 4035950	Soltaniyeh			Continuous			700		Exploitation 19V-3D
22	291550 4055750	Kahnab			Continuous			390		Exploitation 18Q-2D
23	291050 4044950	Sarijlo Nimavar			Continuous			520		Exploitation
24	287900 4057000	Dizej abad			Continuous			835		Exploitation
25	287150 4056150	Dizej abad			Continuous			21		Exploitation
26	289300 4057250	Dizej abad			Continuous			1814		Exploitation
27	288100 4055550	Dizej abad			Continuous			2400		Exploitation
28	277050 4062950	Doasb Home zanjan			Continuous			351		Exploitation 15P-10-D
29	276800 4059000	Home zanjan			Continuous			143		Exploitation 15Q-16D
30	279300 4059150	Home zanjan			Continuous			268		Exploitation 15Q-39D
31	274600 4061850	Home zanjan Lailabad			Continuous			240		Exploitation 14P-18D
32	271500 4057500	Dizej zarabe			Continuous			306		Exploitation 14Q-31D
33	268500 4067100	Nezam abad			Continuous			785.7		Exploitation 13O-10D
34	269950 4061450	Nezam abad			Continuous			45.6		Exploitation 13O-26D

Appendix 3 (1304) Result of Each Pumping Test (420-025) کد فرم :

Name of study areaTarom-Khalkhal			Study area code:1304				Plain name: Zanjan			
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
35	269700 4065000	Koshkan			Continuous			276		Exploitation 13O-9D
36	268000 4062250	Koshkan			Continuous			444		Exploitation 13P-70D
37	267450 4061150	Koshkan Agriculture faculty			Continuous			42.2		Exploitation 12N
38	262700 4072000	Sahrain diba			Continuous			20		Exploitation 12N
39	263600 4073750	Saremsaghlom			Continuous			360		Exploitation 12N
40	264000 4067350	Khorampi			Continuous			250		Exploitation 12Q
41	299550 4082750	Ghrehjaryan			Continuous			633		Exploitation
42	257650 4079000	Sahrain			Continuous			250		Exploitation
43	315100 4034300	Valaish 2			Continuous			64.5		Exploitation
44	312800 4038450	Dosangan			Continuous			700		Exploitation
45	311300 4026250	Hosain abad			Continuous			208		Exploitation
46	311500 4025600	Hosain abad			Continuous			555		Exploitation 22W-4D
47	305300 4047300	Hosain abad			Continuous			755		Exploitation 21S-
48	306400 4045950	Hosain abad			Continuous			600		Exploitation 21S-4D
49	307000 4044600	Kakabad			Continuous			1198		Exploitation 21T-1D
50	308250 4028250	Vair			Continuous			47		Exploitation 21W-12D
51	303000 4048200	Sorkh dizej			Continuous			890		Exploitation 20S-7D

Appendix 3 (1304) Result of Each Pumping Test (420-025) کد فرم :

Name of study areaTarom-Khalkhal			Study area code:1304				Plain name: Zanjan			
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
52	301100 4047500	Sorkh dizej			Continuous			2029		Exploitation 20S-12D
53	300350 4043550	Gharebolagh			Continuous			405		Exploitation 20T-77D
54	304600 4039900	Elmalki Ghaleye soltaniyeh			Continuous			749		Exploitation
55	304100 4038800	Elmalki Ghaleye soltaniyeh			Continuous			102		Exploitation
56	300900 4036500	Elmalki Ghaleye soltaniyeh			Continuous			1037		Exploitation
57	304600 4029000	Soltaniyeh Vair			Continuous			436		Exploitation
58	303000 4028300	Ghiyaseh			Continuous			74		Exploitation
59	303900 4028250	Ghiyaseh			Continuous			310		Exploitation
60		Hosain abad								Exploratory
61		Sarijlo								"
62		Chir								"

Appendix 3 (1306) Result of Each Pumping Test (420-025) : کد فرم

Name of study area:sojas			Study area code:1306				Plain name:Sojas			
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping: Kind of testing	Result of pumping: Water yield L/S	Result of pumping: Drawdown (m) (متر)	Coefficient of transmissibility m²/day	Coefficient of storage percent	Note
1	274825 4006650	Zarand	120		Step-drawdown	25		935	0.022	Exploratory
2	281225 4008175	Siyaman	217	1373/8/9	Step-drawdown	50		1275	0.67	Exploratory
3		Nazar goli	144	1373/8/15	Step-drawdown	72.5		1660	_	Exploitation Agricultuer Organization
4		Mazidabad	160	1373/9/15	Step-drawdown	72		2720	_	Exploitation Agricultuer Organization
5		Mazidabad	146	1373/8/27	Step-drawdown	71	50	2925	_	Exploitation Agricultuer Organization
6		Khomarak	150	1373/10/12	Step-drawdown	76		2069	_	Exploitation Agricultuer Organization
7		Khomarak	150	1373/8/6	Continuous	74		1700	_	Exploitation Agricultuer Organization
8		Kashkabad	150.9	1373/7/8	Continuous	70		2500	_	Exploitation Agricultuer Organization
9		Paband	160	1373/6/26	Step-drawdown	75		2530	_	Exploitation Agricultuer Organization
10		Koshkabad	160		Step-drawdown	64		1600	_	Exploitation Agricultuer Organization
11	290150 4007825	Gavan dare	249		Step-drawdown	50		1400	0..85	Exploratory
12	291351 4014950	Hasanabad	130		Step-drawdown	17	29.66	100	_	Exploitation
13	285000 4017075	Khomarak	162		Step-drawdown			30	_	Exploitation
14	279175 4015075	Hasanabad	180		Step-drawdown	10		130	3.5	Exploratory
15	283050 4020100	Sojas	102		Step-drawdown			300	_	Exploitation
16	207820 4029000	Aghbolagh	71		Step-drawdown					Exploratory
17	266950 40219000	Aghajeri	71		Step-drawdown					Exploratory
18	279850 4022800	Dabanlogh	150		Step-drawdown					Exploitation

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Appendix 3 (1308) Result of Each Pumping Test (420-025) : کد فرم

Name of study area:Dehgolan-Ghorveh			Study area code:1308				Plain name:Dehgolan			
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping: Kind of testing	Result of pumping: Water yield L/S	Result of pumping: Drawdown (m) (متر)	Coefficient of transmissibility m²/day	Coefficient of storage percent	Note
1	716650 3904500	Karim abad	132.5	1370/3/24	Step-drawdown	54	26.85	2850	0.006	

A3-9

Appendix 3 (1310) Result of Each Pumping Test

کد فرم : (420-025)

Name of study area:Taleghan -alamot			Study area code:1310			Plain name:Taleghan-Alamot				
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percentage	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
1		Loshan	12	1371/12/03	Recovery	24		2700	_	Exploitation
2		Loshan	15	1372/1/23	Recovery	17	12.49	3290	_	Exploitation
3		Loshan	15	1371/1/25	Recovery	25.8	12.06	3370	_	Exploitation
4										
5										
6										
7										
8										
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12										
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14										
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16										

Appendix 3 (1311) Result of Each Pumping Test

کد فرم : (420-025)

Name of study area:Manjil			Study area code:1311			Plain name:Manjil				
NO	Coordinate points of well in system U.T.M	Name of place	Depth of well (m)	Date of testing	Result of pumping				Coefficient of storage percent	Note
					Kind of testing	Water yield L/S	Drawdown (m) (متر)	Coefficient of transmissibility m²/day		
1	345000 4065000	Reasearch center Zaiton	42	1368/6/1	Step-drawdown	15.08	14.81	127		Exploratory
2	345000 4065000	Dasht Gorkhaneh	61	1368/3/11	Step-drawdown	39.88	7.44	560		"
3	345000 4065000	Aliabad	54	1369/2/19	Step-drawdown	56	10.08	450	0.00458	"
4	345000 4065000	Reasearch center Zaiton	51	1369/3/10	Step-drawdown	56	2.03	1120	0.00317	"
5	332000 4073000	Gilvan	40	1373/3/12	Step-drawdown	42.6	6.35	1267		"
6	330500 4073770	Gilvan	34	1373/3/1	Step-drawdown	33.3	2.6	average1800	17	"
7	332500 4072500	Mohamad abad	26	1373/4/7	Step-drawdown	23.3	4.75	average 1000	18	"
8	330850 4071650	Gilan kasheh	42	1368/2/18	Step-drawdown				19	"

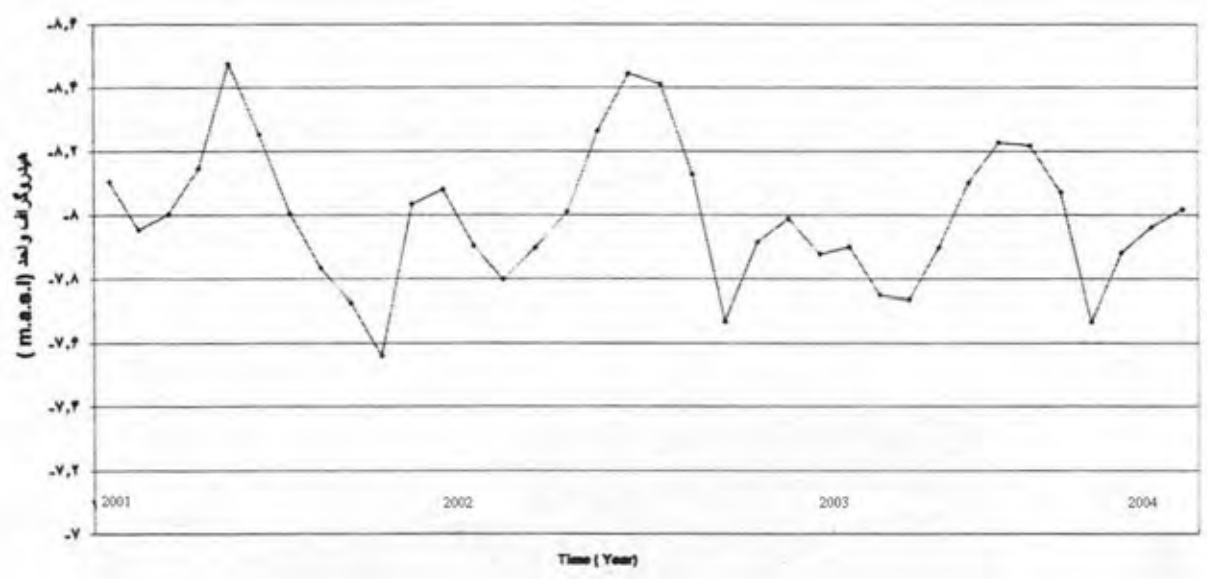
Appendix 4 Annual Discharge Rate of Exploitation Wells Until 1380 (2001)

NO	study area name	Code of Groundwater Basin	Well NO			Average Water yield L/s	Average operation time (h)	Annual discharge(million m³)		Note
			Having discharge and operation time (h)	Lacking discharge	Total		Annual	Unclear	Total	
1	Talesh	1201	4053		4053	4.52	1742	- -	114.9	
2	Foumanat	1202	3043	-	3043	3.25	2635	- -	93.82	
3	Astane-Kochesfahan	1301	654.00	-	654.00	5.70	3,738.00	- -	50.17	
4	Tarom-Kalkal	1302	901.00	-	901.00	15.74	625.00	- -	31.93	
5	Miyane	1303	2,230.00	1,122.00	3,352.00	8.69	1,518.00	- -	105.92	
6	Zanjan	1304	3,741.00	-	3,741.00	11.10	1,512.00	- -	226.12	
7	Mahneshan-Angoran	1305	823.00	-	823.00	5.28	917.00	- -	14.35	
8	Sojas	1306	997.00	-	997.00	6.15	1,806.00	- -	39.87	
9	Goltape-Zarinabad	1307	1,591.00	-	1,591.00	6.52	1,474.00	- -	55.04	
10	Ghorveh-Dehgolan	1308	3,461.00	-	3,461.00	11.23	2,131.00	- -	298.19	
11	Divandare-Bijar	1309	955.00	-	955.00	6.91	1,258.00	- -	29.89	
12	Taleghan-Alamot	1310	12.00	2.00	14.00	15.91	3,739.00	- -	2.57	
13	Manjil	1311	32.00	-	32.00	15.95	2,844.00	- -	5.23	
Total in Sefidrud River Basin			15,397.00	1,124.00	16,521.00	9.93	1,960.18	- -	859.27	

Appendix 5 Groundwater Fluctuation

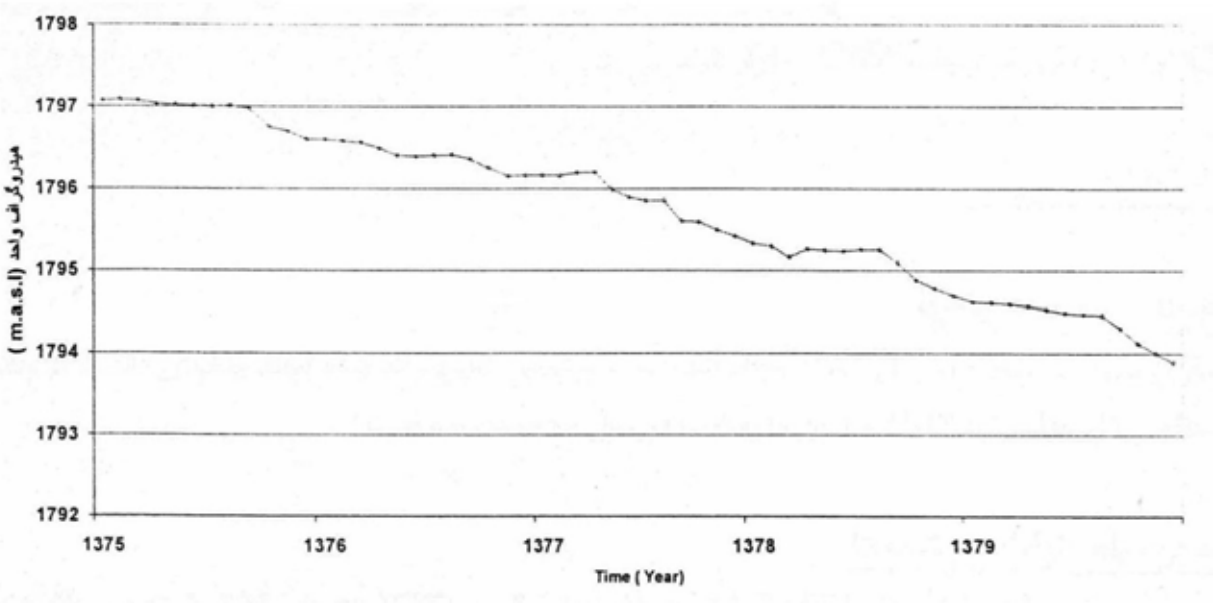
(Data source: Mahab Ghodss Company "Report Vol.2, 2-3 Groundwater, 2007"

1301 Astaneh - Kuchesfahan

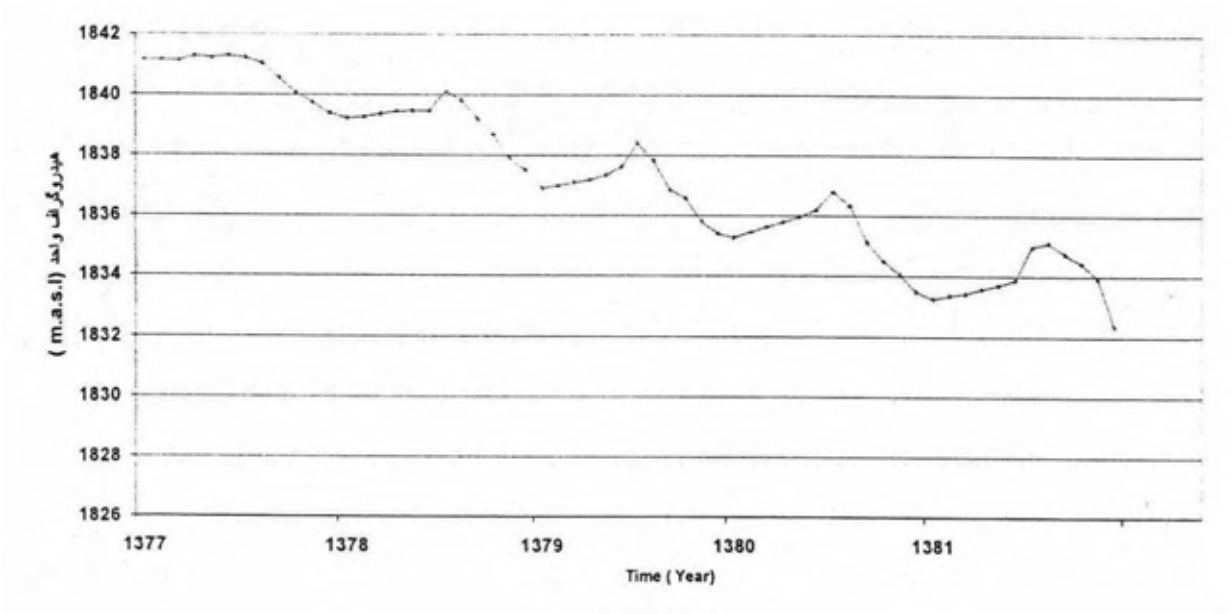


1304 Zanjan

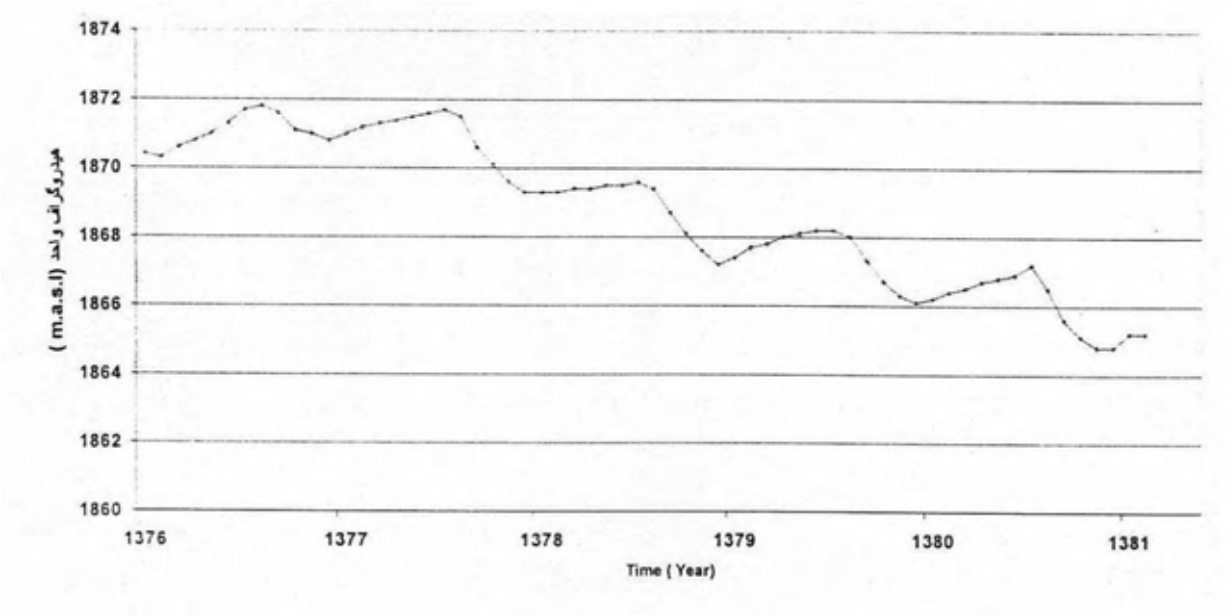
1306 Sujas



1308 Gehgulan



1308 Ghorveh



Appendix 6 Standard for Drinking Water

Parameter	Unit	**ISIRI (Iran)** Max. Permissible	Japan	EC (guide)	EC (MAC)*	WHO (health)	WHO (complains)
Color	mg/l Pt-Co	≦1 (desirable)	≦5	≦1	≦20		≦15
Turbidity	Fomazine turbidity units	≦1 (desirable)	≦2	≦0.4	≦4		≦5
Odor	Dilution number at 25℃	3	not abnormal		≦3		
Taste	Dilution number at 25℃	not abnormal	not abnormal		≦3		
Temperature	℃	-		≦12	≦25		
pH		6.5-9.0	5.8-8.6	6.5-8.7			
Conductivity	micro-S/cm at 20℃			≦400			
Chloride	mg Cl/l	400	≦200	≦25			≦250
Sulphate	mg SO_4/l	400		≦25			≦250
Silica	mg $Si0_2$/l						
Calcium	mg Ca/l	250		≦100			
Magnesium	mg Mg/l	50		≦30	≦50		
Sodium	mg Na/l	200	≦200	≦20	≦150		≦200
Potassium	mg K/l			≦10	≦12		
Aluminum	mg Al/l	0.2		≦0.05	≦0.2		≦0.2
Total hardness	mg $CaCO_3$/l	500	≦300				
Dry residuals (TDS)	mg/l	1500	≦500	≦1500	≦1500		≦1000
Nitrates (NO_3^-)	mg NO_3^-/l	5	$(NO_3)+(N0_2)$≦10	≦5.6	≦11.3	≦11.3	
Nitrites (NO_2^-)	mg NO_2^-/l	3			≦0.03	≦0.96	
Ammonium	mg NH_3/l	1.5		≦0.04	≦0.4		≦1.2
Kjeldahl nitrogen	mg N/l				≦1		
Oxidizability (permanganate value)	mg O_2/l			≦2	≦5		
Total organic carbon	mg C/l						
Hydrogen sulphide	micro-g S/l						≦50
Substances extractable in chloroform	mg/l dry residual			≦0.1			
Dissolved or emulsified hydrocarbons	micro-g/l				≦10		
Phenols	micro-g C6H5OH/l		≦5		≦0.5		
Boron	micro-g B/l			≦1000		≦300	
Surfactants	micro-g/l as lauryl sulfate		≦200		≦200		
Iron	micro-g Fe/l	300	≦300	≦50	≦200		≦300
Manganese	micro-g Mn/l	500	≦50	≦20	≦50	≦500*	≦100
Copper	micro-g Cu/l	1000	≦1000	≦3000		≦2000*	≦1000
Zinc	micro-g Zn/l	3000	≦1000	≦5000			≦3000
Phosphorus	micro-g P/l			≦175	≦2170		
Fluoride	micro-g F/l		≦800		≦1500	≦1500	
Cobalt	micro-g Co/l						
Suspended solids	mg/l			0			
Residual chlorine	micro-g Cl/l						
Barium	micro-g Ba/l					≦700	
Silver	micro-g Ag/l				≦10		
Arsenic	micro-g As/l	50	≦10		≦50	≦10*	
Beryllium	micro-g Be/l						
Cadmium	micro-g Cd/l	5	≦10		≦5	≦3	
Cyanides	micro-g CN/l	70			≦50	≦70	
Chromium	micro-g Cr/l	50	Cr(VI)≦50		≦50	≦50*	
Mercury	micro-g Hg/l	1	≦0.5		≦1	≦1	
Molybdenum	micro-g Mo/l	70				≦70	
Nickel	micro-g Ni/l				≦50	≦20	
Lead	micro-g Pb/l	50	≦50		≦50	≦10	
Antimony	micro-g Sb/l	5			≦10	≦5*	
Selenium	micro-g Se/l	10	≦10		≦10	≦10	
Strontium	micro-g St/l						
Vanadium	micro-g V/l	100					
Total coliforms	No./100ml		0		0	0	
Total bacteria colony counts	No./ml		≦100		≦100		

*MAC: maximum admissable concentration
Reference: meg/l x 50 = mg/l

Appendix 7 Sample of Water Quality Test (1/4)

UTM X	UTM Y	Area	code	Village	cnt	Organization	Province	Kind of source	Owner
393698	4068252	آستانه - کوچصفهان	1301	داماش	5	گیلان 11	گیلان 03	چشمه 5	داماش
361243	4071241	آستانه - کوچصفهان	1301	کلشتر	4	گیلان 11	گیلان 03	چشمه 5	سر چشمه
356800	4082850	آستانه - کوچصفهان	1301	دارستان	4	گیلان 11	گیلان 03	چشمه 5	پیله خوني
365150	4078100	آستانه - کوچصفهان	1301	دولت آباد	4	گیلان 11	گیلان 03	چشمه 5	ديوار زمين
360250	4078450	آستانه - کوچصفهان	1301	لویه	7	گیلان 11	گیلان 03	چشمه 5	معدني لويه
397162	4129433	آستانه - کوچصفهان	1301	جویشت	7	گیلان 11	گیلان 03	چاه نیمه عمیق 2	آب وفاضلاب
401318	4124760	آستانه - کوچصفهان	1301	ابراهیم سرا	7	گیلان 11	گیلان 03	چاه نیمه عمیق 2	آبفاي روستايي
384400	4117250	آستانه - کوچصفهان	1301	گیل پرد سر	7	گیلان 11	گیلان 03	چاه نیمه عمیق 2	کارگاه سنگ وبلوك سازي
417400	4135800	آستانه - کوچصفهان	1301	دهکاه	7	گیلان 11	گیلان 03	چاه نیمه عمیق 2	گرمابه
406600	4141800	آستانه - کوچصفهان	1301	کیاشهر	7	گیلان 11	گیلان 03	چاه نیمه عمیق 2	شيلات
380400	4137552	آستانه - کوچصفهان	1301	خواچکین	7	گیلان 11	گیلان 03	چاه عمیق 1	کارخانه شهد
383052	4110444	آستانه - کوچصفهان	1301	شاقاجي	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي روستايي
380866	4108397	آستانه - کوچصفهان	1301	سراوان	7	گیلان 11	گیلان 03	چاه عمیق 1	دستکش گیلان
389991	4136147	آستانه - کوچصفهان	1301	خشکبیجار	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي شهري شماره 3
402298	4136418	آستانه - کوچصفهان	1301	لیچاه	7	گیلان 11	گیلان 03	چاه عمیق 1	آب وفاضلاب
385087	4133761	آستانه - کوچصفهان	1301	دافچاه	7	گیلان 11	گیلان 03	چاه عمیق 1	آب وفاضلاب
398470	4135258	آستانه - کوچصفهان	1301	لشت نشا	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي شهري شماره1
405610	4130910	آستانه - کوچصفهان	1301	نازکسرا	7	گیلان 11	گیلان 03	چاه عمیق 1	توليدي مرغ وماهي
385917	4126410	آستانه - کوچصفهان	1301	جعفر آباد	7	گیلان 11	گیلان 03	چاه عمیق 1	ريسندگي گيلان
390966	4126473	آستانه - کوچصفهان	1301	کوچصفهان	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي شهري
405107	4125868	آستانه - کوچصفهان	1301	گورکاه	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي روستايي
394313	4124623	آستانه - کوچصفهان	1301	رودبارکي	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي روستايي
390311	4118768	آستانه - کوچصفهان	1301	کدوسرا	7	گیلان 11	گیلان 03	چاه عمیق 1	اهالي
384060	4115435	آستانه - کوچصفهان	1301	سنگر	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي شهري
405300	4123800	آستانه - کوچصفهان	1301	آستانه-جاده کیا	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي شهري شماره 5
399500	4122100	آستانه - کوچصفهان	1301	کیسم	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي روستايي
398900	4114900	آستانه - کوچصفهان	1301	لشکریان	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي روستايي
393800	4092600	آستانه - کوچصفهان	1301	پاشاکي	7	گیلان 11	گیلان 03	چاه عمیق 1	آبفاي روستايي
332850	4073040	طارم - خلخال	1302	گیلوان	6	گیلان 11	گیلان 03	چشمه 5	کربلايي قربان
324236	4079142	طارم - خلخال	1302	زهتر آباد	7	گیلان 11	گیلان 03	چشمه 5	پيل آقا سر
320962	4074204	طارم - خلخال	1302	تشویر	0	گیلان 11	گیلان 03	چشمه 5	اهالي محل
333290	4071707	طارم - خلخال	1302	گیلوان	7	گیلان 11	گیلان 03	چشمه 5	اهالي محل
341415	4070708	طارم - خلخال	1302	بهرام آباد	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
330930	4078908	طارم - خلخال	1302	انارستان	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
327210	4082527	طارم - خلخال	1302	خرم آباد	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
323831	4085361	طارم - خلخال	1302	ده بهار	2	گیلان 11	گیلان 03	قنات 4	اهالي محل
316628	4078674	طارم - خلخال	1302	شور آب	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
316965	4080070	طارم - خلخال	1302	دستجرده	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
311613	4083441	طارم - خلخال	1302	وني سر	6	گیلان 11	گیلان 03	قنات 4	اهالي محل
306262	4091254	طارم - خلخال	1302	ارشت 2	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
333632	4066350	طارم - خلخال	1302	آلتن کش	4	گیلان 11	گیلان 03	قنات 4	اهالي محل
314330	4079215	طارم - خلخال	1302	قاضي بلاغي	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
322490	4079965	طارم - خلخال	1302	پیرچم	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
322165	4073423	طارم - خلخال	1302	تشویر	5	گیلان 11	گیلان 03	قنات 4	اهالي محل
306282	4092380	طارم - خلخال	1302	ارشت 1	7	گیلان 11	گیلان 03	قنات 4	اهالي محل
313350	4033450	زنجان	1304	اراضي والايشر	6	زنجان 15	زنجان 21		
309150	4030700	زنجان	1304	اراضي حسين آ	8	زنجان 15	زنجان 21		
313100	4038050	زنجان	1304	اراضي دوسنک	7	زنجان 15	زنجان 21		
310150	4041950	زنجان	1304	اراضي بويين	8				
306550	4046750	زنجان	1304	اراضي كك آباد	7	زنجان 15	زنجان 21		
303825	4048550	زنجان	1304	اراضي سرخه	7	زنجان 15	زنجان 21		
299800	4051050	زنجان	1304	اراضي مرواريد	7	زنجان 15	زنجان 21		
296675	4052675	زنجان	1304	اراضي اسكند	8	زنجان 15	زنجان 21		
311475	4025600	زنجان	1304	اراضي وير	7	زنجان 15	زنجان 21		
307925	4027750	زنجان	1304	اراضي وير	7	زنجان 15	زنجان 21		
302950	4028350	زنجان	1304	اراضي قياسيه	3	زنجان 15	زنجان 21		
307650	4034600	زنجان	1304	اراضي سنبل اب	8	زنجان 15	زنجان 21		
299700	4030100	زنجان	1304	اراضي سلطانيه	8	زنجان 15	زنجان 21		
297250	4037000	زنجان	1304	اراضي عباس آ	1	زنجان 15	زنجان 21		
298300	4036250	زنجان	1304	اراضي عباس آ	8	زنجان 15	زنجان 21		
306525	4038550	زنجان	1304	اراضي قره بلا	7	زنجان 15	زنجان 21		
303075	4040800	زنجان	1304	اراضي قره بلا	7	زنجان 15	زنجان 21		
306450	4043075	زنجان	1304	اراضي قره بلا	8	زنجان 15	زنجان 21		
301450	4045150	زنجان	1304	اراضي خير آب	7	زنجان 15	زنجان 21		
299150	4039675	زنجان	1304	اراضي الملكي	8	زنجان 15	زنجان 21		
297150	4043150	زنجان	1304	اراضي مشك اب	6	زنجان 15	زنجان 21		
293050	4040650	زنجان	1304	اراضي ساريجا	3	زنجان 15	زنجان 21		
296375	4047825	زنجان	1304	اراضي نيماور	6	زنجان 15	زنجان 21		
291025	4044950	زنجان	1304	اراضي نيماور	8	زنجان 15	زنجان 21		
293850	4049525	زنجان	1304	اراضي نيماور	7	زنجان 15	زنجان 21		
289500	4053375	زنجان	1304	اراضي بناب	8	زنجان 15	زنجان 21		
293425	4054000	زنجان	1304	اراضي بناب	7	زنجان 15	زنجان 21		
293375	4053850	زنجان	1304	اراضي بناب	5	زنجان 15	زنجان 21		
292125	4052200	زنجان	1304	اراضي بناب	8	زنجان 15	زنجان 21		
291500	4055750	زنجان	1304	اراضي كهناب	7	زنجان 15	زنجان 21		

Appendix 7 Sample of Water Quality Test (2/4)

UTM X	UTM Y	Area	code	Village	cnt	Organization	Province	Kind of source	Owner
287587	4057025	زنجان	1304	راضي ديزج آب	9	زنجان 15	زنجان 21		
284950	4055400	زنجان	1304	راضي ديزج آب	7	زنجان 15	زنجان 21		
286100	4058850	زنجان	1304	راضي ديزج آب	4	زنجان 15	زنجان 21		
280875	4058000	زنجان	1304	اراضي سايان	8	زنجان 15	زنجان 21		
280625	4061300	زنجان	1304	اراضي سيلان	0	زنجان 15	زنجان 21		
282475	4060600	زنجان	1304	اراضي سايان	8	زنجان 15	زنجان 21		
276500	4059000	زنجان	1304	اراضي حومه ز	6	زنجان 15	زنجان 21		
271750	4056200	زنجان	1304	اراضي ديزج ح	8	زنجان 15	زنجان 21		
264850	4057850	زنجان	1304	راضي آقجه بير	6	زنجان 15	زنجان 21		
276000	4063200	زنجان	1304	زنجان مجاورش	5	زنجان 15	زنجان 21		
272175	4060850	زنجان	1304	حومه زنجان	6	زنجان 15	زنجان 21		
270050	4065825	زنجان	1304	اراضي كوشكز	7	زنجان 15	زنجان 21		
268950	4068775	زنجان	1304	اراضي كوشكز	6	زنجان 15	زنجان 21		
265900	4067000	زنجان	1304	اراضي نظام آب	7	زنجان 15	زنجان 21		
261900	4068400	زنجان	1304	اراضي نظام آب	6	زنجان 15	زنجان 21		
266950	4062250	زنجان	1304	اراضي كوشكز	8	زنجان 15	زنجان 21		
281100	4063750	زنجان	1304	اراضي كوشكز	0	زنجان 15	زنجان 21		
261300	4064250	زنجان	1304	اراضي مهتر	5	زنجان 15	زنجان 21		
265250	4071800	زنجان	1304	اراضي سارمس	6	زنجان 15	زنجان 21		
263000	4073050	زنجان	1304	اراضي سارمس	8	زنجان 15	زنجان 21		
263425	4079150	زنجان	1304	اراضي سهرين	1	زنجان 15	زنجان 21		
263425	4079150	زنجان	1304	اراضي سهرين	1	زنجان 15	زنجان 21		
257400	4074050	زنجان	1304	اراضي ينكجه	8	زنجان 15	زنجان 21		
252450	4080750	زنجان	1304	اراضي كزبر	8	زنجان 15	زنجان 21		
315875	4033500	زنجان	1304	والايش	5	زنجان 15	زنجان 21		عين الله اسماعيلي
268000	4030950	سوجاس	1306	اينجه	9	زنجان 15	زنجان 21		
272450	4035200	سوجاس	1306	جتز	7	زنجان 15	زنجان 21		
267825	4033750	سوجاس	1306	جتز	8	زنجان 15	زنجان 21		
273000	4031925	سوجاس	1306	باريكاب	7	زنجان 15	زنجان 21		
276000	4031375	سوجاس	1306	آقبلاغ	9	زنجان 15	زنجان 21		
261800	4027150	سوجاس	1306	جوقين	7	زنجان 15	زنجان 21		
266600	4026025	سوجاس	1306	شيوه	9	زنجان 15	زنجان 21		
283875	4025275	سوجاس	1306	بولاماجي	8	زنجان 15	زنجان 21		
263125	4023950	سوجاس	1306	شيوه	7	زنجان 15	زنجان 21		
268050	4021825	سوجاس	1306	آقاجري	8	زنجان 15	زنجان 21		
271905	4020200	سوجاس	1306	زرزر	8	زنجان 15	زنجان 21		
283100	4022250	سوجاس	1306	بولاماجي	8	زنجان 15	زنجان 21		
289660	4020300	سوجاس	1306	شوراب	9	زنجان 15	زنجان 21		
274050	4018650	سوجاس	1306	خوش	8	زنجان 15	زنجان 21		
276800	4016800	سوجاس	1306	خنداب	8	زنجان 15	زنجان 21		
281000	4016075	سوجاس	1306	سجاس	8	زنجان 15	زنجان 21		
285775	4019100	سوجاس	1306	ينكجه	8	زنجان 15	زنجان 21		
291245	4017050	سوجاس	1306	خمارك	8	زنجان 15	زنجان 21		
298300	4016800	سوجاس	1306	بابند	8	زنجان 15	زنجان 21		
282625	4012400	سوجاس	1306	سجاس	8	زنجان 15	زنجان 21		
278550	4013400	سوجاس	1306	سجاس	8	زنجان 15	زنجان 21		
285910	4013415	سوجاس	1306	مجيد آباد	8	زنجان 15	زنجان 21		
288875	4014450	سوجاس	1306	خمارك	8	زنجان 15	زنجان 21		
285575	4011150	سوجاس	1306	مزيد آباد	8	زنجان 15	زنجان 21		
293975	4012625	سوجاس	1306	بابند	8	زنجان 15	زنجان 21		
288725	4007800	سوجاس	1306	كوندره	7	زنجان 15	زنجان 21		
272350	4016650	سوجاس	1306	خوش	7	زنجان 15	زنجان 21		
269075	4019650	سوجاس	1306	جوزك	7	زنجان 15	زنجان 21		
285525	4024850	سوجاس	1306	محمد آباد	7	زنجان 15	زنجان 21		
277450	4008800	سوجاس	1306	نهروان	8	زنجان 15	زنجان 21		
283150	4008325	سوجاس	1306	مزيد آباد	8	زنجان 15	زنجان 21		
286650	4007500	سوجاس	1306	مزيدآباد	8	زنجان 15	زنجان 21		
282700	4004350	سوجاس	1306	زواجر	8	زنجان 15	زنجان 21		
285625	4003855	سوجاس	1306	كوندره	6	زنجان 15	زنجان 21		
275775	4001202	سوجاس	1306	جنقور	8	زنجان 15	زنجان 21		
280625	4010805	سوجاس	1306	سيامان	8	زنجان 15	زنجان 21		
277600	3968050	گل تپه - زرين آباد	1307	بيرمرزبان	8	زنجان 15	زنجان 21		
279750	3965425	گل تپه - زرين آباد	1307	قجور	8	زنجان 15	زنجان 21		
283000	3966925	گل تپه - زرين آباد	1307	زاغه	8	زنجان 15	زنجان 21		
282250	3961000	گل تپه - زرين آباد	1307	محمدخلج	8	زنجان 15	زنجان 21		
286125	3960450	گل تپه - زرين آباد	1307	محمد خلج	8	زنجان 15	زنجان 21		
286350	3955125	گل تپه - زرين آباد	1307	شرور	8	زنجان 15	زنجان 21		
276250	3957500	گل تپه - زرين آباد	1307	سرين	8	زنجان 15	زنجان 21		
272850	3960710	گل تپه - زرين آباد	1307	زرين آباد	7	زنجان 15	زنجان 21		
275225	3963300	گل تپه - زرين آباد	1307	قوطي آباد	9	زنجان 15	زنجان 21		
272525	3952450	گل تپه - زرين آباد	1307	داش بلاغ	8	زنجان 15	زنجان 21		
276550	3946675	گل تپه - زرين آباد	1307	غلام ويس	8	زنجان 15	زنجان 21		
300655	3947400	گل تپه - زرين آباد	1307	جبقلو	8	زنجان 15	زنجان 21		

Appendix 7 Sample of Water Quality Test (3/4)

UTM X	UTM Y	Area	code	Village	cnt	Organization	Province	Kind of source	Owner
298200	3950075	گل تپه - زرين آباد	1307	آربادره	8	زنجان 15	زنجان 21		
279375	3953975	گل تپه - زرين آباد	1307	استرود	8	زنجان 15	زنجان 21		
282765	3951475	گل تپه - زرين آباد	1307	توزلو	8	زنجان 15	زنجان 21		
281365	3948850	گل تپه - زرين آباد	1307	توزلو	7	زنجان 15	زنجان 21		
276300	3947390	گل تپه - زرين آباد	1307	توزلو	8	زنجان 15	زنجان 21		
286425	3952575	گل تپه - زرين آباد	1307	بزين	8	زنجان 15	زنجان 21		
290200	3950325	گل تپه - زرين آباد	1307	كهلا	8	زنجان 15	زنجان 21		
286050	3949450	گل تپه - زرين آباد	1307	كهلا	8	زنجان 15	زنجان 21		
290150	3952625	گل تپه - زرين آباد	1307	كهلا	8	زنجان 15	زنجان 21		
295395	3950975	گل تپه - زرين آباد	1307	كهلا	8	زنجان 15	زنجان 21		
292925	3949025	گل تپه - زرين آباد	1307	حي	8	زنجان 15	زنجان 21		
291550	3948200	گل تپه - زرين آباد	1307	حي	8	زنجان 15	زنجان 21		
290125	3945100	گل تپه - زرين آباد	1307	حي	8	زنجان 15	زنجان 21		
297500	3947475	گل تپه - زرين آباد	1307	ملابداغ	8	زنجان 15	زنجان 21		
293750	3945350	گل تپه - زرين آباد	1307	ملابداغ	8	زنجان 15	زنجان 21		
297950	3943275	گل تپه - زرين آباد	1307	ملابداغ	8	زنجان 15	زنجان 21		
299575	3938950	گل تپه - زرين آباد	1307	قره بلاغ	7	زنجان 15	زنجان 21		
300850	3942425	گل تپه - زرين آباد	1307	قره بلاغ	8	زنجان 15	زنجان 21		
294905	3942400	گل تپه - زرين آباد	1307	تخت	8	زنجان 15	زنجان 21		
293250	3941875	گل تپه - زرين آباد	1307	تخت	8	زنجان 15	زنجان 21		
304325	3941575	گل تپه - زرين آباد	1307	منصور آباد	8	زنجان 15	زنجان 21		
333333	4444444	گل تپه - زرين آباد	1307	بالغلي بلاغ	0	زنجان 15	زنجان 21		
232797	3879143	قروه - دهگلان	1308	وينسار	0	كردستان 25	كردستان 14	1 چاه عميق	شاداله رضايي
767032	3887036	قروه - دهگلان	1308	دزج	0	كردستان 25	كردستان 14	1 چاه عميق	الماسي فرد
769492	3883039	قروه - دهگلان	1308	دزج	0	كردستان 25	كردستان 14	1 چاه عميق	عزت صابريان
772553	3883560	قروه - دهگلان	1308	دزج	0	كردستان 25	كردستان 14	1 چاه عميق	نبي نبي زاده
771354	3883952	قروه - دهگلان	1308	دزج	0	كردستان 25	كردستان 14	1 چاه عميق	نبي خوشنواز
769593	3879890	قروه - دهگلان	1308	صندوق آباد	0	كردستان 25	كردستان 14	1 چاه عميق	حسين آييني
232525	3882383	قروه - دهگلان	1308	وينسار	0	كردستان 25	كردستان 14	1 چاه عميق	عبدالله كريمي
768954	3889483	قروه - دهگلان	1308	ناظم آباد	0	كردستان 25	كردستان 14	1 چاه عميق	ربيع ربيعي
768851	3888166	قروه - دهگلان	1308	ناظم آباد	0	كردستان 25	كردستان 14	1 چاه عميق	مصطفي فرهادي
768235	3889483	قروه - دهگلان	1308	ناظم آباد	0	كردستان 25	كردستان 14	1 چاه عميق	هادي فرهادي
768615	3887014	قروه - دهگلان	1308	دزج	0	كردستان 25	كردستان 14	1 چاه عميق	مشاع
232471	3882394	قروه - دهگلان	1308	مجين	0	كردستان 25	كردستان 14	1 چاه عميق	نورالله ايزدي
772266	3885214	قروه - دهگلان	1308	دزج	0	كردستان 25	كردستان 14	1 چاه عميق	بخشعلي قانع
772000	3871648	قروه - دهگلان	1308	سياه گله	3	كردستان 25	كردستان 14	1 چاه عميق	علي چهاردولي
772745	3877160	قروه - دهگلان	1308	شهاب الدين	3	كردستان 25	كردستان 14	1 چاه عميق	قربان كرمي
227803	3891672	قروه - دهگلان	1308	زنگ آباد	0	كردستان 25	كردستان 14	1 چاه عميق	روح الله نامداري
229501	3888864	قروه - دهگلان	1308	دوسر	0	كردستان 25	كردستان 14	1 چاه عميق	عليجان مهرابي
230431	3872680	قروه - دهگلان	1308	حسن آباد امام	0	كردستان 25	كردستان 14	1 چاه عميق	داوري كرامت
231477	3893115	قروه - دهگلان	1308	جداقيه	0	كردستان 25	كردستان 14	1 چاه عميق	ميرزا خدا ويسي
230157	3875714	قروه - دهگلان	1308	قادر آباد	1	كردستان 25	كردستان 14	1 چاه عميق	حسين حيدريان
230721	3890510	قروه - دهگلان	1308	دوسر	3	كردستان 25	كردستان 14	1 چاه عميق	منابع طبيعي
231541	3882018	قروه - دهگلان	1308	وينسار	0	كردستان 25	كردستان 14	1 چاه عميق	عزت رضايي
234549	3890852	قروه - دهگلان	1308	نارنجك	0	كردستان 25	كردستان 14	1 چاه عميق	خليل جليلي
708178	3914615	قروه - دهگلان	1308	قوريچاي	0	كردستان 25	كردستان 14	2 چاه نيمه عميق	نبي خسروي
709040	3916303	قروه - دهگلان	1308	قوريچاي	0	كردستان 25	كردستان 14	1 چاه عميق	حسين پناهي
714782	3908807	قروه - دهگلان	1308	كروندان	0	كردستان 25	كردستان 14	1 چاه عميق	صلاح حسامي
720222	3908902	قروه - دهگلان	1308	حسيني	0	كردستان 25	كردستان 14	1 چاه عميق	شريف احمدي
714535	3913957	قروه - دهگلان	1308	حاجي پموق	0	كردستان 25	كردستان 14	2 چاه نيمه عميق	خالد نوري
719385	3906305	قروه - دهگلان	1308	دهگلان	0	كردستان 25	كردستان 14	1 چاه عميق	شركت آبفا
715693	3900914	قروه - دهگلان	1308	مبارك آباد	0	كردستان 25	كردستان 14	1 چاه عميق	محمد مباركي
717877	3902553	قروه - دهگلان	1308	مبارك آباد	0	كردستان 25	كردستان 14	1 چاه عميق	حسن مباركي
710563	3901021	قروه - دهگلان	1308	چراغ آباد	0	كردستان 25	كردستان 14	1 چاه عميق	احمد عباسي
713482	3898011	قروه - دهگلان	1308	سرنجيانه	0	كردستان 25	كردستان 14	1 چاه عميق	غلام حيدريان
700753	3911774	قروه - دهگلان	1308	هليز آباد	0	كردستان 25	كردستان 14	1 چاه عميق	صالح يوسفي
718439	3900281	قروه - دهگلان	1308	مبارك آباد	0	كردستان 25	كردستان 14	1 چاه عميق	اسماعيل مباركي
744750	3896455	قروه - دهگلان	1308	شانوره	0	كردستان 25	كردستان 14	1 چاه عميق	امين كريمي
720505	3903721	قروه - دهگلان	1308	سعيد آباد	0	كردستان 25	كردستان 14	1 چاه عميق	احمد مباركي
733535	3905420	قروه - دهگلان	1308	شجاع آباد	0	كردستان 25	كردستان 14	1 چاه عميق	عابد صيدي
723735	3907090	قروه - دهگلان	1308	آب باريك	0	كردستان 25	كردستان 14	1 چاه عميق	فتح الله كريمي
740181	3902398	قروه - دهگلان	1308	شهابيه	0	كردستان 25	كردستان 14	1 چاه عميق	عباس اردلان
738956	3895488	قروه - دهگلان	1308	خليل آباد	0	كردستان 25	كردستان 14	1 چاه عميق	مراد نژاد
737126	3900330	قروه - دهگلان	1308	گنجي	0	كردستان 25	كردستان 14	1 چاه عميق	موسي رحماني
743930	3900860	قروه - دهگلان	1308	آونگان	0	كردستان 25	كردستان 14	1 چاه عميق	امين صالحي
721270	3914600	قروه - دهگلان	1308	تلوار	0	كردستان 25	كردستان 14	2 چاه نيمه عميق	احمد محمدي
713780	3903247	قروه - دهگلان	1308	چراغ آباد	0	كردستان 25	كردستان 14	1 چاه عميق	آقابار يوسفي
702540	3916700	قروه - دهگلان	1308	چرخه بيان	0	كردستان 25	كردستان 14	1 چاه عميق	جميل سليماني
725157	3900679	قروه - دهگلان	1308	عالي آباد	0	كردستان 25	كردستان 14	2 چاه نيمه عميق	آقابرا خالديان
725720	3901389	قروه - دهگلان	1308	توبره ريز	0	كردستان 25	كردستان 14	1 چاه عميق	عبدالله خالديان
733070	3895843	قروه - دهگلان	1308	سراب قحط	0	كردستان 25	كردستان 14	1 چاه عميق	حبيب الله رضايي
727551	3895375	قروه - دهگلان	1308	قاملو	0	كردستان 25	كردستان 14	1 چاه عميق	مراد علي جعفري
723050	3894485	قروه - دهگلان	1308	كبود خاني	0	كردستان 25	كردستان 14	2 چاه نيمه عميق	اهالي

Appendix 7 Sample of Water Quality Test (4/4)

UTM X	UTM Y	Area	code	Village	cnt	Organization	Province	Kind of source	Owner
723430	3891200	قروه - دهگلا ن	1308	سلسله	0	کردستان 25	کردستان 14	1 چاه عمیق	عبدالله مفاخري
738650	3894605	قروه - دهگلا ن	1308	کنگره	0	کردستان 25	کردستان 14	1 چاه عمیق	احمد خالديان
708389	3908621	قروه - دهگلا ن	1308	زاغه	0	کردستان 25	کردستان 14	1 چاه عمیق	محمد رشيدي
720654	3899355	قروه - دهگلا ن	1308	جوانمرد آباد	0	کردستان 25	کردستان 14	1 چاه عمیق	جوانمردي
734305	3901535	قروه - دهگلا ن	1308	کامشگران	0	کردستان 25	کردستان 14	1 چاه عمیق	جعفر نظام پور
728977	3906429	قروه - دهگلا ن	1308	عباسجوب	0	کردستان 25	کردستان 14	1 چاه عمیق	نصر الله ميركي
725459	3890074	قروه - دهگلا ن	1308	احمد آباد پنجه	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	محمد محمدي
752752	3899514	قروه - دهگلا ن	1308	مظفر اباد	0	کردستان 25	کردستان 14	1 چاه عمیق	حسن محمدي
748752	3897406	قروه - دهگلا ن	1308	جنيان	0	کردستان 25	کردستان 14	1 چاه عمیق	ايرج محمدي
752206	3892241	قروه - دهگلا ن	1308	سنگين آباد	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	عباس محمدي
760563	3895006	قروه - دهگلا ن	1308	ديوزند	0	کردستان 25	کردستان 14	1 چاه عمیق	فقيه سليماني
763866	3890804	قروه - دهگلا ن	1308	شكوه آباد	0	کردستان 25	کردستان 14	1 چاه عمیق	حسين كريمي
749622	3897740	قروه - دهگلا ن	1308	سريش آباد	3	کردستان 25	کردستان 14	1 چاه عمیق	علي كاوه
758789	3900700	قروه - دهگلا ن	1308	امين آباد	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	هادي صيدي
764707	3897226	قروه - دهگلا ن	1308	خريله	0	کردستان 25	کردستان 14	1 چاه عمیق	علي حسيني
756298	3895744	قروه - دهگلا ن	1308	قروه	0	کردستان 25	کردستان 14	1 چاه عمیق	عزيز ستاري
767082	3894043	قروه - دهگلا ن	1308	قاسم آباد	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	كمانگر
764752	3895407	قروه - دهگلا ن	1308	قاسم آباد	0	کردستان 25	کردستان 14	1 چاه عمیق	جعفر قراگوزلو
759864	3892812	قروه - دهگلا ن	1308	قلعه	0	کردستان 25	کردستان 14	1 چاه عمیق	صفر علي مريدي
755182	3891377	قروه - دهگلا ن	1308	قلعه	0	کردستان 25	کردستان 14	1 چاه عمیق	اهالي
762106	3892669	قروه - دهگلا ن	1308	سنگين آباد	0	کردستان 25	کردستان 14	1 چاه عمیق	شركت فدك
718429	3900281	قروه - دهگلا ن	1308	مبارك آباد	0	کردستان 25	کردستان 14	1 چاه عمیق	اسماعيل مباركي
732405	3974231	ديواندره - بيجار	1309	حلوابي	0	کردستان 25	کردستان 14	5 چشمه	اهالي
731563	3979933	ديواندره - بيجار	1309	علي بدل	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	احمد احمدي
732658	3977345	ديواندره - بيجار	1309	مخور	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	حسين مرادي
735040	3979040	ديواندره - بيجار	1309	قامشلو	0	کردستان 25	کردستان 14	1 چاه عمیق	آبفا
737765	3980213	ديواندره - بيجار	1309	قامشلو	0	کردستان 25	کردستان 14	4 قنات	بخشي عظيمي
739608	3975555	ديواندره - بيجار	1309	تخت	0	کردستان 25	کردستان 14	1 چاه عمیق	آبفا
742741	3977828	ديواندره - بيجار	1309	سيدان	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	ملك محمدي
743729	3976811	ديواندره - بيجار	1309	سيدان	0	کردستان 25	کردستان 14	1 چاه عمیق	فرهاد رجبي
744371	3979165	ديواندره - بيجار	1309	سيدان	0	کردستان 25	کردستان 14	2 چاه نيمه عميق	اوسط نادري
747650	3978405	ديواندره - بيجار	1309	زاغه فولاد	0	کردستان 25	کردستان 14	4 قنات	اهالي
746936	3969763	ديواندره - بيجار	1309	چوپي	3	کردستان 25	کردستان 14	5 چشمه	اهالي
750307	3984350	ديواندره - بيجار	1309	دولت كند	3	کردستان 25	کردستان 14	5 چشمه	اهالي
740264	3970897	ديواندره - بيجار	1309	حسن آباد حومه	3	کردستان 25	کردستان 14	5 چشمه	اهالي
753068	3983644	ديواندره - بيجار	1309	خورخوره	1	کردستان 25	کردستان 14	5 چشمه	حاج محمدي
754627	3978600	ديواندره - بيجار	1309	خورخوره	1	کردستان 25	کردستان 14	5 چشمه	عليجان محمد خاني
379132	4059477	طالقان - الموت	1310	سنگرود	8	گيلان 11	گيلان 03	5 چشمه	معدني راست
375932	4059055	طالقان - الموت	1310	كرومات	7	گيلان 11	گيلان 03	5 چشمه	چشمه- قنات
379140	4059506	طالقان - الموت	1310	سنگرود	8	گيلان 11	گيلان 03	5 چشمه	معدني چپ
393917	4063361	طالقان - الموت	1310	انينه ده	7	گيلان 11	گيلان 03	5 چشمه	سرو
401315	4069043	طالقان - الموت	1310	كليشم	8	گيلان 11	گيلان 03	5 چشمه	قل قل
362556	4069070	منجيل	1311	هرزويل	4	گيلان 11	گيلان 03	5 چشمه	دربند
360103	4067970	منجيل	1311	هرزويل	8	گيلان 11	گيلان 03	5 چشمه	باباكر

Appendix 8 Results of Water Quality Test (2001 -2006) (1/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1000	1301	0										0						385087	4133761	
1381	1301	0.918	5.56	5.41	0.07	1.3	1.74	2.3	1.01	0.55	4	0	7.55	364.14	578	12	15	360250	4078450	c2-s1
1381	1301	0.197	2.1	2.08	0.01	0.19	0.38	1.5	0.15	0.2	1.75	0	8	131.04	208	12	15	393698	4068252	c1-s1
1381	1301	0.118	3.01	3.09	0.01	0.14	0.88	2.06	0.27	0.25	2.5	0	8.25	200.97	319	12	28	361243	4071241	c2-s1
1381	1301	0.175	2.06	2.06	0.01	0.17	0.68	1.2	0.11	0.25	1.7	0	7.35	122.85	195	6	10	393698	4068252	c1-s1
1381	1301	0.082	3.11	3.13	0.03	0.1	0.88	2.12	0.16	0.15	2.7	0.1	8.25	197.82	314	6	31	361243	4071241	c2-s1
1381	1301	0.434	4.18	4.18	0.03	0.58	1.07	2.5	0.53	0.4	3.25	0	7.85	263.97	419	6	10	356800	4082850	c2-s1
1381	1301	0.271	5.8	5.74	0.04	0.44	1.26	4	0.4	0.3	5.1	0	7.2	354.06	562	6	10	365150	4078100	c2-s1
1381	1301	0.789	5.61	5.55	0.07	1.16	1.17	3.15	1.06	0.65	3.9	0	7.25	360.36	572	6	10	360250	4078450	c2-s1
1381	1301	2.527	9.68	9.55	0.08	4.13	1.42	3.92	0.79	2.74	6.15	0	7.7	650.79	1033	12	6	380400	4137552	c3-s1
1381	1301	1.851	12.29	11.72	0.08	3.69	3.45	4.5	1.46	3.53	7.3	0	7.35	805	1277	12	5	383052	4110444	c3-s1
1381	1301	1.54	13.94	14.24	0.12	3.54	2.35	8.23	1.01	3.58	9.35	0	7.15	881.37	1399	12	6	389991	4136147	c3-s1
1381	1301	3.287	13.78	13.34	0.19	6.15	4	3	0.15	5.93	7.7	0	7.9	830	1318	12	4	402298	4136418	c3-s1
1381	1301	1.552	13.59	13.62	0.09	3.48	2.99	7.06	1.84	3.6	8.15	0	7.18	861.21	1367	12	6	385087	4133761	c3-s1
1381	1301	2.137	11.74	11.36	0.1	4.06	2.55	4.66	0.15	3.04	8.55	0	7.71	745.92	1184	12	6	398470	4135258	c3-s1
1381	1301	1.49	14.2	14.53	0.07	3.49	5.2	5.77	0.77	3.63	9.8	0	7.35	890	1413	12	4	397162	4129433	c3-s1
1381	1301	1.793	9.48	9.6	0.09	3.19	1.81	4.51	0.45	3.77	5.25	0	7.52	663.4	1053	12	4	405610	4130910	c3-s1
1381	1301	1.33	12.26	11.69	0.1	2.79	4.2	4.6	1.6	2.56	8.1	0	7.5	791	1256	12	4	385917	4126410	c3-s1
1381	1301	1.253	12.57	12.28	0.05	2.73	4.4	5.1	1.74	3.23	7.6	0	7.2	748	1188	12	4	390966	4126473	c3-s1
1381	1301	1.31	9.32	9.1	0.05	2.39	2.66	4	0.94	3.48	4.9	0	7.6	580	921	12	4	405107	4125868	c3-s1
1381	1301	2.024	10.6	10.07	0.05	3.62	2.6	3.8	1.05	2.55	7	0	7.6	641	1018	12	4	394313	4124623	c3-s1
1381	1301	1.74	10.05	9.97	0.07	3.19	2.11	4.61	0.13	3.02	6.9	0	7.61	664.65	1055	12	4	401318	4124760	c3-s1
1381	1301	2.312	15.91	15.87	0.46	5.22	2.16	8.04	2.66	5.75	7.5	0	7.31	1077.93	1711	12	7	390311	4118768	c3-s1
1381	1301	1.577	15.49	15.26	0.13	3.76	3.19	8.18	2.74	5.5	7.25	0	7.03	989.73	1571	12	7	384060	4115435	c3-s1
1381	1301	1.413	12.34	11.93	0.05	2.98	2.3	6.6	0.51	3.53	8.3	0	7	788	1250	12	6	384400	4117250	c3-s1
1381	1301	1.065	13.57	13.81	0.88	2.44	2.99	7.5	2.32	2.16	9.09	0	7.8	881	1398	12	14	417400	4135800	c3-s1
1381	1301	0.991	21.91	11.05	0.62	2.03	2.9	5.5	12.7	2.06	6.9	0.25	8.35	745	1182	12	14	406600	4141800	c3-s1
1381	1301	1.418	9.12	9.09	0.07	2.55	3.17	3.3	0.64	3.73	4.75	0	7.65	635.04	1008	12	14	405300	4123800	c3-s1
1381	1301	1.251	9.4	9.74	0.05	2.39	1.6	5.7	0.56	3.34	5.5	0	7.6	670	1062	12	14	399500	4122100	c3-s1
1381	1301	0.829	6.97	7.06	0.04	1.39	1.62	4.02	0.13	0.83	5.7	0.3	8.5	446.04	708	12	11	398900	4114900	c2-s1
1381	1301	2.945	12.91	12.79	0.07	5.57	1.72	5.44	0.49	6.27	5.9	0.25	8.53	896.49	1421	12	12	393800	4092600	c3-s1
1381	1301	2.334	9.87	9.44	0.07	3.87	1.65	3.85	0.77	2.8	6.3	0	7.55	619.92	984	6	3	380400	4137552	c3-s1
1381	1301	1.502	12.64	12.3	0.09	3.19	3.61	5.41	1.69	3.6	7.35	0	7.75	776.16	1232	6	5	383052	4110444	c3-s1
1381	1301	1.271	13.92	13.49	0.1	2.91	1.88	8.6	1.12	3.6	9.2	0	7.15	860.58	1366	6	4	389991	4136147	c3-s1
1381	1301	3.663	14.3	13.73	0.22	6.74	3.95	2.82	0.55	6	7.75	0	7.9	900.9	1430	6	5	402298	4136418	c3-s1
1381	1301	1.424	12.14	12.25	0.09	3.04	3.92	5.2	1.84	3.7	6.6	0	7.5	773.01	1227	6	9	385087	4133761	c3-s1
1381	1301	2.189	11.77	11.24	0.08	4.11	2.77	4.28	0.32	3.45	8	0	7.5	723.24	1148	6	4	398470	4135258	c3-s1
1381	1301	1.378	14.7	14.53	0.08	3.26	3.49	7.7	0.9	3.9	9.9	0	7.25	914.76	1452	6	4	397162	4129433	c3-s1
1381	1301	1.593	10.19	9.78	0.08	2.93	1.98	4.79	0.59	4	5.6	0	7.8	650.79	1033	6	5	405610	4130910	c3-s1
1381	1301	1.362	13.27	13.1	0.1	3.04	2.82	7.14	1.72	3.05	8.5	0	7.3	826.56	1312	6	4	385917	4126410	c3-s1
1381	1301	1.424	14.26	13.87	0.13	3.26	4.18	6.3	2.06	3.6	8.6	0	7.1	875.7	1390	6	4	390966	4126473	c3-s1
1381	1301	1.229	9.12	8.88	0.07	2.23	2.02	4.56	0.82	3.55	4.75	0	7.6	605.43	961	6	5	405107	4125868	c3-s1
1381	1301	2.149	11.1	10.93	0.09	3.98	1.46	5.4	1.2	2.6	7.3	0	7.55	684.18	1086	6	4	394313	4124623	c3-s1
1381	1301	1.633	9.75	9.38	0.12	2.91	1.8	4.55	0.25	3.1	6.4	0	7.5	613.62	974	6	4	401318	4124760	c3-s1
1381	1301	2.245	15.14	14.84	0.46	4.89	3.19	6.3	2.69	5	7.45	0	7.2	975.87	1549	6	5	390311	4118768	c3-s1
1381	1301	1.453	15.39	15.07	0.12	3.48	4.37	7.1	2.94	5.5	6.95	0	7.6	951.3	1510	6	5	384060	4115435	c3-s1
1381	1301	1.311	13.61	13.23	0.07	2.96	4.14	6.06	2.51	5.2	5.9	0	7.75	870.66	1382	6	5	384400	4117250	c3-s1
1381	1301	0.861	13.24	13.14	1.15	1.93	3.43	6.63	2.11	1.95	9.18	0	8	842.94	1338	6	22	417400	4135800	c3-s1
1381	1301	0.901	12.56	13.01	0.83	2.03	3.15	7	1.41	2.7	7.74	0.71	8.3	872.55	1385	6	22	406600	4141800	c3-s1
1381	1301	1.696	8.61	8.65	0.05	2.87	1.78	3.95	0.61	3.7	4.1	0.2	8.4	594.72	944	6	22	405300	4123800	c3-s1
1381	1301	1.367	10	9.55	0.04	2.55	2.16	4.8	1.6	3	5.1	0.3	8.07	616.77	979	6	24	399500	4122100	c3-s1
1381	1301	0.891	7.41	7.38	0.04	1.52	1.68	4.14	0.13	0.65	6.53	0.1	8.2	468.72	744	6	18	398900	4114900	c2-s1
1381	1301	2.908	13.78	13.75	0.07	5.78	2.1	5.8	0.39	6.45	6.79	0.15	8.2	922.95	1465	6	18	393800	4092600	c3-s1
Average			569.32	550.45	7.93	152.34	130.98	259.25	66.74	161.68	338.53	2.36	398.01	35818.11	56851					
			10.95	10.59	0.15	2.93	2.52	4.99	1.28	3.11	6.51	0.05	7.65	688.81	1093.29					

Appendix 8 Results of Water Quality Test (2001 -2006) (2/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1382	1301	1.131	2.12	5.69	0.04	1.61	1.32	2.72	1.17	0.55	0.4	0	7.9	362	575	12	15	360250	4078450	c2-s1
1382	1301	0.211	2.38	2.34	0.01	0.22	0.51	1.6	0.18	0.15	2.05	0	7.9	142	226	12	9	393698	4068252	c1-s1
1382	1301	0.207	4.26	4.24	0.01	0.29	1.54	2.4	0.56	0.35	3.35	0	6.9	262	416	12	26	361243	4071241	c2-s1
1382	1301	0.536	4.4	4.38	0.03	0.72	1.61	2.02	0.55	0.25	3.6	0	7.6	276	438	12	10	356800	4082850	c2-s1
1382	1301	0.885	7.66	7.89	0.07	1.57	2.42	3.84	0.66	0.4	6.6	0	7.7	474	753	12	10	365150	4078100	c3-s1
1382	1301	1.131	5.72	5.69	0.04	1.61	1.32	2.72	1.17	0.55	4	0	7.9	362	575	12	10	360250	4078450	c2-s1
1382	1301	0.239	2.28	2.29	0.03	0.24	0.72	1.3	0.28	0.2	1.8	0	7.2	132	209	6	27	393698	4068252	c1-s1
1382	1301	0.224	4.19	4.18	0.03	0.31	1.21	2.63	0.29	0.3	3.6	0	7.7	258	410	6	30	361243	4071241	c2-s1
1382	1301	0.558	4.12	4.09	0.04	0.72	1.21	2.12	0.67	0.35	3.1	0	7.45	263	418	6	30	356800	4082850	c2-s1
1382	1301	0.441	7.37	11.56	0.05	1.01	3.13	7.37	1.17	0.4	5.8	0	7.2	457	725	6	30	365150	4078100	c2-s1
1382	1301	0.944	5.82	5.81	0.08	1.39	1.82	2.52	1.17	0.65	4	0	7.1	362	575	6	30	360250	4078450	c2-s1
1382	1301	2.216	9.57	9.59	0.07	3.76	2.04	3.72	0.52	2.75	6.3	0	7.8	624.33	991	12	3	380400	4137552	c3-s1
1382	1301	1.327	12.41	12.16	0.08	2.85	3.36	5.87	1.66	3.6	7.15	0	7.4	797.58	1266	12	5	383052	4110444	c3-s1
1382	1301	1.041	13.64	13.62	0.1	2.45	3.11	7.96	0.94	3.65	9.05	0	7.39	860.58	1366	12	3	389991	4136147	c3-s1
1382	1301	3.708	14.04	13.44	0.21	6.7	3.79	2.74	0.19	5.85	8	0	8.02	899.01	1427	12	5	402298	4136418	c3-s1
1382	1301	1.226	13.53	13.75	0.09	2.85	2.55	8.26	1.58	3.8	8.15	0	7.7	860.58	1366	12	3	385087	4133761	c3-s1
1382	1301	1.312	15.14	15.11	0.09	3.19	2.45	9.38	2.29	5.3	7.55	0	6.8	975.24	1548	12	3	398470	4135258	c3-s1
1382	1301	1.253	14.38	14.38	0.08	2.98	3.52	7.8	0.68	3.7	10	0	7.35	879.48	1396	12	4	397162	4129433	c3-s1
1382	1301	1.695	9.48	9.55	0.08	3.04	2.15	4.28	0.43	3.7	5.35	0	7.85	631.26	1002	12	4	405610	4130910	c3-s1
1382	1301	1.231	12.43	12.65	0.08	2.73	2.65	7.19	1.33	2.7	8.4	0	7.5	783.72	1244	12	4	385917	4126410	c3-s1
1382	1301	1.305	14.02	14.02	0.12	3.04	2.8	8.06	1.92	3.5	8.6	0	7.15	873.18	1386	12	4	390966	4126473	c3-s1
1382	1301	1.252	9.01	8.98	0.07	2.28	2.04	4.59	0.76	3.5	4.75	0	7.9	600.39	953	12	4	405107	4125868	c3-s1
1382	1301	1.9	10.64	10.56	0.08	3.54	1.89	5.05	1.04	2.45	7.15	0	7.82	681.66	1082	12	4	394313	4124623	c3-s1
1382	1301	1.198	12.45	12.15	0.05	2.61	4.19	5.3	0.35	2.5	9.6	0	7.42	752.22	1194	12	4	401318	4124760	c3-s1
1382	1301	1.811	14.51	14.42	0.43	4.04	2.4	7.55	2.51	4.1	7.9	0	7.41	962.24	1528	12	5	390311	4118768	c3-s1
1382	1301	1.647	15.33	15.76	0.1	3.98	2.55	9.13	2.33	5.8	7.2	0	6.82	974.61	1547	12	5	384060	4115435	c3-s1
1382	1301	0.448	11.16	11.24	0.08	1.01	2.55	7.6	1.06	2.4	7.7	0	7.88	670.95	1065	12	5	384400	4117250	c3-s1
1382	1301	0.788	12.6	12.62	1.13	1.74	2.48	7.27	1.8	1.5	9.3	0	7.45	780.75	1239	12	26	417400	4135800	c3-s1
1382	1301	0.942	11.45	11.95	0.64	2.03	2.29	6.99	2.4	2.15	6.9	0	7.7	750.96	1192	12	24	406600	4141800	c3-s1
1382	1301	1.429	8.79	8.69	0.07	2.5	1.94	4.18	0.59	3.9	4.3	0	7.4	595.98	946	12	24	405300	4123800	c3-s1
1382	1301	1.364	9.89	9.59	0.05	2.55	2.09	4.9	0.64	3.15	5.9	0.2	7.95	633.5	1005	12	26	399500	4122100	c3-s1
1382	1301	0.833	7.4	7.37	0.04	1.43	1.62	4.28	0.15	0.8	6.1	0.35	8.5	448.56	712	12	18	398900	4114900	c2-s1
1382	1301	2.454	13.49	13.59	0.07	5.05	3.47	5	0.39	6.4	6.45	0.25	8.55	882	1400	12	18	393800	4092600	c3-s1
1382	1301	1.336	12.71	12.5	0.1	2.91	2.67	6.82	1.01	3.8	7.9	0	7.15	813	1290	6	10	380400	4137552	c3-s1
1382	1301	1.496	12.14	12	0.12	3.13	3.7	5.05	1.39	3.75	7	0	7.7	760	1207	6	11	383052	4110444	c3-s1
1382	1301	1.336	12.71	12.5	0.1	2.91	2.67	6.82	1.01	3.8	7.9	0	7.15	813	1290	6	10	389991	4136147	c3-s1
1382	1301	3.441	13.99	13.33	0.23	6.33	4.14	2.63	0.29	6.05	7.65	0	7.4	910	1445	6	10	402298	4136418	c3-s1
1382	1301	1.46	13.67	13.82	0.09	3.33	3.99	6.41	1.77	3.85	8.05	0	7.12	881	1399	6	10	385087	4133761	c3-s1
1382	1301	2.413	11.67	11.29	0.08	4.44	2.48	4.29	0.77	3.5	7.4	0	6.6	727	1154	6	10	398470	4135258	c3-s1
1382	1301	1.237	14.4	13.98	0.08	2.9	4.13	6.87	0.7	3.75	9.95	0	6.8	910	1445	6	10	397162	4129433	c3-s1
1382	1301	1.828	9.67	9.7	0.08	3.26	1.81	4.55	0.47	3.9	5.3	0	7.02	647	1027	6	10	405610	4130910	c3-s1
1382	1301	1.337	12.29	12.03	0.09	2.85	2.73	6.36	1.44	2.75	8.1	0	7.8	768	1219	6	10	385917	4126410	c3-s1
1382	1301	1.388	11.35	11	0.13	2.79	3.33	4.75	2	3.55	5.8	0	7.7	768	1219	6	10	390966	4126473	c3-s1
1382	1301	1.175	9.07	9.04	0.05	2.17	2.78	4.04	0.82	3.45	4.8	0	8	597	948	6	10	405107	4125868	c3-s1
1382	1301	1.977	10.5	10.76	0.1	3.69	3.33	3.64	1.9	4.3	4.3	0	7.9	740	1174	6	10	394313	4124623	c3-s1
1382	1301	1.266	11.96	11.61	0.05	2.67	3.13	5.76	0.76	2.75	8.45	0	7.05	744	1181	6	10	401318	4124760	c3-s1
1382	1301	2.181	14.07	13.76	0.46	4.56	3.17	5.57	2.17	4.85	7.05	0	7.82	940	1492	6	10	390311	4118768	c3-s1
1382	1301	1.305	14.93	14.57	0.1	3.11	3.73	7.63	2.43	5.8	6.7	0	7.2	978	1552	6	10	384060	4115435	c3-s1
1382	1301	1.437	14.48	14.44	0.07	3.37	2.72	8.28	2.38	4.9	7.2	0	6.7	939	1490	6	10	384400	4117250	c3-s1
1382	1301	0.985	13.03	13.42	1.55	2.17	1.8	7.9	1.93	1.7	9.4	0	6.8	829	1316	6	11	417400	4135800	c3-s1
1382	1301	1.19	12.04	12.57	0.83	2.55	1.99	7.2	1.34	2.7	8	0	7.8	790	1254	6	11	406600	4141800	c3-s1
1382	1301	1.748	8.86	9.04	0.05	3.02	1.53	4.44	0.61	3.8	4.45	0	7.5	609	967	6	11	405300	4123800	c3-s1
1382	1301	1.641	9.97	9.83	0.04	3.02	1.52	5.25	1.22	2.95	5.8	0	8.2	621	985	6	11	399500	4122100	c3-s1
1382	1301	0.779	7.36	7.39	0.04	1.35	1.76	4.24	0.16	0.75	6.1	0.35	8.3	461	731	6	11	398900	4114900	c2-s1
1382	1301	2.538	13.17	13.12	0.07	5.07	1.92	6.06	0.37	5.9	6.9	0	7.3	922	1464	6	11	393800	4092600	c3-s1
Average			579.72	585.05	8.75	147.64	135.77	292.90	60.37	163.90	354.30	1.15	413.32	37435.78	########					
			10.54	10.64	0.16	2.68	2.47	5.33	1.10	2.98	6.44	0.02	7.51	680.65	1080.44					

Appendix 8 Results of Water Quality Test (2001 -2006) (3/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1301	0.949	5.7	5.72	0.03	1.39	1.75	2.55	1.25	0.7	3.75	0	7.65	363	577	12	23	360250	4078450	c2-s1
1383	1301	2.414	10.04	9.98	0.07	4.11	2.5	3.3	0.64	3.1	6.3	0	7.4	636	1009	12	9	380400	4137552	c3-s1
1383	1301	1.614	10.47	10.24	0.1	3.04	3	4.1	2.07	4.1	4.3	0	7.55	714	1133	12	10	383052	4110444	c3-s1
1383	1301	1.178	13.84	13.29	0.09	2.7	4.5	6	1.04	3.5	9.3	0	7.1	878	1393	12	11	389991	4136147	c3-s1
1383	1301	3.853	14.16	13.82	0.22	7	3.2	3.4	0.96	5.65	7.55	0	7.3	900	1429	12	11	402298	4136418	c3-s1
1383	1301	1.542	13.23	12.91	0.05	3.36	4.2	5.3	1.73	3.6	7.9	0	7.7	847	1345	12	11	385087	4133761	c3-s1
1383	1301	2.633	11.65	11.59	0.07	4.82	2.6	4.1	1	2.95	7.7	0	7.7	726	1153	12	11	398470	4135258	c3-s1
1383	1301	1.143	18.9	19.06	2.48	2.98	5.6	8	5.5	4.8	8.6	0	7.3	1203	1909	12	11	397162	4129433	c3-s1
1383	1301	1.604	9.63	9.34	0.07	2.87	2.4	4	0.78	3.5	5.35	0	7.3	653	1037	12	11	405610	4130910	c3-s1
1383	1301	1.464	12.87	12.79	0.1	3.19	3.2	6.3	1.57	2.85	8.45	0	7.65	807	1281	12	11	385917	4126410	c3-s1
1383	1301	1.426	14.23	14.36	0.13	3.33	3.9	7	2.03	3.35	8.85	0	7.1	895	1420	12	11	390966	4126473	c3-s1
1383	1301	1.109	9.05	18.12	2.07	2.85	4.15	9.05	0.85	3.3	4.9	0	7.25	616	977	12	11	405107	4125868	c3-s1
1383	1301	1.699	10.67	10.32	0.08	3.19	3.05	4	1.17	2.3	7.2	0	7.3	679	1077	12	11	394313	4124623	c3-s1
1383	1301	1.122	11.45	11.09	0.05	2.34	4	4.7	0.45	2.4	8.6	0	7.4	726	1153	12	11	401318	4124760	c3-s1
1383	1301	1.213	8.72	8.84	0.27	2.17	2.4	4	0.82	1.2	6.7	0	7.5	577	916	12	10	390311	4118768	c3-s1
1383	1301	1.332	14.02	14.11	0.1	3.11	3	7.9	2.67	5.05	6.3	0	7.5	950	1508	12	10	384060	4115435	c3-s1
1383	1301	0.702	9.68	9.81	0.08	1.43	2.7	5.6	2.13	1.55	6	0	7.6	639	1015	12	10	384400	4117250	c3-s1
1383	1301	0.924	13.39	12.96	1.28	2.03	4.1	5.55	2.29	1.2	9.9	0	6.9	833	1322	12	11	417400	4135800	c3-s1
1383	1301	0.854	10.91	10.68	0.64	1.74	2.15	6.15	2.41	1.95	6.55	0	7.08	731	1160	12	11	406600	4141800	c3-s1
1383	1301	1.426	9.02	9.02	0.07	2.55	2.2	4.2	0.57	3.45	5	0	7.18	641	1017	12	12	405300	4123800	c3-s1
1383	1301	1.567	9.71	9.74	0.05	2.89	2.3	4.5	0.51	2.9	6.3	0	7.35	640	1016	12	17	399500	4122100	c3-s1
1383	1301	0.922	7.49	7.41	0.04	1.57	2.65	3.15	0.24	0.75	6.4	0.1	8.3	462	733	12	15	398900	4114900	c2-s1
1383	1301	3.059	13.88	13.92	0.08	6.04	3.6	4.2	0.48	6.4	7	0	7.8	910	1445	12	15	393800	4092600	c3-s1
1383	1301	2.662	9.54	9.43	0.08	4.25	2.3	2.8	0.59	2.95	6	0	7.65	620	984	6	12	380400	4137552	c3-s1
1383	1301	2.032	10.18	10.1	0.13	3.62	2.35	4	1.78	3.9	4.5	0	7.76	697	1107	6	13	383052	4110444	c3-s1
1383	1301	1.704	11.72	11.83	0.18	3.45	2.1	6.1	1.22	3.8	6.7	0	7.66	767	1217	6	12	389991	4136147	c3-s1
1383	1301	4.107	13.77	13.84	0.33	7.26	2.75	3.5	0.32	5.95	7.1	0.4	8.41	895	1420	6	12	402298	4136418	c3-s1
1383	1301	1.688	12.19	12.37	0.15	3.52	2.3	6.4	1.14	3.85	7.2	0	7.98	818	1298	6	12	385087	4133761	c3-s1
1383	1301	2.272	11.52	11.27	0.15	4.22	2.4	4.5	0.42	3.5	7.2	0.4	8.25	721	1144	6	12	398470	4135258	c3-s1
1383	1301	1.534	14.24	13.91	0.13	3.48	3	7.3	0.69	3.9	9.65	0	7.88	885	1404	6	12	397162	4129433	c3-s1
1383	1301	2.365	10.39	10.44	0.21	4.13	1.5	4.6	0.74	3.95	5.7	0	7.65	665	1055	6	12	405610	4130910	c3-s1
1383	1301	1.168	13.24	13.1	0.15	2.65	3.3	7	1.54	3.2	8.5	0	7.38	833	1323	6	13	385917	4126410	c3-s1
1383	1301	1.969	11.18	11.02	0.21	3.71	2.1	5	2.18	3.55	5.45	0	7.86	742	1177	6	13	390966	4126473	c3-s1
1383	1301	1.63	9.12	9.25	0.18	2.87	1.6	4.6	0.77	3.45	4.9	0	7.94	614	974	6	12	405107	4125868	c3-s1
1383	1301	2.381	10.89	10.81	0.15	4.26	2.6	3.8	1.09	2.5	7.3	0	7.82	690	1096	6	13	394313	4124623	c3-s1
1383	1301	1.264	10.32	10.28	0.1	2.48	2.7	5	0.77	3.1	6.2	0.25	8.28	638	1012	6	12	401318	4124760	c3-s1
1383	1301	2.67	14.53	14.17	0.43	5.44	3.4	4.9	3.43	4.3	6.8	0	7.37	889	1411	6	13	390311	4118768	c3-s1
1383	1301	1.916	11.55	11.58	0.12	3.76	3.2	4.5	2.45	5.2	3.9	0	7.66	801	1271	6	13	384060	4115435	c3-s1
1383	1301	1.281	10.96	10.95	0.04	2.61	2.7	5.6	2.66	3.9	4.4	0	7.42	689	1094	6	13	384400	4117250	c3-s1
1383	1301	1.112	10.12	9.94	0.86	2.08	2	5	1.12	1.2	7.8	0	8.28	657	1043	6	22	417400	4135800	c3-s1
1383	1301	1.16	12.63	12.8	0.49	2.56	2.9	6.85	2.28	2.65	7.7	0	7.72	821	1303	6	20	406600	4141800	c3-s1
1383	1301	1.717	9.61	9.46	0.05	3.06	2.45	3.9	0.76	3.8	5.05	0	7.23	622	987	6	20	405300	4123800	c3-s1
1383	1301	1.581	9.3	9.32	0.03	2.84	2.3	4.15	0.7	3.1	5.2	0.3	8.48	631	1001	6	20	399500	4122100	c3-s1
1383	1301	1.09	7.69	7.57	0.03	1.84	1.65	4.05	0.24	0.75	6.7	0	7.32	486	772	6	19	398900	4114900	c3-s1
1383	1301	3.038	14.06	15.8	2	6	2.7	5.1	0.51	6.35	7.2	0	7.32	922	1463	6	19	393800	4092600	c3-s1
Average		78.09	511.46	518.36	14.42	150.79	127.45	225.7	60.56	149.4	300.05	1.45	342.23	33129	52581					
		1.74	11.37	11.52	0.32	3.35	2.83	5.02	1.35	3.32	6.67	0.03	7.61	736.20	1168.47					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1301	0.232	2.09	2.03	0.01	0.22	0.25	1.55	0.24	0.15	1.7	0	7.65	130	207	12	21	393698	4068252	c1-s1
1384	1301	0.552	4.11	4.15	0.03	0.72	1.35	2.05	0.51	0.3	3.3	0	7.87	265	421	12	21	356800	4082850	c2-s1
1384	1301	0.855	7.49	7.54	0.06	1.48	2.9	3.1	0.74	0.5	6.25	0	7.54	480	762	12	21	365150	4078100	c3-s1
1384	1301	1.189	5.47	5.55	0.05	1.65	1.25	2.6	1.17	0.6	3.7	0	7.32	366	581	12	21	360250	4078450	c2-s1
1384	1301	2.478	9.72	9.65	0.04	4.11	1.6	3.9	0.67	2.85	6.2	0	7.65	637.6	1012	12	6	380400	4137552	c3-s1
1384	1301	1.798	12.43	12.57	0.06	3.76	3.95	4.8	1.58	3.75	7.1	0	7.6	799	1268	12	15	383052	4110444	c3-s1
1384	1301	1.485	13.6	13.75	0.08	3.37	3.5	6.8	0.9	3.7	9	0	7.29	873.2	1386	12	6	389991	4136147	c3-s1
1384	1301	4.254	14.17	14.18	0.17	7.61	3.1	3.3	0.17	6	8	0	7.74	924.2	1467	12	6	402298	4136418	c3-s1
1384	1301	2.648	11.59	11.05	0.05	4.7	2.4	3.9	0.19	3.5	7.9	0	7.74	726.4	1153	12	6	398470	4135258	c3-s1
1384	1301	1.673	14.67	14.61	0.04	3.87	4.6	6.1	0.67	3.8	10.2	0	7.23	924.2	1467	12	6	397162	4129433	c3-s1
1384	1301	1.988	9.64	9.75	0.05	3.5	1.6	4.6	0.39	3.8	5.45	0	7.49	643.9	1022	12	6	405610	4130910	c3-s1
1384	1301	1.534	13.16	13.07	0.05	3.37	3.65	6	1.46	3.7	8	0	7.41	828.5	1315	12	6	385917	4126410	c3-s1
1384	1301	1.598	13.08	13.15	0.05	3.5	3.2	6.4	1.58	3.5	8	0	7.18	841.1	1335	12	6	390966	4126473	c3-s1
1384	1301	1.572	9.02	9.13	0.04	2.79	1.9	4.4	0.92	3.5	4.6	0	7.65	606.1	962	12	6	405107	4125868	c3-s1
1384	1301	2.542	24.46	24.37	0.08	7.39	4.1	12.8	3.66	9.8	11	0	7.32	1542	2448	12	6	394313	4124623	c4-s1
1384	1301	1.627	10.65	10.56	0.03	3.13	2.4	5	0.65	3	7	0	7.4	701.2	1113	12	6	401318	4124760	c3-s1
1384	1301	2.203	12.92	12.98	0.32	4.46	2.35	5.85	1.72	3.2	8	0	7.6	848	1345	12	15	390311	4118768	c3-s1
1384	1301	1.811	13.84	14.19	0.08	4.06	2.85	7.2	2.19	4.9	6.75	0	7.03	902	1431	12	15	384060	4115435	c3-s1
1384	1301	1.558	15.39	15.46	0.05	3.76	2.7	8.95	2.39	5.15	7.85	0	6.73	968	1537	12	15	384400	4117250	c3-s1
1384	1301	1.114	12.66	12.77	1.18	2.39	2.5	6.7	1.86	1.1	9.7	0	7.11	783	1243	12	15	417400	4135800	c3-s1
1384	1301	2.263	10.03	9.57	0.05	3.82	1.8	3.9	1.73	3.9	4.1	0.3	8.45	629	998	12	15	406600	4141800	c3-s1
1384	1301	2.198	10.23	10.12	0.05	3.87	2	4.2	2.13	3.1	5	0	7.65	655	1039	12	15	405300	4123800	c3-s1
1384	1301	1.861	10.46	10.02	0.04	3.38	1.7	4.9	1.86	3	5.2	0.4	8.62	635	1008	12	15	399500	4122100	c3-s1
1384	1301	1.194	7.28	7.51	0.03	1.98	1.25	4.25	0.28	0.7	6.1	0.2	8.13	473	751	12	13	398900	4114900	c3-s1
1384	1301	7.741	17.75	17.4	0.05	12.3	1.9	3.15	1.6	11.65	4.5	0	7.59	1187	1884	12	13	393800	4092600	c3-s2
Average		49.968	285.91	285.13	2.74	95.19	60.8	126.4	31.26	89.15	164.6	0.9	188.99	18368.4	29155					
		2.00	11.44	11.41	0.11	3.81	2.43	5.06	1.25	3.57	6.58	0.04	7.56	734.74	1166.20					

Appendix 8 Results of Water Quality Test (2001 -2006) (4/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1380	1302	1.699	11.11	11.08	0.07	3.33	3.07	4.61	4.56	2	4.55	0	7.39	718.2	1140	6	10	341415	4070708	c3-s1
1380	1302	3.039	29.6	28.59	0.1	9.39	7.48	11.62	13.65	10.35	5.6	0	6.74	1818.18	2886	6	10	332850	4073040	c4-s1
1380	1302	1.417	9.96	9.83	0.05	2.67	2.97	4.13	3.21	1.2	5.55	0	7.5	624.96	992	6	10	330930	4078908	c3-s1
1380	1302	2.919	26.17	26.54	0.09	8.7	6.75	11	14.07	6.6	5.5	0	7.09	1674.54	2658	6	10	327210	4082527	c4-s1
1380	1302	2.34	29.99	29.66	0.93	7.61	6.33	14.79	14.39	10.3	5.3	0	7.38	1874.88	2976	6	10	333290	4071707	c4-s1
1380	1302	1.57	11.55	11.01	0.04	3.11	3.01	4.85	5.2	1.15	5.2	0	7.46	750.96	1192	6	10	316628	4078674	c3-s1
1380	1302	0.809	10.15	10.06	0.07	1.65	2.52	5.82	4.15	0.7	5.3	0	7.27	649.53	1031	6	10	316965	4080070	c3-s1
1380	1302	2.047	13.35	12.89	0.07	4.24	2.37	6.21	5.25	3.15	4.95	0	7.17	905.94	1438	6	10	306262	4091254	c3-s1
1380	1302	0.196	56.53	54.59	0.23	1.01	25.8	27.55	47.33	6	3.2	0	7.79	2868.39	4553	6	10	322165	4073423	c4-s1
1380	1302	1.403	12.82	13.06	0.09	3.11	2.38	7.47	5.87	1.55	5.4	0	7.22	862.47	1369	6	10	311613	4083441	c3-s1
1380	1302	2.378	15.49	14.92	0.08	5.22	3.91	5.72	5.09	4.85	5.55	0	7.2	1062.18	1686	6	10	324236	4079142	c3-s1
1380	1302	0.739	8.21	8.59	0.12	1.39	2.62	4.46	3.46	0.65	4.1	0	7.69	649.53	1031	6	10	314330	4079215	c3-s1
1380	1302	31.302	128.36	122.53	0.1	101.43	9.36	11.64	7.51	117	3.85	0	7.79	7687.26	12202	6	10	322490	4079965	c4-s4
1380	1302	1.795	13.64	13.02	0.07	3.83	3.3	5.82	5.49	3.15	5	0	7.27	918.54	1458	6	10	306282	4092380	c3-s1
Average		53.653	376.93	366.37	2.11	156.69	81.87	125.69	139.23	168.65	69.05	0	102.96	23065.56	36612					
		3.83	26.92	26.17	0.15	11.19	5.85	8.98	9.95	12.05	4.93	0.00	7.35	1647.54	2615.14					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1381	1302	1.707	11.07	11.4	0.07	3.4	3.23	4.7	3.46	2.01	5.6	0	8.05	707.49	1123	11	12	341415	4070708	c3-s1
1381	1302	2.357	20.23	20.45	0.08	6.26	6.37	7.74	7.98	6.5	5.75	0	7.89	1204.56	1912	11	12	332850	4073040	c3-s1
1381	1302	1.316	7.72	7.37	0.05	2.12	1.62	3.58	1.89	0.88	4.95	0	8.2	509.04	808	11	12	330930	4078908	c3-s1
1381	1302	3.294	27.91	29.15	0.1	10.13	6.86	12.05	13.66	8.5	5.75	0	8.02	1733.76	2752	11	12	327210	4082527	c4-s1
1381	1302	2.47	22.74	21.7	0.12	6.73	3.1	11.75	11.36	5.88	5.5	0	8.12	1427.58	2266	11	12	333290	4071707	c4-s1
1381	1302	1.476	13.89	13.5	0.03	3.33	4.12	6.03	7.47	1.72	4.7	0	8.3	847.98	1346	11	12	316628	4078674	c3-s1
1381	1302	0.715	9.97	10.1	0.07	1.48	3.36	5.19	3.83	0.74	5.4	0	8.25	637.56	1012	11	12	316965	4080070	c3-s1
1381	1302	1.519	11.11	12.54	0.07	3.26	3.76	5.45	4.67	0.64	5.8	0	8.12	834.75	1325	11	12	306262	4091254	c3-s1
1381	1302	1.45	51.1	53.23	0.17	6.96	16.1	30	41.6	5	4.5	0	8.1	304.92	484	11	12	322165	4073423	c2-s1
1381	1302	1.222	10.65	10.94	0.08	2.5	2.78	5.59	3.83	1.27	5.55	0	8.3	732.69	1163	11	12	311613	4083441	c3-s1
1381	1302	2.601	15.17	15.73	0.08	5.78	3.95	5.92	3.96	4.7	6.5	0	7.75	1019.97	1619	11	12	324236	4079142	c3-s1
1381	1302	0.556	11.48	11.71	0.1	1.27	2.91	7.43	5.24	0.69	5.55	0	7.8	745.92	1184	11	12	314330	4079215	c3-s1
1381	1302	35.296	129.32	128.93	0.1	109.56	8.74	10.53	7.02	117.6	4.7	0	8.2	8477.24	13456	11	12	322490	4079965	c4-s4
1381	1302	2.079	14.92	15.62	0.05	4.82	3.8	6.96	6.76	2.06	6.1	0	8.1	949.41	1507	11	12	306282	4092380	c3-s1
1381	1302	2.357	10.25	10.18	0.07	4.09	1.51	4.51	3.9	1.55	4.8	0	7.7	638.82	1014	6	15	341415	4070708	c3-s1
1381	1302	2.013	20.99	20.97	0.08	5.57	4.98	10.34	7.58	7.85	5.56	0	7.3	1313.55	2085	6	15	332850	4073040	c3-s1
1381	1302	1.405	8.08	8.05	0.05	2.36	1.6	4.04	2.43	0.95	4.7	0	8.25	503.37	799	6	15	330930	4078908	c3-s1
1381	1302	2.714	25.17	25.25	0.09	7.96	5.54	11.66	12.77	6.9	5.5	0	7.8	1670.76	2652	6	15	327210	4082527	c4-s1
1381	1302	2.94	25.85	25.24	0.12	8.48	4.8	11.84	11.95	8.6	5.3	0	7.65	1631.07	2589	6	15	333290	4071707	c4-s1
1381	1302	1.526	11.4	11.96	0.03	3.19	3.19	5.55	5.25	0.7	5.45	0	7.9	754.74	1198	6	15	316628	4078674	c3-s1
1381	1302	0.807	10.61	11.12	0.07	1.74	3.2	6.11	4.56	0.65	5.4	0	7.52	679.14	1078	6	15	316965	4080070	c3-s1
1381	1302	2.383	13.01	13.05	0.05	4.82	3.1	5.08	4.81	2.6	5.6	0	7.3	815.85	1295	6	15	306262	4091254	c3-s1
1381	1302	1.302	12.77	12.53	0.09	2.85	3.06	6.53	4.67	1.1	7	0	7.45	805.14	1278	6	15	311613	4083441	c3-s1
1381	1302	2.682	17.4	17.24	0.08	6.26	4.32	6.58	5.7	5.4	6.3	0	7.15	1091.16	1732	6	15	324236	4079142	c3-s1
1381	1302	0.66	10.75	10.96	0.13	1.43	3.29	6.11	3.8	0.65	6.3	0	7.3	688.59	1093	6	15	314330	4079215	c3-s1
1381	1302	9.807	37.06	37.27	0.43	24.43	5.36	7.05	4.46	27.7	4.9	0	7.19	2472.75	3925	6	15	322490	4079965	c4-s3
1381	1302	1.913	14.42	14.73	0.04	4.35	3.43	6.91	6.62	2.2	5.6	0	7.4	946.26	1502	6	15	306282	4092380	c3-s1
1381	1302	0.822	10.42	10.3	0.05	1.7	3.38	5.17	3.82	0.8	5.8	0	7.5	638.82	1014	6	15	323831	4085361	c3-s1
1381	1302	0.752	12.6	12.54	0.1	1.74	2.8	7.9	6.4	1	5.2	0	7.33	769.86	1222	6	15	333632	4066350	c3-s1
Average		92.141	598.06	603.76	2.65	248.57	124.26	228.3	211.45	226.84	159.76	0	225.94	35552.75	56433					
		3.18	20.62	20.82	0.09	8.57	4.28	7.87	7.29	7.82	5.51	0.00	7.79	1225.96	1945.97					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1382	1302	1.634	10.32	9.96	0.03	3.03	2.4	4.5	3.52	1.5	5.3	0	7.05	627	996	12	15	341415	4070708	c3-s1
1382	1302	1.257	7.46	7.25	0.03	2.03	1.9	3.3	2.16	0.7	4.6	0	7.5	459	728	12	15	330930	4078908	c2-s1
1382	1302	2.542	23.55	24.34	0.05	7.39	6	10.9	11.95	6.1	5.5	0	7.2	1565	2485	12	15	327210	4082527	c4-s1
1382	1302	2.645	20.51	21.08	0.08	7	5.81	8.19	8.91	5.6	6	0	7.2	1302	2067	12	15	333290	4071707	c3-s1
1382	1302	1.392	12.41	12.56	0.03	3.03	3.6	5.9	5.31	2.6	4.5	0	7.65	806	1280	12	15	316628	4078674	c3-s1
1382	1302	0.904	10.29	10.04	0.05	1.83	3.3	4.86	4.94	0.85	4.5	0	7.55	657	1043	12	15	316965	4080070	c3-s1
1382	1302	2.35	19.7	19.92	0.07	6.15	5.8	7.9	11	4	4.7	0	7.7	1266	2010	12	15	306262	4091254	c3-s1
1382	1302	0.574	43.51	45.42	0.1	2.65	17.99	24.68	38.21	2.5	2.8	0	7.95	2356	3740	12	15	322165	4073423	c4-s1
1382	1302	1.64	12.22	12.55	0.08	3.48	3.5	5.5	4.77	1.45	6	0	7.45	777	1233	12	15	311613	4083441	c3-s1
1382	1302	2.254	15.36	15.22	0.05	5.07	3.27	6.83	4.86	4.4	6.1	0	7.2	985	1564	12	15	324236	4079142	c3-s1
1382	1302	0.735	11.99	11.83	0.08	1.65	3.16	6.94	6.99	0.7	4.3	0	7.7	777	1233	12	15	314330	4079215	c3-s1
1382	1302	32.802	120.09	119.08	0.08	100.3	7.93	10.77	6.39	109	4.7	0	7.75	7768	12330	12	15	322490	4079965	c4-s4
1382	1302	1.1	12.75	12.39	0.08	2.44	4.1	5.77	6.65	0.5	5.6	0	7.4	777	1233	12	15	306282	4092380	c3-s1
1382	1302	1.734	10.05	10.01	0.05	3.19	2.63	4.14	4.15	1.6	4.3	0	7.1	656	1041	6	11	341415	4070708	c3-s1
1382	1302	1.831	20.93	21.56	0.08	5.22	6.36	9.9	7.13	10	3.8	0	7.5	1519	2411	6	11	332850	4073040	c4-s1
1382	1302	1.336	9.03	9.15	0.04	2.44	2.83	3.84	2.53	1.4	5.1	0	7.2	590	936	6	11	330930	4078908	c3-s1
1382	1302	2.423	26.7	27.73	0.08	7.66	8.89	11.1	13.8	7.8	5.1	0	7.1	1857	2948	6	11	327210	4082527	c4-s1
1382	1302	2.31	54.5	29.76	0.1	7.66	5	17	30.1	13	11.4	0	7	1923	3052	6	11	333290	4071707	c4-s1
1382	1302	1.568	17.7	11.5	0.03	3.19	3.43	4.85	11.4	1.2	5.1	0	7.45	754	1197	6	11	316628	4078674	c3-s1
1382	1302	0.778	11.51	11.68	0.05	1.73	3.64	6.26	5.51	0.9	5.1	0	7.1	721	1145	6	11	316965	4080070	c3-s1
1382	1302	1.933	14.09	14.25	0.05	4.3	3.33	6.57	5.19	3	5.9	0	7.1	956	1517	6	11	306262	4091254	c3-s1
1382	1302	1.474	12.66	12.64	0.08	3.19	1.49	7.88	6.06	1.5	5.1	0	7.5	830	1318	6	11	311613	4083441	c3-s1
1382	1302	2.092	15.19	14.83	0.03	4.7	3.4	6.7	4.79	4.4	6	0	7.1	1011	1604	6	11	324236	4079142	c3-s1
1382	1302	0.672	11.2	11.28	0.1	1.48	3.1	6.6	5.3	1.3	4.6	0	7.4	721	1145	6	11	314330	4079215	c3-s1
1382	1302	32.11	117.3	112.46	0.09	94.9	8.67	8.8	9.15	104	4.15	0	7.6	7539	11967	6	11	322490	4079965	c4-s4
1382	1302	1.657	14.99	15.29	0.04	3.94	4.21	7.1	6.44	3.4	5.15	0	7.3	1038	1648	6	11	306282	4092380	c3-s1
1382	1302	0.99	14.5	14.68	0.09	2.44	5.05	7.1	7.2	1.7	5.6	0	7.5	929	1474	6	11	333632	4066350	c3-s1
Average		104.74	670.51	638.46	1.72	292.09	130.79	213.88	234.41	295.1	141	0	199.25	41166	65345					
		3.88	24.83	23.65	0.06	10.82	4.84	7.92	8.68	10.93	5.22	0.00	7.38	1524.67	2420.19					

Appendix 8 Results of Water Quality Test (2001 -2006) (5/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1302	1.632	9.12	9.02	0.07	2.85	1.1	5	2.87	1.45	4.8	0	7.74	587	932	6	15	341415	4070708	c3-s1
1383	1302	1.997	24.16	24.11	0.12	5.99	5.7	12.3	8.31	10.35	5.5	0	7.01	1534	2435	6	15	332850	4073040	c4-s1
1383	1302	1.42	8.81	8.75	0.05	2.5	2	4.2	2.81	1.2	4.8	0	7.68	558	886	6	15	330930	4078908	c3-s1
1383	1302	3.226	28.21	28.79	0.1	9.89	8.8	10	15.16	7.95	5.1	0	8.05	1818	2885	6	15	327210	4082527	c4-s1
1383	1302	2.895	28.07	28.67	0.13	9.04	6.5	13	11.97	10.4	5.7	0	7.1	1811	2874	6	15	333290	4071707	c4-s1
1383	1302	1.588	13.05	13.11	0.03	3.48	3.2	6.4	4.55	3.6	4.9	0	7.67	845	1342	6	15	316628	4078674	c3-s1
1383	1302	0.816	10.56	10.92	0.08	1.74	4.1	5	4.36	1	5.2	0	7.4	690	1095	6	15	316965	4080070	c3-s1
1383	1302	2.474	13.53	13.56	0.09	5.07	1.8	6.6	5.13	3.1	5.3	0	7.22	917	1456	6	15	306262	4091254	c3-s1
1383	1302	1.669	12.39	12.64	0.1	3.54	1.2	7.8	4.39	1.9	6.1	0	7.35	890	1413	6	15	311613	4083441	c3-s1
1383	1302	2.43	13.02	13.07	0.08	4.89	1.3	6.8	3.67	4.25	5.1	0	7.25	923	1465	6	15	324236	4079142	c3-s1
1383	1302	0.715	9.13	9.55	0.12	1.43	2.8	5.2	2.93	0.7	5.5	0	7.34	646	1026	6	15	314330	4079215	c3-s1
1383	1302	33.489	114.47	113.2	0.12	96.48	6.8	9.8	6.07	104	4.4	0	7.6	7610	12080	6	15	322490	4079965	c4-s4
1383	1302	1.971	12.72	12.86	0.05	4.11	3.2	5.5	5.12	1.9	5.7	0	7.67	889	1411	6	15	306282	4092380	c3-s1
1383	1302	0.816	10.64	10.94	0.1	1.74	2.3	6.8	4.49	0.95	5.2	0	7.42	697	1106	6	15	333632	4066350	c3-s1
Average		57.138	307.88	309.19	1.24	152.75	50.8	104.4	81.83	152.75	73.3	0	104.5	20415	32406					
		4.08	21.99	22.09	0.09	10.91	3.63	7.46	5.85	10.91	5.24	0.00	7.46	1458.21	2314.71					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1302	2.29	9.41	9.75	0.05	3.9	1.7	4.1	2.71	1.25	5.45	0	7.92	619	982	12	15	341415	4070708	c3-s1
1384	1302	2.1	20.51	21.12	0.07	5.8	5.65	9.6	6.76	8.2	5.55	0	7.92	1288	2044	12	15	332850	4073040	c3-s1
1384	1302	1.419	7.48	7.7	0.03	2.32	2.05	3.3	1.88	0.9	4.7	0	7.85	483	767	12	15	330930	4078908	c3-s1
1384	1302	0.574	5.33	5.48	0.01	0.87	1.4	3.2	1.33	0.4	3.5	0.1	8.22	348	553	12	15	323831	4085361	c2-s1
1384	1302	3.526	27.75	27.74	0.07	10.37	6.5	10.8	15.7	7.05	5	0	7.31	1704	2705	12	15	327210	4082527	c4-s1
1384	1302	2.677	22.81	23.28	0.08	7.5	3.9	11.8	10.91	6.25	5.65	0	7.18	1441	2287	12	15	333290	4071707	c4-s1
1384	1302	1.65	14.83	14.9	0.03	3.87	4.8	6.2	8.38	1.95	4.5	0	7.87	943	1497	12	15	316628	4078674	c3-s1
1384	1302	0.997	10.44	10.4	0.07	2.03	3.9	4.4	5.99	0.5	3.95	0	7.5	657	1043	12	15	316965	4080070	c3-s1
1384	1302	2.28	13.06	13.25	0.05	4.7	3.6	4.9	4.66	2.6	5.8	0	7.6	839	1332	12	15	306262	4091254	c3-s1
1384	1302	0.705	438.42	7.85	0.08	1.27	1.75	4.75	2.77	0.65	435	0	7.7	501	796	12	15	322165	4073423	c3-s1
1384	1302	0.849	10.85	10.66	0.08	1.78	3.8	5	5.05	0.9	4.9	0	7.78	683	1084	12	15	333632	4066350	c3-s1
1384	1302	2.521	14.85	14.85	0.05	5.45	4.35	5	5.05	4.4	5.4	0	7.19	943	1497	12	15	324236	4079142	c3-s1
1384	1302	0.647	12.48	12.67	0.1	1.52	2.05	9	5.73	0.6	6.15	0	7.61	789	1252	12	15	314330	4079215	c3-s1
1384	1302	0.705	7.77	7.85	0.08	1.27	1.75	4.75	2.77	0.65	4.35	0	7.7	501	796	12	15	322165	4073423	c3-s1
1384	1302	31.385	118.36	117.58	0.08	98	8.7	10.8	7.41	106.5	4.45	0	7.9	7488	11886	12	15	322490	4079965	c4-s4
1384	1302	0.59	5.6	5.58	0.03	0.9	0.95	3.7	1.8	0.4	3.35	0.05	8.2	356	565	12	15	306282	4092380	c2-s1
Average		54.915	739.95	310.66	0.96	151.55	56.85	101.3	88.9	143.2	507.7	0.15	123.45	19583	31086					
		3.43	46.25	19.42	0.06	9.47	3.55	6.33	5.56	8.95	31.73	0.01	7.72	1223.94	1942.88					

Appendix 8 Results of Water Quality Test (2001 -2006) (6/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1381	1304	27.46	0.55	0.02	1.21	0.75	2.5	4.13	0.4	3.18			7.68	264.6	420	5	287587	4057025		15
1381	1304	31.56	1.68	0.07	2.65	1.9	4	8.17	0.9	5.59			7.48	491.4	780	5	291025	4044950		15
1381	1304	25.33	1.65	0.07	1.88	1.55	4.2	7.61	0.6	5.36			7.75	441	700	5	289500	4053375		15
1381	1304	17.59	2.18	0.04	1.07	1.35	3.85	6	1.05	2.77			7.58	378	600	5	296675	4052675		15
1381	1304	22.78	1.21	0.03	1.15	0.85	3.15	4.69	0.3	3.18			7.83	302.4	480	5	292125	4052200		15
1381	1304	30.98	3.9	0.07	2.78	1.55	4.8	8.02	1.25	2.87			7.91	548.1	870	5			زنجان باب و قاضیلاب	15
1381	1304	29.2	0.95	0.04	1.61	1.05	2.95	5.35	0.6	3.8			7.85	333.9	530	5	293425	4054000		15
1381	1304	14.71	0.21	0.03	0.47	0.8	2.1	3.23	0.25	2.77			7.81	201.6	320	5	280875	4058000		15
1381	1304	36.57	4.2	0.07	2.87	1.2	3.9	8.17	1.4	2.57			7.82	527.9	838	6	263000	4073050		15
1381	1304	51.28	8.17	0.1	10.11	4.65	5.05	14.17	2.1	3.9			8.06	1198.9	1903	27	264850	4057850		15
1381	1304	40.09	2.25	0.07	2.74	1.55	2.65	6.92	2	2.67			8.03	461.8	733	6	252450	4080750		15
1381	1304	28.07	0.57	0.04	1.17	1	2.1	4.04	0.65	2.82			8.11	267.8	425	3	265900	4067000		15
1381	1304	17.02	0.11	0.02	0.38	0.75	1.2	2.06	0.25	1.7			7.91	132.9	211	3	257400	4074050		15
1381	1304	49.16	3.03	0.07	4.04	1.05	3.2	8.19	2.65	2.51			8	563.2	894	3	261900	4068400		15
1381	1304	28.72	7.94	0.1	5.28	4.65	8.7	17.59	3.95	5.7			7.88	1180	1873	3	266950	4062250		15
1381	1304	68.35	3.35	0.1	7.35	1.35	2.1	11.26	3.7	4.21			8.03	748.4	1188	3	276500	4059000		15
1381	1304	55.67	4.2	0.1	5.3	1.3	3	9.6	1.4	4			7.83	634.4	1007	3	271750	4056200		15
1381	1304	46.67	3.56	0.07	3.78	1.1	3.3	7.94	1.05	3.33			8.04	528.5	839	3	270050	4065825		15
1381	1304	14.72	2.58	0.07	0.81	1.25	3.85	5.64	0.45	2.61			7.7	357.84	568	3	268950	4068775		15
1381	1304	54.99	4	0.1	4.42	1.45	2.25	7.62	0.75	2.87			7.91	512.8	814	3	265250	4071800		15
1381	1304	39.98	3	0.1	3.43	3.2	2.1	8.82	0.9	4.92			7.84	527.9	838	19	307650	4034600		15
1381	1304	35.97	1.73	0.07	2.57	2.7	2	7.46	0.6	5.13			7.87	439.7	698	24	306450	4043075		15
1381	1304	30.95	0.53	0.04	1.17	0.9	1.8	3.6	0.35	2.72			7.77	221.7	352	29	306525	4038550		15
1381	1304	58.79	1.97	0.07	4.21	1.75	1.25	6.87	1	3.9			8.01	451.7	717	20	299150	4039675		15
1381	1304	14.11	0.42	0.04	0.74	2.4	2.35	5.85	0.5	4.93			7.73	329.4	523	24	299700	4030100		15
1381	1304	30.18	1.27	0.07	1.94	2.7	1.95	6.64	0.5	4.87			8.01	381.7	606	13	309150	4030700		15
1381	1304	56.02	0.4	0.07	2.35	0.5	1.4	4.08	0.4	3.28			7.97	260.8	414	19	313100	4038050		15
1381	1304	43.65	0.59	0.04	1.78	1.1	1.25	3.65	0.7	2.36			7.94	249.4	396	12	291500	4055750		15
1381	1304	51.78	0.82	0.07	2.4	0.65	1.65	4.5	0.3	3.38			7.91	287.9	457	19	315875	4033500		15
1381	1304	55.63	5.47	0.1	6.42	2.85	2.35	8.64	2.63	0.54			7.97	752.8	1195	16	313350	4033450		15
1381	1304	51.13	0.15	0.07	2.65	1.55	1.05	5.16	0.5	4.51			8.07	310	492	24	302950	4028350		15
1381	1304	50.6	0.85	0.07	2.9	1.9	1	5.63	1.4	3.38			8.07	351	558	20	303075	4040800		15
1381	1304	42.86	6.23	0.1	8.9	6.35	5.65	15.25	4.45	4.57			7.9	1204	1912	9	261300	4064250		15
1381	1304	31.01	3.71	0.07	2.38	1.45	4	7.18	0.5	2.97			7.65	493.3	783	12				15
1381	1304	34.85	0.55	0.04	2.1	2.3	1.7	6.05	0.75	4.75			8.06	351	558	20	293050	4040650		15
1381	1304	52.21	3.27	0.1	4.87	2.05	2.5	9.09	0.9	4.92			8.1	581	922	20	297150	4043150		15
1381	1304	38.06	1.14	0.07	2.91	2.55	2.3	7.44	1.1	5.2			8.2	459	730	20	298300	4036250		15
1381	1304	35.45	0.17	0.04	1.58	0.85	2.1	4.32	0.45	3.7			7.97	279.7	444	5	310150	4041950		15
1381	1304	29.92	0.45	0.04	1.07	0.3	2.3	3.87	0.4	3.02			7.38	262.1	416	5	306550	4046750		15
1381	1304	51.93	3.11	0.1	4.87	2.1	2.5	9.19	0.8	5.28			7.56	577.7	917	5	311475	4025600		15
1381	1304	29.44	0.24	0.04	1.42	1.9	1.6	4.9	0.45	4.21			8.15	303.7	482	5	307925	4027750		15
1381	1304	42.21	5.24	0.12	5.87	1.9	6.3	8.09	0.6	2.25			7.91	645.1	1024	5	296375	4047825		15
1381	1304	35.02	1.5	0.07	1.87	1.25	2.35	5.17	0.6	3.07			7.86	330.7	525	5	299800	4051050		15
1381	1304	37.93	0.37	0.07	1.58	0.9	1.8	3.99	0.5	3.12			7.99	256.4	407	5	301450	4045150		15
1381	1304	34.41	0.24	0.07	1.95	1.9	1.95	6.17	0.5	5.43			7.11	337.7	536	5	303825	4048550		15
1381	1304	26.34	8.1	0.2	5.54	5.4	10.65	20.94	5.1	7.74			7.34	1266.3	2010	9	272175	4060850		15
1381	1304	37.76	0.61	0.03	1.79	1.6	1.4	4.18	0.5	2.25	0.82		8.32	270	427	5	293375	4053850		15
1381	1304	33.26	0.61	0.03	1.54	1.25	1.9	5.31	0.4	4.3			8.03	275.9	438	5	293850	4049525		15
1381	1304	36.15	3.05	0.1	3.07	1.9	3.7	9.01	1.25	4.71			7.87	540.5	858	5	282475	4060600		15
1381	1304	41.75	5.4	0.2	5.57	3.35	4.7	12.83	2	5.43			7.97	836	1327	5	284950	4055400		15
1381	1304	41.76	0.72	0.03	1.87	0.9	1.75	4.71	0.5	3.49			7.77	339	538	15	299800	4051050		15
1381	1304	34.21	4.07	0.04	2.95	2.05	3.7	7.84	1.3	2.47			7.88	531	843	11	263000	4073050		15
1381	1304	50.41	0.49	0.03	2.41	0.8	1.6	4.27	0.35	3.43			7.98	282	448	20	315875	4033500		15
1381	1304	29.6	0.54	0.03	1.82	2.95	1.45	6.06	0.55	4.97			8.07	368	584	11	309150	4030700		15
1381	1304	48.56	0.11	0.04	2.65	1.7	1.15	5.08	0.5	4.47			7.85	310	492	22	302950	4028350		15
1381	1304	28.4	0.41	0.02	1.15	0.75	2.2	3.63	0.4	2.82			7.83	244	388	16	306550	4046750		15
1381	1304	40.94	7.2	0.1	8.91	7.05	5.95	16.87	4.85	4.82			7.99	1258.1	1997	16	261300	4064250		15
1381	1304	29.39	1.46	0.4	1.91	1.4	4.15	7.91	0.55	5.9			7.83	457.4	726	16	289500	4053375		15
1381	1304	54.21	4.81	0.07	6.56	3.05	2.55	11.21	2.4	4			7.99	749.1	1186	20	313350	4033450		15
1381	1304	38.68	0.2	0.03	1.61	0.6	2	3.97	0.4	3.37			7.82	250	317	20	313100	4038050		15
1381	1304	14.23	0.25	0.02	0.76	2.3	2.4	5.83	0.45	5.13			7.81	337	535	22	299700	4030100		15
1381	1304	37.11	0.33	0.03	1.74	1	2	4.72	0.65	3.74			7.9	294	468	15	291500	4055750	0	15
1381	1304	47.71	3.27	0.07	5.04	1.95	3.65	10.68	0.85	6.56			7.27	617	980	24	297150	4043150		15
1381	1304	33.42	1.21	0.04	2.57	3.9	1.3	7.78	1.75	4.82			7.85	437.8	695	30	306450	4043075		15
1381	1304	40.12	1.42	0.07	3.28	2.2	2.8	7.75	0.9	5.43			7.45	444	705	24	298300	4036250		15
1381	1304	35.48	0.55	0.04	1.61	0.8	2.2	4.79	0.5	3.74			7.65	268	426	30	310150	4041950		15
1381	1304	31.25	3.68	0.07	2.43	1.35	4.15	7.25	0.55	3.02			7.74	457.4	726	30	296375	4047825		15
1381	1304	32.96	0.62	0.03	1.15	0.65	1.75	3.69	0.3	2.77			7.55	206	327	30	306525	4038550		15
1381	1304	36.53	0.57	0.03	1.61	0.75	2.1	4.2	0.3	3.33			7.57	270	427	30	303825	4048550		15
1381	1304	17.26	1.85	0.04	0.93	1.45	3.2	5.37	0.6	2.92			7.41	322	511	30	296675	4052675		15
1381	1304	34.26	0.92	0.4	1.58	1.05	2.75	4.69	0.07	3.7			7.63	313	497	16	293425	4054000		15
1381	1304	37.5	1.58	0.07	2.57	1.85	2.55	6.89	1	4.31			7.57	422	670	16	291025	4044950		15
1381	1304	12.99	0.58	0.03	0.47	1.15	2.2	3.95	0.3	3.07			7.51	204.7	325	15	280875	4058000		15
1381	1304	32.19	4.7	0.07	2.47	1.75	3.6	7.35	0.5	2.15			7.7	460.5	731	10				15
1381	1304	52.79	1.59	0.14	4.78	2.1	2.3	7.72	0.8	5.33			7.63	543.7	863	8	311475	4025600		15
1381	1304	48.63	2.58	0.07	4	1.1	3.2	7.79	2.65	2.56			7.79	524	831	5	261900	4068400		15
1381	1304	41.95	0.55	0.07	1.52	0.8	1.4	4.07	0.5	3.02			7.53	238.1	378	8	301450	4045150		15
1381	1304	26.33	0.65	0.04	1.3	1.8	1.95	5.8	0.45	4.7			7.72	307	487	8	307925	4027750		15
1381	1304	36.76	2.88	0.07	3.04	1.65	3.7	8.35	2.6	2.87			7.67	524.8	833	7	252450	4080750		15
1381	1304	17.41	0.34	0.02	0.37	0.55	1.3	2.24	0.2	1.7			7.71	125.2	198.8	5	257400	4074050		15
1381	1304	13.94	2.11	0.07	0.74	1.4	3.6	5.12	0.5	2.51			7.74	328	521	19	268950	4068775		15
1381	1304	46.96	3.52	0.07	4.49	1.75	3.4	7.9	1.15	3.23			7.74	558	886	19	270050	4065825		15
1381	1304	26.76	6.45	0.11	4.95	4.7	9.15	16.15	4.1	5.6			7.29	1075	1707	19	266950	4062250		15
1381	1304	55.65	3.03	0.12	5.4	1.7	2.7	8.68	1.45	4.2			7.91	593	941	19	271750	4056200		15
1381	1304	52.44	3.63	0.07	4.34	1.6	2.4	7.3	0.75	2.92			7.77	461.8	7338	19	265250	4071800		15
1381	1304	28.77	5.9	0.12	5.98	5.35	9.75	19.5	5.45	8.15			7.29	1234	1959	19	272175	4060850		15
1381	1304	56.7	2.23	0.07	4.84	1.2	2.55	8.43	2	4.2			7.7	517	821	14	276500	4059000		15
1381	1304	30.28	0.34	0.07	2.21	2.15	3.1	7.24	0.75	6.15			7.39	403.8	641	14	293050	4040650		15
1381	1304	37.76	0.71	0.04	1.78	1.7	1.3	4.33	0.45	3.17			7.87	270	428	8	293375	4053850		15
1381	1304	29.52	0.52	0.04	1.51	1.4	2.3	4.97	0.4	4.05			7.7	291.7	463	14	293850	4049525		15
1381	1304	27.54	0.53	0.03	1.11	0.8	2.2	4	0.65	2.82			7.63	243	386	5	265900	4067000		15
1381	1304	18.43	3.64	0.07	1.67	1.9	5.8	11.34	1.55	6.15			7.34	620	984	14	282475	4060600		15
1381	1304	30.38	0.47	0.03	1.17	0.85	1.9	3.57	0.03	3.07			7.97	225.5	358	8	287587	4057025		15
1381	1304	22.85	0.83	0.04	1.13	1.35	2.6	4.47	0.35	3.29			7.78	284.8	452	14	292125	4052200		15
1381	1304	49.86	7.02	0.12	10.22	4.7	5.7	9.67	2.24	0.41			7.91	1123.3	1783	19	264850	4057850		15
1381	1304	37.5	0.13	0.03	1.17	1.35	0.65	3.4	0.4	2.87			7.74	185.2	294	24	303075	4040800	0	15
1381	1304	41.47	1.7	0.2	3.13	2.65	2.05	7.83	1	5.13			7.77	503	798	30	307650	4034600		15
1381	1304	21.88	6.4	0.1	4.13	5.45	9.65	15.15	4.9	3.85			8.13	1323	2100	7	263125	4023950		15
Average		3572	216.77	7.19	287.54	186	296.2	705.79	112.57	375.63	-		764.08	46254.44	79947.8					
		36.45	2.21	0.07	2.93	1.90	3.02	7.20	1.15	3.83	-		7.80	471.98	815.79					

Appendix 8 Results of Water Quality Test (2001 -2006) (7/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1382	1304	32.51	0.57	0.03	1.47	1.28	1.83	4.39	0.55	3.27			8.21	300	492	16	306550	4046750		15
1382	1304	28.23	0.5	0.01	1.17	0.6	2.4	4.11	0.3	3.31			3.37	241.9	384	13	287587	4057025		15
1382	1304	44.25	5.12	0.1	6.25	3	5	14.74	2.85	6.77			7.21	848.6	1347	24	276500	4059000		15
1382	1304	49.17	8.23	0.2	10.44	5.7	5.3	14.14	2.1	3.81			7.38	1230.4	1953	24	264850	4057850		15
1382	1304	37.82	2.18	0.07	2.85	2.75	2.05	6.94	2.25	2.51			7.65	457.4	726	24	252450	4080750		15
1382	1304	29.88	4.41	0.1	3.65	2.45	6.35	5.95	1.27	0.27			7.41	716.3	1137	13	282475	4060600		15
1382	1304	35.92	0.86	0.07	1.78	0.55	2.75	5.57	0.85	3.86			7.57	383.04	608	13	293425	4054000		15
1382	1304	36.94	4.14	0.1	2.77	2.6	2.3	9.35	1.35	3.86			7.73	582.1	924	24	271750	4056200		15
1382	1304	38.53	0.47	0.04	1.84	1.3	1.7	4.33	0.45	3.41			7.73	260.1	413	24	286100	4058850		15
1382	1304	12.46	0.23	0.02	0.4	0.95	2	3.09	0.25	2.61			7.79	182.7	290	24	280875	4058000		15
1382	1304	25.19	7.81	0.14	5.65	8.7	8.5	18.22	7.15	3.26			7.72	1285.2	2040	24	266950	4062250		15
1382	1304	35.72	6.37	0.1	5.43	4.95	5	14.14	1.9	5.87			7.59	843	1338	24	284950	4055400		15
1382	1304	35.29	0.35	0.03	1.77	1.4	1.9	4.16	0.65	3.16			7.53	287.3	456	24	291500	4055750		15
1382	1304	19.74	3.13	0.07	1.32	1.45	4.2	6.09	0.55	2.41			7.83	423.4	672	12	303825	4048550		15
1382	1304	41.14	0.77	0.1	2.87	2	2.25	6.63	1.05	4.81			7.84	439.7	698	13	298300	4036250		15
1382	1304	35.05	0.13	0.03	1.13	1.25	0.9	3.13	0.35	2.65			8.03	176.4	280	12	303075	4040800		15
1382	1304	44.33	0.25	0.4	1.67	1.1	1.5	3.56	0.45	2.86			7.87	220.5	350	13	301450	4045150		15
1382	1304	53.29	1.47	0.1	4.35	2	1.9	7.23	1.05	4.71			7.84	473.8	752	13	299150	4039675		15
1382	1304	22.77	0.7	0.04	1.11	1.8	2.1	4.01	0.3	3.01			7.91	281	446	13	292125	4052200		15
1382	1304	34.26	1.47	0.07	2.64	3.8	1.4	7.82	1.94	4.41			7.77	447.9	711	13	306450	4043075		15
1382	1304	27.4	0.39	0.04	1.13	1.4	1.7	3.6	0.35	2.86			7.97	236.8	376	12	306550	4046750		15
1382	1304	26.57	0.85	0.04	1.57	1.35	3.1	5.41	0.55	4.01			7.77	342.7	544	12	289500	4053375		15
1382	1304	39.62	0.51	0.03	1.84	1.55	1.3	4.22	0.5	3.21			7.97	270	428	12	293375	4053850		15
1382	1304	32.87	0.97	0.04	1.87	1.55	2.35	4.88	0.55	3.36			7.67	341.5	542	12	299800	4051050		15
1382	1304	54.19	5.17	0.14	6.78	3.35	2.5	11.58	2.55	3.86			8.1	744	1181	30	313350	4033450		15
1382	1304	31.88	3.55	0.07	2.34	2.05	3.1	7.06	0.65	2.86			7.75	447	709	19	296375	4047825		15
1382	1304	50.38	0.49	0.07	2.57	0.9	1.7	4.5	0.4	3.61			4.57	317	503	30	315875	4033500		15
1382	1304	35.93	2.18	0.07	2.65	2.45	2.4	7.19	0.9	4.11			7.56	434.7	690	29	291025	4044950		15
1382	1304	50.54	0.12	0.04	2.77	1.65	1.1	5.03	0.6	4.31			7.88	311	494	29	302950	4028350		15
1382	1304	46.96	3.57	0.1	5.3	3	3.1	10.64	0.9	6.17			7.87	632	1004	30	297150	4043150		15
1382	1304	49.13	2.7	0.04	4.21	2	2.4	7.85	2.8	2.35			7.86	512.2	813	4	261900	4068400		15
1382	1304	28.31	0.44	0.04	1.5	0.8	3.1	4.65	0.4	3.81			7.64	301.1	478	31	293850	4049525		15
1382	1304	26.61	0.63	0.03	1.13	2.1	1.1	4.14	0.6	2.91			7.77	257	408	4	265900	4067000		15
1382	1304	14.85	0.1	0.02	0.32	0.45	1.5	2.31	0.3	1.91			7.51	139	220	4	257400	4074050		15
1382	1304	43.01	0.24	0.3	1.7	0.95	1.7	3.81	0.4	3.17			7.85	243.2	386	30	313100	4038050		15
1382	1304	25.42	2.14	0.7	0.97	1.9	3	5.31	0.5	2.67			7.71	343	543	29	296675	4052675		15
1382	1304	13.12	2.44	0.04	0.76	1.9	3.4	5.54	0.55	2.55			7.77	353.4	561	16	268950	4068775		15
1382	1304	37.31	2.97	0.07	3.65	3.85	2.4	9.14	1.1	5.07			7.65	574	911	18	307650	4034600		15
1382	1304	34.43	4.3	0.07	2.87	3	2.6	8.01	1.3	2.41			8.03	510.3	810	16	263000	4073050		15
1382	1304	40.58	4.45	0.1	4.27	3.2	3.2	8.81	1.35	3.01			7.88	637	1011	16	270050	4065825		15
1382	1304	28.22	3.53	0.07	2.25	2.2	3.7	6.68	0.5	2.65			7.71	481	764	8				15
1382	1304	39.75	6.8	0.14	8.7	8.1	5.3	16.57	5.4	4.37			8.1	1272.6	2020	6	261300	4064250		15
1382	1304	32.63	0.87	0.04	1.97	2.75	1.4	5.58	0.5	4.21			8.13	350.3	556	26	309150	4030700		15
1382	1304	34.16	0.26	0.03	1.63	1.5	1.7	4.08	0.45	3.37			7.67	271	430	16	310150	4041950		15
1382	1304	34.85	0.24	0.02	1.13	0.35	1.8	3.45	0.4	2.81			7.77	206	327	5	257400	4074050		15
1382	1304	13.68	0.27	0.07	0.77	2.85	2.45	5.78	0.6	4.91			8.02	343.3	545	29	299700	4030100		15
1382	1304	25.13	0.75	0.07	1.34	2.55	1.65	5.62	0.4	4.47			7.94	308.7	490	18	307925	4027750		15
1382	1304	16.57	3.85	0.1	1.27	3.2	3.7	8.21	1.45	2.91			7.34	571.1	907	17	276000	4063200		15
1382	1304	57.74	2.85	0.1	4.75	1.75	1.8	5.71	0.75	2.11			7.75	506.5	804	18	311475	4025600		15
1382	1304	62.99	2.94	0.1	4.24	0.15	2.4	6.47	0.75	2.78			8.12	446.7	709	16	265250	4071800		15
1382	1304	15.34	0.34	0.1	0.77	2.6	2.2	5.58	0.5	4.74			7.87	317	504	22	299700	4030100		15
1382	1304	32.95	2.6	0.14	2.71	1.7	4.1	6.75	1.2	2.95			7.91	494	784	6	276000	4063200		15
1382	1304	36.01	2.8	0.1	2.91	1.2	4.15	6.68	1.35	2.53			7.25	520	825	16	263000	4073050		15
1382	1304	53.98	5.38	0.14	6.78	2.85	3.05	11.89	2.5	4.01			7.81	729	1158	29	313350	4033450		15
1382	1304	32.7	4.54	0.1	2.5	1.55	3.8	6.72	0.5	1.68			7.72	466.2	740	11				15
1382	1304	46.56	3.15	0.14	5	2.2	3.7	10.25	0.8	6.3			7.11	620	983	26	297150	4043150		15
1382	1304	36.35	0.71	0.1	2.67	3.75	1.1	7.63	2.6	4.32			8.18	421	668	7	306450	4043075		15
1382	1304	40.38	7.83	0.2	8.91	7.55	5.9	17.65	5.6	4.22			7.75	1243	1973	10	261300	4064250		15
1382	1304	40.65	3.05	0.07	3.08	1.6	3	7.48	2.8	1.63			7.77	472	750	11	252450	4080750		15
1382	1304	30.32	0.7	0.4	1.21	1	2.7	4.27	0.3	3.27			8.12	275	436	4	292125	4052200		15
1382	1304	37.78	0.42	0.03	1.67	1.2	1.6	4.13	0.5	3.21			8.1	237.5	377	5	301450	4045150		15
1382	1304	53	3.35	0.2	5.1	1.6	3.1	10.19	2.2	4.64			7.81	574.5	912	11	276500	4059000		15
1382	1304	32.17	0.33	0.07	1.4	0.9	2.2	3.83	0.5	3			7.87	261	414	5	306550	4046750		15
1382	1304	26.56	7.99	0.2	4.9	5.3	8.8	15.96	4.7	3.27			7.77	1067.8	1695	2	266950	4062250		15
1382	1304	37.25	0.3	0.03	1.84	1.05	2.1	4.5	0.5	3.7			7.91	273	433	4	286100	4058850		15
1382	1304	14.29	0.41	0.02	0.43	0.75	1.95	3.35	0.3	2.64			7.78	181.4	288	4	280875	4058000		15
1382	1304	32.6	0.71	0.04	1.58	0.95	2.4	4.59	0.35	3.53			8.14	284	451	5	303825	4048550		15
1382	1304	37.91	7.77	0.1	5.7	4.45	5.05	15.4	2.25	5.38			7.59	867.5	1377	4	284950	4055400		15
1382	1304	25.45	7.88	0.1	5.43	5.3	10.9	19.43	4.85	6.7			7.04	866.3	1375	2	272175	4060850		15
1382	1304	49.45	7.97	0.25	9.14	4.3	5.3	13.72	1.75	4			7.34	1195	1898	2	264850	4057850		15
1382	1304	37.78	0.27	0.07	1.63	0.3	2.5	3.84	0.4	3.17			7.81	238.7	379	29	313100	4038050		15
1382	1304	32.64	3.67	0.12	3.15	1.95	4.8	9.77	1.4	4.7			7.94	462	733	4	282475	4060600		15
1382	1304	34.54	0.79	0.07	1.17	0.65	1.7	3.51	0.4	2.32			7.74	221.7	352	4	287587	4057025		15
1382	1304	57.82	4	0.2	4.94	1.05	2.7	8.87	1.5	3.37			7.83	562	892	2	271750	4056200		15
1382	1304	26.67	0.1	0.02	0.78	0.55	1.65	3.08	0.4	2.58			7.92	174.5	277	5	306525	4038550		15
1382	1304	33.87	0.41	0.02	1.67	0.9	2.4	4.64	0.7	3.53			8.11	291.7	46.3	4	291500	4055750		15
1382	1304	24.78	0.94	0.03	1.65	1.5	3.6	6.05	0.95	4.16			7.15	376.1	597	4	293425	4054000		15
1382	1304	34.82	0.14	0.03	1.84	1.15	2.35	4.7	0.55	4.01			8.06	290.4	461	5	310150	4041950		15
1382	1304	22.22	0.11	0.03	1.27	1.45	3.1	3.09	0.4	2.58			7.85	182.7	290	7	303075	4040800		15
1382	1304	37.88	0.71	0.04	1.85	1.9	1.2	4.27	0.45	3.11			7.94	274	435	5	293375	4053850		15
1382	1304	34.33	2.95	0.1	2.54	1.9	3.15	9.17	0.95	5.27			7.71	459.9	730	7	291025	4044950		15
1382	1304	35.94	2.8	0.12	2.91	2.3	3.1	9.29	0.95	5.54			7.23	462.4	734	7	298300	4036250		15
1382	1304	25.14	1.55	0.1	2.1	1.75	4.8	8.47	0.85	6.07			8.2	483.8	768	4	289500	4053375		15
1382	1304	32.52	4.2	0.1	2.43	1.25	4	7.23	0.55	2.48			8.01	447.9	711	5	296375	4047825		15
1382	1304	59.95	3.05	0.7	4.24	1.75	1.55	7.9	1	3.85			8.05	429	681	7	299150	4039675		15
1382	1304	36.51	0.91	0.1	1.97	1.05	2.55	4.58	0.6	3.07			7.97	320	508	5	299800	4051050		15
1382	1304	19.68	1.01	0.14	0.84	1.15	2.85	4.2	0.6	2.59			7.82	303.7	482	5	296675	4052675		15
1382	1304	31.35	0.67	0.07	1.3	0.5	2.5	4.22	0.6	2.95			7.37	266.5	423	11	265900	4067000		15
1382	1304	52	3.4	0.14	4.41	0.9	3.3	8.84	2.7	2.74			7.77	504	800	11	261900	4068400		15
1382	1304	33.64	0.77	0.07	2.11	2.9	1.4	5.28	0.5	4.01			7.97	337	535	7	309150	4030700		15
1382	1304	51.86	3.5	0.2	4.81	1.1	3.55	8.07	1.4	3.17			7.87	538	854	18	270050	4065825		15
1382	1304	14.09	0.14	0.02	0.39	0.55	1.95	2.82	0.2	2.48			7.4	162.5	258	11	257400	4074050		15
1382	1304	55.11	0.35	0.07	4.41	2	1.65	4.92	0.5	4.07			7.93	281.6	447	7	307925	4027750		15
1382	1304	52.47	3.7	0.2	3.83	1.1	2.55	7.39	0.75	2.94			7.83	434.7	690	18	265250	4071800		15
1382	1304	56.57	3.4	0.12	4.7	2	1.7	12.59	0.85	4.17	4.17		7.84	500	793	7	311475	4025600		15
1382	1304	46.31	5.78	0.2	6.7	4.5	3.5	13.93	1.4	6.75			7.77	771	1224	7	307650	4034600		15
1382	1304	14.75	2.4	0.03	0.87	1.2	4	5.74	0.6	2.74			7.31	342.1	543	18	268950	4068775		15
1382	1304	55.8	1.03	0.14	3.9	1.9	1.3	6.29	0.95	4.31			8.05	428.4	680	24	299150	4039675		15
Average		3510.1	230.71	10.39	286.95	207.43	286.48	702.18	115.21	352.09			754.6	44696.34	70545.3					
		35.82	2.35	0.11	2.93	2.12	2.92	7.17	1.18	3.59			7.70	456.09	719.85					

Appendix 8 Results of Water Quality Test (2001 -2006) (8/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1304	39.44	10.38	0.07	7.3	7.22	4.1	18.02	5.72	1.92			8.04	1220	2060	21	261300	4064250		15
1383	1304	26.8	3.93	0.04	3.21	3.37	5.5	11.79	5.98	1.88			7.21	760	1273	18	252450	4080750		15
1383	1304	38.27	3.56	0.03	2.54	2	2.15	6.39	1.32	1.51			7.73	460	208	15				15
1383	1304	49.6	12.36	0.08	8.47	4.7	3.99	16.1	2.06	1.68			7.95	1140	1832	17	264850	4057850		15
1383	1304	31.54	9.1	0.06	4.67	4.77	5.5	14.57	4.27	1.2			7.86	980	1611	18	266950	4062250		15
1383	1304	28.16	1.92	0.02	1	1.04	1.55	3.3	0.35	1.03			8.12	250	414	23	293375	4053850		15
1383	1304	26.17	1.23	0.02	1.13	1.24	1.99	4.05	0.82	2			7.98	280	414	23	293425	4054000		15
1383	1304	51.63	0.67	0.03	1.71	0.96	0.67	3.06	0.63	1.76			8.13	230	382	23	291500	4055750		15
1383	1304	40.81	6.35	0.07	4.26	4.05	2.23	10.24	2.01	1.88			8.07	700	1152	20	284950	4055400		15
1383	1304	41.1	0.66	0.02	1.26	1.04	0.79	2.75	0.33	1.76			8.12	220	358	20	287587	4057025		15
1383	1304	40.07	1.35	0.03	2.21	1.12	2.23	5.33	1.1	2.88			7.13	370	613	20	282475	4060600		15
1383	1304	50.48	2.89	0.05	5.04	1.96	3.03	9.7	2.7	4.11			7.52	650	1092	20	276500	4059000		15
1383	1304	55.35	1.26	0.03	2.34	1.04	0.87	3.96	1.1	1.6			8.12	280	463	20	280875	4058000		15
1383	1304	52.78	3.68	0.12	4.43	2.32	1.75	7.57	1.26	2.63			8.47	560	907	29	299150	4039675		15
1383	1304	39.25	2.38	0.03	2.08	2.08	1.19	5.04	0.66	2			7.95	360	581	23	289500	4053375		15
1383	1304	47.02	0.81	0.03	1.67	1.08	0.83	3.3	0.38	2.11			8.14	240	395	23	292125	4052200		15
1383	1304	47.54	3.35	0.04	2.63	1.44	1.51	5.27	0.52	1.4			8.06	380	614	15	263000	4073050		15
1383	1304	43.61	1.59	0.03	2.47	2	1.23	5.42	0.88	2.95			7.97	380	619	29	298300	4036250		15
1383	1304	33.72	0.64	0.03	1.43	2	0.87	3.68	0.44	2.6			8.44	280	468	30	311475	4025600		15
1383	1304	39.83	5.1	0.03	4.15	3.97	2.35	10.1	2.2	2.8			7.85	680	1104	30	307925	4027750		15
1383	1304	53.1	2.79	0.04	3.8	2.77	0.62	6.57	1.07	2.71			8.39	470	767	29	307650	4034600		15
1383	1304	22.31	0.84	0.03	1	2.36	1.22	4.04	0.52	2.68			8.45	290	493	30	299700	4030100		15
1383	1304	37.24	1.23	0.03	2.34	3.13	0.87	5.7	1.79	2.68			8.47	400	673	31	306450	4043075		15
1383	1304	41.43	0.14	0.02	1.3	1.08	0.79	3.2	0.46	2.28	0.32		8.42	220	348	31	303075	4040800		15
1383	1304	34.28	1.25	0.04	2.34	3.29	1.27	6.64	1.51	3.36	0.52		8.53	430	731	31	306525	4038550		15
1383	1304	47.88	2.48	0.03	5.3	3.09	2.71	10.78	3.28	5.02			8.1	730	1213	17	313350	4033450		15
1383	1304	36.1	1.73	0.04	1.86	2.57	0.79	5.01	0.52	2.48	0.28		8.48	340	561	31	309150	4030700		15
1383	1304	34.88	1.38	0.02	1.6	1.04	1.99	3.32	1.91	0.03			7.82	310	498	30	310150	4041950		15
1383	1304	25.61	0.13	0.02	0.56	0.48	1.19	2.28	0.27	1.88			8.11	160	259	18				15
1383	1304	28.27	1.21	0.02	1.3	1.04	2.31	4.43	0.59	2.63			7.47	310	507	17				15
1383	1304	45.13	2.66	0.04	3.71	1.41	3.15	7.99	2.53	2.8			7.34	530	883	18				15
1383	1304	50.16	4.1	0.02	4.65	2.09	2.55	8.95	1.49	3.36			7.86	600	977	17	271750	4056200		15
1383	1304	27.05	0.75	0.02	1.13	1.12	1.99	3.96	0.33	2.88			7.48	280	463	21	306550	4046750		15
1383	1304	42.1	0.22	0.02	1.43	0.8	1.19	3.29	0.27	2.8			7.12	230	379	21	303825	4048550		15
1383	1304	34.24	4.12	0.03	2.43	1.93	2.79	6.64	1.24	1.28			7.91	470	762	25	276000	4063200		15
1383	1304	40.74	2.89	0.04	3.04	1.73	2.75	6.91	1.54	2.48			7.86	480	797	17	272175	4060850		15
1383	1304	41.78	0.79	0.02	1.76	0.96	1.52	4.27	0.49	2.71	0.28		8.49	290	471	26	287587	4057025		15
1383	1304	33.67	0.31	0.02	1	1.04	0.96	2.77	0.38	2.08			8.11	200	336	21	301450	4045150		15
1383	1304	38.98	0.85	0.02	1.36	1.2	0.96	3.37	0.44	2.08			8.12	240	394	21	296375	4047825		15
1383	1304	34.6	2.03	0.03	2.34	1.93	2.55	6.56	0.93	3.6			7.75	460	730	21	293850	4049525		15
1383	1304	38.54	0.81	0.03	1.48	1.12	1.28	3.65	0.44	2.4			8.09	260	426	21	291025	4044950		15
1383	1304	44.73	0.96	0.03	1.71	0.6	1.55	3.65	0.38	2.31			8.14	260	431	28	313100	4038050		15
1383	1304	32.05	1.95	0.02	1.73	1.32	2.39	5.22	0.52	2.75			7.21	360	592	28	299800	4051050		15
1383	1304	36.4	2.83	0.02	1.78	1.28	1.87	4.66	0.55	1.28			7.97	340	541	28	296675	4052675		15
1383	1304	35.64	0.72	0.03	1.52	1.04	1.75	4.05	0.38	2.75	0.2		8.39	290	468	16				15
1383	1304	14.69	2.87	0.02	0.86	1.76	3.35	5.67	0.57	2.23			8.16	400	641	11				15
1383	1304	25.79	5.83	0.03	2.84	2.2	6.06	10.72	3.25	1.64			7.73	720	1177	14				15
1383	1304	50.6	3	0.02	3.08	1.16	1.87	5.83	0.63	2.2			8.14	410	651	11				15
1383	1304	26.13	4.55	0.05	3.71	3.37	7.26	14.06	6.2	3.31			7.44	880	1484	9	252450	4080750		15
1383	1304	26.35	8.21	0.04	4.65	5.05	8.06	17.47	3.91	5.35			7.32	1110	1826	14				15
1383	1304	38.8	11.95	0.09	6.95	3.73	7.38	15.65	2.14	1.56			7.87	1120	1852	11				15
1383	1304	32.74	4.08	0.03	2.34	2.08	2.79	6.86	1.35	1.43			7.97	480	761	11	263000	4073050		15
1383	1304	28.55	5.02	0.04	2.13	1.96	3.47	7.25	0.55	1.68			7.79	510	803	11				15
1383	1304	29.94	1.3	0.03	1.65	2.73	1.19	5.12	0.55	3.27			8.39	360	597	19	309150	4030700		15
1383	1304	11.5	0.81	0.02	0.6	2.64	2.11	5.05	0.41	3.83			7.89	330	568	19	311475	4025600		15
1383	1304	42.01	3.56	0.03	3.15	2.64	1.75	7.24	0.8	2.88			8.16	500	798	20	297150	4043150		15
1383	1304	31.77	1.18	0.03	2.13	2.97	1.67	6.44	1.51	3.75			7.55	430	726	7	306450	4043075		15
1383	1304	28.55	10.79	0.05	4.21	3.97	6.7	14.1	0.88	2.43			7.87	970	1543	13	291025	4044950		15
1383	1304	33.33	0.71	0.03	2.21	2.16	2.31	5.72	0.82	3.91	0.28		8.42	390	612	13	298300	4036250		15
1383	1304	24.05	0.25	0.02	0.93	1.48	1.51	3.74	0.49	3			7.78	260	429	13	301450	4045150		15
1383	1304	29.78	1.29	0.04	2.17	3.21	1.99	7.16	1.92	3.95			7.98	470	776	2	306525	4038550		15
1383	1304	15.78	0.59	0.03	0.86	2.88	1.87	5.4	0.57	4	0.24		8.4	350	593	16	299700	4030100		15
1383	1304	37.42	0.12	0.02	1.17	1.36	0.63	3.03	0.6	2.31			8.11	220	344	2	303075	4040800		15
1383	1304	56.04	2.37	0.03	3.8	2.41	0.59	7.37	1.04	3.56	0.4		8.49	490	823	20	299150	4039675		15
1383	1304	22.58	0.66	0.03	1.3	2.65	1.91	5.63	0.49	4.48			7.88	370	624	19	307925	4027750		15
1383	1304	16.69	0.89	0.01	0.6	1.04	1.99	3.42	0.38	2.15			8.19	250	403	13	296675	4052675		15
1383	1304	14.23	0.29	0.01	0.36	1.28	0.95	2.42	0.22	1.91			8.15	180	296	16	310150	4041950		15
1383	1304	50.17	5.23	0.04	6	3.29	2.71	11.62	2.64	3.75			7.98	770	1257	16	313350	4033450		15
1383	1304	29.6	1.27	0.02	1.52	1.28	2.39	4.93	0.71	2.95			8.13	340	538	7	292125	4052200		15
1383	1304	53.81	1.32	0.03	2.13	1.62	0.23	5.73	1.21	3.2			7.97	390	618	5	280875	4058000		15
1383	1304	44.58	2.04	0.03	3.08	1.32	2.55	6.64	2.45	2.15			7.98	450	736	13	261900	4068400		15
1383	1304	27.09	1.18	0.02	1.43	1.28	2.63	5	0.74	3.08			7.62	350	578	7	287587	4057025		15
1383	1304	34.58	3.87	0.04	4.67	3.01	5.9	13.2	5.73	3.6			7.39	840	1407	14	266950	4062250		15
1383	1304	44.02	4	0.02	3.21	1.24	2.87	6.9	1.07	1.83			8.11	206	490	14	270050	4065825		15
1383	1304	27.46	3.2	0.03	1.95	1.56	3.67	6.85	0.57	3.08			8.21	480	756	13	293675	4047825		15
1383	1304	34.46	2.68	0.03	3.08	1.64	4.27	8.63	0.68	5.03	0.24		8.47	570	948	13	289500	4053375		15
1383	1304	52.46	3.62	0.02	4.43	1.64	2.39	8.08	1.43	3.03			7.93	560	893	9	271750	4056200		15
1383	1304	33.08	3.79	0.03	2.54	2	3.19	7.37	1.35	2.23			7.97	510	817	5	282475	4060600		15
1383	1304	24.84	5.06	0.02	2.34	2.04	5.11	9.13	1.76	2.31			8.1	620	997	5	276000	4063200		15
1383	1304	33.58	2.41	0.03	2.21	2.36	2.07	6.29	0.68	3.2			8.1	620	997	14	293850	4049525		15
1383	1304	28.45	0.79	0.02	1.11	1.16	1.67	3.69	0.3	2.6			8.11	270	431	7	286100	4058850		15
1383	1304	40.35	5.1	0.01	5.13	4.81	2.79	12.5	1.37	5.55	0.48		8.42	790	1341	16	307650	4034600		15
1383	1304	22.08	0.25	0.01	0.45	0.68	0.95	1.91	0.22	1.44			7.95	140	236	13	257400	4074050		15
1383	1304	45.74	12.41	0.09	8.43	4.61	5.5	17.96	1.95	3.36	0.24		8.4	1220	1928	9	264850	4057850		15
1383	1304	31.68	1.37	0.02	1.11	0.28	2.15	4.4	0.63	2.4			7.86	310	498	13	265900	4067000		15
1383	1304	54.9	2.78	0.04	4.43	1.56	2.11	7.9	2.09	3.03			7.98	520	867	5	276500	4059000		15
1383	1304	24.14	1.17	0.02	1.1	1.08	2.43	4.38	0.33	2.88			8.11	310	507	7				15
1383	1304	37.32	3.56	0.04	2.65	1.88	2.63	8.41	1.29	3.56			8.05	480	756	13				15
Average		3171.8	249.8	2.85	231.17	184.89	214.96	604.42	117.04	234.1	3.48		703.46	41316	67183					
		36.04	2.84	0.03	2.63	2.10	2.44	6.87	1.33	2.66	0.04		7.99	469.50	763.44					

Appendix 8 Results of Water Quality Test (2001 -2006) (9/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1304	40.57	3.27	0.14	3.58	2.35	3.1	8.29	0.75	4.27			7.44	535.5	850	31	297150	4043150		15
1384	1304	15.49	0.4	0.07	0.81	2.7	2.1	5.28	0.5	4.38			8.07	321.3	510	31	299700	4030100		15
1384	1304	37.42	0.94	0.1	2.71	2.1	2.6	6.68	0.8	4.94			8.19	441	700	18	298300	4036250		15
1384	1304	53.19	2.23	0.2	4.55	1.88	2.3	8.33	1.3	3.77	1.03		8.49	522.9	830	31	299150	4039675		15
1384	1304	33.66	0.17	0.07	0.97	1.1	0.95	3.17	0.35	2.65			8.13	195.3	310	26	301450	4045150		15
1384	1304	29.22	3.51	0.2	3	2.1	5.65	10.22	4.9	1.81			7.77	686.7	1090	3	252450	4080750		15
1384	1304	30.46	5.17	0.2	2.91	5.3	1.8	9.68	1.8	2.71			8.1	623.7	990	24	276000	4063200		15
1384	1304	42.62	3.77	0.2	3.7	3.15	2.1	9.55	1	4.78			8.01	560.7	890	26	307650	4034600		15
1384	1304	39.88	2.39	0.2	3.15	3.95	1.1	8.41	1.65	3.2	1.17		8.37	510.3	810	26	306450	4043075		15
1384	1304	35.4	0.41	0.14	1.23	1.3	1.2	3.83	0.5	2.92			8.17	207.9	330	26	303075	4040800		15
1384	1304	36.96	0.29	0.07	1.63	1.7	1.2	3.29	0.35	2.65			7.9	233.1	370			مشخصات ندارد		15
1384	1304	41.13	7.91	0.3	7	4.05	6.4	11.51	1.05	2.55			7.99	1020.6	1620	29	263425	4079150		15
1384	1304	32.39	1.27	0.07	1.87	2.6	1.45	6.29	0.55	4.47			7.99	384.3	610	30	309150	4030700		15
1384	1304	21.13	3.09	0.07	1.39	1.3	4.15	5.94	0.45	2.4			8.1	409.5	650	24	303825	4048550		15
1384	1304	19.58	4.52	0.07	1.33	0.65	5.1	7.46	0.65	2.29			6.97	485.1	770	26	296675	4052675		15
1384	1304	25.28	0.49	0.07	1.3	2.15	1.9	5.62	0.5	4.63			8.17	321.3	510	30	307925	4027750		15
1384	1304	52.84	1.44	0.1	5.67	3.95	1.2	7.86	2.05	2.97	1.4		8.47	466.2	740	30	306525	4038550		15
1384	1304	40.07	3.51	0.14	3.47	1.65	3.75	8.84	1.55	2.29	1.49		8.43	535.5	850	24	272175	4060850		15
1384	1304	32.38	3.61	0.1	2.27	1.1	3.85	6.92	0.6	2.71			8.01	441	700	26	293850	4049525		15
1384	1304	51.54	0.31	0.1	2.24	0.85	1.35	4.71	1	2.55	0.85		8.28	270.9	430	25	313100	4038050		15
1384	1304	25.63	0.83	0.07	1.67	1.5	3.55	6.57	2.55	3.19			7.88	441	700	24	292125	4052200		15
1384	1304	41.22	2.21	0.14	2.7	1.4	2.65	7.2	0.95	4.04			7.7	447.3	710	24	291025	4044950		15
1384	1304	33.28	1.63	0.07	1.9	1.05	2.9	5.43	0.6	3.2			8.05	359.1	570	24	299800	4051050		15
1384	1304	30.44	0.11	0.03	0.67	0.35	1.25	2.48	0.3	2.07			8.01	176.4	280	25	310150	4041950		15
1384	1304	36.14	3.51	0.2	2.63	1.25	3.75	7.41	1.35	2.55			7.83	491.4	780	13	263000	4073050		15
1384	1304	21.05	0.13	0.03	0.41	0.4	1.25	1.97	0.2	1.64			7.94	132.3	210	4	257400	4074050		15
1384	1304	63.96	3.94	0.25	5.43	1.2	2	8.32	1.3	3.08			8.03	567	900	22	271750	4056200		15
1384	1304	43.92	1.67	0.2	2.58	1.1	2.45	6.27	1.25	3.35			8.13	396.9	630	23	282475	4060600		15
1384	1304	28.36	7	0.25	4.48	3.8	8.15	16.28	3.75	5.53			7.24	970.2	1540		268950	4068775		15
1384	1304	30.67	8.03	0.25	5.17	4.6	7.65	16.14	4.6	3.51			7.97	1071	1700		266950	4062250		15
1384	1304	53.08	3.1	0.25	3.54	1.05	2.3	6.67	0.8	2.77			8.2	441	700	13	265250	4071800		15
1384	1304	26.54	4.51	0.25	1.9	2.05	3.9	8.03	0.55	2.97			7.71	585.9	930	22	280875	4058000		15
1384	1304	42.03	0.29	0.07	1.67	0.85	1.55	4.6	1.6	2.71			8.1	270.9	430	23	291500	4055750		15
1384	1304	45.04	0.07	0.07	1.2	0.65	0.9	2.59	0.4	2.12			7.99	176.4	280		315875	4033500		15
1384	1304	41.12	7.12	0.3	5.95	4.4	4.55	13.97	2.15	4.7			7.83	882	1400	23	284950	4055400		15
1384	1304	29.83	0.81	0.07	1.29	0.85	2.35	4.17	0.75	2.61			8.03	296.1	470	4	265900	4067000		15
1384	1304	40.2	7.79	0.25	5.43	2.25	6.2	12.09	1.45	1.78	1.07		8.39	825.5	1310	23	270050	4065825		15
1384	1304	38.03	0.55	0.07	1.71	1.1	1.8	4.57	0.45	2.63	0.94		8.41	277.2	440	23	293425	4054000		15
1384	1304	46.49	0.59	0.07	2.45	1.1	1.8	4.95	0.45	3.91			7.93	321.3	510	18	297250	4037000		15
1384	1304	28.25	0.37	0.04	1.2	1	2.15	4.44	0.8	3.27			7.51	258.3	410	23	287587	4057025		15
1384	1304	34.09	2.11	0.1	2.15	1.6	2.75	6.11	0.8	3.2			8.01	403.2	640	23	289500	4053375		15
1384	1304	44.89	1.76	0.1	2.71	0.85	2.6	6.24	1.35	3.13			7.41	384.3	610		282475	4060600		15
1384	1304	22.67	0.41	0.04	0.81	0.5	2.4	3.78	0.3	3.07			7.23	226.8	360	12	306550	4046750		15
1384	1304	37.99	5.95	0.1	4.74	4.55	3.35	12.87	2	4.92			7.11	743.4	1180	23	307650	4034600		15
1384	1304	33.58	1.97	0.07	2.61	3.85	1.45	8.32	1.6	4.75			7.53	472.5	750		306525	4038550		15
1384	1304	24.03	8.59	0.04	5.21	4.8	11.8	19.48	5.3	5.59			7.23	1260	2000	30	266950	4062250		15
1384	1304	35.56	0.48	0.02	1.47	0.75	1.95	4.05	0.5	3.07			7.53	252	400	28	296375	4047825		15
1384	1304	25.18	2.09	0.07	2	1.25	4.9	8.2	0.8	5.31			6.78	485.1	770	26	289500	4053375		15
1384	1304	32.32	3.02	0.1	2.67	1.55	4.25	8.31	3.45	1.84			7.01	554.4	880	6	252450	4080750		15
1384	1304	53.56	2.21	0.17	4.27	1.8	2.05	8	1.1	4.69			7.49	485.1	770	24	299150	4039675		15
1384	1304	51.31	2.75	0.2	3.91	0.65	3.25	8.5	2.9	2.85			7.57	497.7	790	5	261900	4068400		15
1384	1304	23	1.67	0.07	1.08	0.85	3	4.98	0.35	2.96			6.48	289.8	460	26	296675	4052675		15
1384	1304	37.04	7.1	0.1	6.43	4.05	7.05	17.41	2.6	7.71			6.93	957.6	1520	25	284950	4055400		15
1384	1304	37.5	0.98	0.14	1.81	1.1	2.15	4.93	0.65	3.3			7.21	302.4	480	25	291500	4055750		15
1384	1304	36.84	1.19	0.1	2.67	1.95	2.8	7.69	0.8	5.7			6.73	441	700	24	298300	4036250		15
1384	1304	48.39	1.27	0.1	2.15	0.55	1.85	4.69	0.35	3.07			7.03	277.2	440	16	315875	4033500		15
1384	1304	42.92	0.75	0.1	1.93	0.75	1.95	4.72	0.45	3.52			7.12	283.5	450	21	286100	4058850		15
1384	1304	35.48	0.31	0.07	1.58	0.6	2.4	4.38	0.55	3.52			7.17	283.5	450	19	310150	4041950		15
1384	1304	36.75	1.02	0.1	1.73	1.1	2.05	4.99	0.45	3.52			7.22	296.1	470	12	293425	4054000		15
1384	1304	29.85	4.06	0.17	3.17	2.4	5.45	11.03	1.55	5.42			7.17	655.2	1040		280875	4058000		15
1384	1304	54.3	3.64	0.07	3.91	1.15	2.2	7.23	0.8	2.79			7.26	441	700		265250	4071800		15
1384	1304	25.03	1.46	0.07	1.8	2.31	3.29	5.66	1.3	2.9			7.17	472.5	750	12	292125	4052200		15
1384	1304	20.4	3.44	0.04	1.19	2.01	2.79	6.18	0.34	2.4			7.43	384.3	610	22	303825	4048550		15
1384	1304	31.82	2.33	0.1	1.93	1.66	2.69	5.6	0.47	2.8			7.58	359.1	570	22	299800	4051050		15
1384	1304	34.26	0.71	0.07	1.65	1	2.3	3.99	0.28	3			7.43	258.3	410	19	313100	4038050		15
1384	1304	27	1.39	0.07	1.21	0.77	2.69	4.68	0.59	2.7			7.43	289.8	460	5	265900	4067000		15
1384	1304	17.09	0.29	0.01	0.33	0.95	0.7	1.89	0.1	1.5			7.17	126	200	6	257400	4074050		15
1384	1304	31.44	4.06	0.1	2.45	1.77	3.79	7.84	0.48	3.3			7.72	478.8	760	26	293850	4049525		15
1384	1304	64.97	3.96	0.17	5.95	1.3	2	9.4	1.24	4.2			7.83	604.8	960		271750	4056200		15
1384	1304	35.64	2.33	0.1	2.78	3.8	1.4	7.91	1.18	4.4			7.87	459.9	730		306450	4043075		15
1384	1304	33.09	2.58	0.1	2.67	2.61	2.99	8.88	0.9	5.4			7.67	478.8	760	26	291025	4044950		15
1384	1304	31.22	1.81	0.1	2.17	2.86	2.14	6.6	0.39	4.4			6.7	396.9	630		309150	4030700		15
1384	1304	15.69	0.75	0.07	0.87	3.91	1.14	5.74	0.19	4.8			6.73	346.5	550	24	299700	4030100		15
1384	1304	26.52	0.73	0.07	1.5	2.53	1.82	5.81	0.38	4.7			7.1	333.9	530		311475	4025600		15
1384	1304	34.76	1.21	0.1	2.67	2.59	2.61	6.68	0.47	5			7	428.4	680		293050	4040650		15
1384	1304	30.46	4.06	0.2	5.98	8.1	6.01	11.3	1.24	6			7.34	1115.1	17770		268950	4068775		15
1384	1304	36.72	3.96	0.14	3.11	2.77	2.83	7.49	1.13	2.4			7.34	510.3	810		263000	4073050		15
1384	1304	45.59	4.06	0.2	5.33	2.93	3.67	8.13	1.07	3			7.12	680.4	1080		270050	4065825		15
1384	1304	30.91	0.77	0.04	1.28	1.27	1.68	3.58	0.21	2.6			7.04	245.7	390		287587	4057025		15
1384	1304	41.01	3.75	0.02	3.7	2.28	3.07	8.25	1.3	3.2			7.3	541.8	860	30	272175	4060850		15
Average		2847.36	199.94	9.34	216.34	161.95	237.61	577.55	90.46	279.2	7.95		610.12	37063.1	74830					
		35.59	2.50	0.12	2.70	2.02	2.97	7.22	1.13	3.49	0.10		7.63	463.29	935.38					

Appendix 8 Results of Water Quality Test (2001 -2006) (10/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1381	1306	31.03	0.71	0.04	1.94	1.2	3.2	6.18	0.75	4.72			7.65	395.4	580	7	269075	4019650		15
1381	1306	26.26	1.41	0.07	2.12	1.75	4.4	8.79	0.4	6.98			7.81	485.1	770	13	286650	4007500		15
1381	1306	27	0.94	0.04	1.55	1.6	2.7	5.5	0.45	4.11			7.99	333.9	530	5	275775	4001202		15
1381	1306	27.19	1.49	0.04	1.51	1	3.15	5.17	0.35	3.33			7.74	327.16	520	13	280625	4010805		15
1381	1306	9.42	0	0.03	0.36	1.5	2.25		0.25	3.75			7.83	233.1	370	14	288725	4007800		15
1381	1306	10.71	0.31	0.04	0.41	0.85	2.9	4.41	0.45	3.65			7.88	270.9	430	5	277450	4008800		15
1381	1306	29.37	5.32	0.07	3.34	3.7	4.5	10.68	0.95	4.41			7.99	655.2	1040	11	283150	4008325		15
1381	1306	31.81	5.05	0.1	7.27	8.05	7.75	20.89	8.6	7.24			7.85	1379.7	2190	7	272350	4016650		15
1381	1306	12.11	0.15	0.04	0.47	1.15	2.55	4.09	0.4	3.54			7.77	258.3	410	13	293975	4012625		15
1381	1306	43.46	5.43	0.1	5.78	3.5	4.15	10.69	0.9	4.36			7.91	774.9	1230	13	285625	4003855		15
1381	1306	7.67	0.14	0.04	0.4	1.2	4.1	5.82	0.75	4.93			7.9	333.9	530	13	282700	4004350		15
1381	1306	14.78	0.21	0.04	0.68	1.65	2.5	4.87	0.45	4.21			7.79	283.5	450	13	285775	4019100		15
1381	1306	20.5	2.23	0.07	1.4	2.85	2.85	6.78	0.5	4.05			7.47	422.1	670	13	288875	4014450		15
1381	1306	19.45	1.49	0.07	1.21	2.15	3.15	6.45	0.65	4.31			7.58	390.6	620	5	281000	4016075		15
1381	1306	18.48	1.6	0.04	1.15	1.6	3.65	5.8	0.5	3.7			7.75	371.7	590	10	276800	4016800		15
1381	1306	11.96	0.31	0.03	0.5	1.4	2.5	4.31	0.35	3.65			7.47	258.3	410	13	298300	4016800		15
1381	1306	19.15	0.74	0.04	0.99	2.4	1.95	4.88	0.6	3.54			7.83	321.3	510	12	285910	4013415		15
1381	1306	21.66	0.77	0.07	1.52	3.05	2.7	7.1	1.05	5.28			7.47	428.4	680	12	278550	4013400		15
1381	1306	22.48	1.24	0.07	1.51	2.55	2.9	5.99	0.85	3.9			8.01	384.3	610	7	274050	4018650		15
1381	1306	10.57	0.75	0.07	0.74	3.15	3.7	6.94	0.85	5.34			7.87	428.4	680	11	291245	4017050		15
1381	1306	15.53	0.33	0.04	0.64	1.35	2.35	6.42	0.55	5.54			7.75	352.1	559	7	273000	4031925		15
1381	1306	7.22	0.07	0.04	0.38	2.25	3.15	4.98	0.4	4.51			7.37	388.1	616	12	283875	4025275		15
1381	1306	7.66	0.7	0.04	0.47	1.95	4.2	6.31	1.35	4.26			7.39	430.3	683	11	267825	4033750		15
1381	1306	17.53	0.11	0.03	0.65	1	2.2	4.36	0.55	3.7			7.91	264.6	420	7	266600	4026025		15
1381	1306	31.17	0.47	0.03	1.6	1.5	2.1	4.46	0.6	3.39			7.59	294.8	468	10	271905	4020200		15
1381	1306	8.9	0.01	0.04	0.38	2.15	2.15	5.08	0.3	4.77			8	269	427	12	283100	4022250		15
1381	1306	48.07	1.13	0.04	3.2	1.15	2.35	6.09	0.5	4.46			7.4	388.1	616	11	261800	4027150		15
1381	1306	10.67	0.15	0.03	0.4	1.4	2.2	4.6	0.4	4.05			7.84	265.86	422	11	272450	4035200		15
1381	1306	8.43	0.13	0.02	0.33	0.8	3	3.66	0.4	3.13			7.43	242.55	385	10	276000	4031375		15
1381	1306	47.37	0.63	0.03	2.4	1.2	1.5	4.62	0.6	3.39			7.94	313.74	498	7	268050	4021825		15
1381	1306	9.98	0.13	0.03	0.38	1.5	2.2	4.8	0.35	4.32			7.83	277.8	441	12	268000	4030950		15
1381	1306	38.02	4.85	0.07	4.04	3.05	3.65	10.77	1	4.92			7.63	615.5	977	13	283150	4008325		15
1381	1306	34.48	0.59	0.03	1.97	1.35	2.45	5.33	0.8	3.94			7.92	322	511	10	269075	4019650		15
1381	1306	24.97	1.41	0.07	1.91	2.55	3.4	8.64	0.4	6.83			7.53	454.8	722	13	286650	4007500		15
1381	1306	31.52	4.31	0.1	5.1	6.1	5.2	16.96	6.3	6.35			7.74	1033	1640	13	272350	4016650		15
1381	1306	35.66	1.05	0.03	1.91	1	2.5	4.16	0.4	2.71			7.54	308.7	490	26	280625	4010805		15
1381	1306	27.45	0.64	0.03	1.71	1.7	2.9	5.75	0.4	4.71			7.91	340.2	540	12	275775	4001202		15
1381	1306	6.49	7.07	0.1	1.95	6	23.55	20.57	9.8	3.7			7	1896.3	3010	12	277450	4008800		15
1381	1306	25.33	0.87	0.03	1.53	2.15	2.45	5.58	0.4	4.31			7.53	348.4	553	26	288725	4007800		15
1381	1306	7.32	0.15	0.02	0.28	1	2.8	4.27	0.35	3.77			7.34	231	366	12	282700	4004350		15
1381	1306	8.98	0.1	0.02	0.35	1.45	2.3	4.22	0.35	3.77			7.59	226.2	359	26	285625	4003855		15
1381	1306	10.63	0.13	0.03	0.41	1.5	2.2	4.27	0.3	3.84			7.84	223.6	355	26	293975	4012625		15
1381	1306	4.76	0.13	0.01	0.19	1.6	2.4	4.07	0.3	3.64			7.91	224	356	11	285525	4024850		15
1381	1306	21.59	1.44	0.04	1.02	1.25	2.6	5.42	0.6	3.38			7.53	325	516	13	276800	4016800		15
1381	1306	18.57	1.33	0.07	1.15	2.15	3.2	6.63	0.6	4.7			7.11	383	608	8	281000	4016075		15
1381	1306	11.52	0.42	0.02	0.39	1.95	1.2	3.43	0.3	2.71			7.91	199	316	11	289660	4020300		15
1381	1306	24.66	1.7	0.04	1.4	1.9	2.5	5.72	0.85	3.17			7.84	343	545	8	274050	4018650		15
1381	1306	18.81	0.25	0.03	0.7	1.6	1.55	3.98	0.45	3.28			7.87	228	362	11	285775	4019100		15
1381	1306	9.84	1.34	0.07	0.65	3.15	3.45	7.77	0.9	5.53			7.07	415	659	26	291245	4017050		15
1381	1306	10.71	0.43	0.02	0.4	1.4	2.1	4.43	0.3	3.7			7.73	240.7	382	26	298300	4016800		15
1381	1306	10.56	1.1	0.04	0.91	2.5	5.55	5.55	0.55	3.9			7.51	317	503	12	282625	4012400		15
1381	1306	18.69	0.77	0.04	1.27	3.55	2.15	6.33	0.95	4.61			7.65	373	592	12	278550	4013400		15
1381	1306	20.55	1.34	0.07	1.34	2.9	2.55	6.25	0.4	4.51			7.11	381.7	606	26	288875	4014450		15
1381	1306	20.36	0.65	0.04	0.97	2.3	1.65	4.89	0.6	3.64			7.91	283.5	450	23	285910	4013415		15
1381	1306	23.65	0.93	0.03	1.24	2.1	2	4.86	0.4	3.53			7.22	301	478	26	285575	4011150	0	15
1381	1306	34.69	0.55	0.04	1.5	0.8	2.1	4.22	0.6	3.07			7.74	277.8	441	10	271905	4020200		15
1381	1306	9.52	0.02	0.04	0.36	0.8	3	5.08	0.35	4.71			7.82	265.8	422	11	283100	4022250		15
1381	1306	18.83	0.21	0.03	0.55	0.6	1.9	4.71	0.4	4.1			8.03	272.8	433	11	261800	4027150		15
1381	1306	7.5	0.09	0.05	0.4	1.65	3.9	6.59	0.45	6.05			7.17	365.4	580	11	283875	4025275		15
1381	1306	17.01	0.11	0.04	0.78	0.9	3.1	5.32	0.5	4.71			7.41	286	454	11	266600	4026025		15
1381	1306	29.76	2.67	0.07	2.26	1.65	3.85	9.41	1	5.74			7.03	578	918	11	263125	4023950		15
1381	1306	43.43	0.68	0.04	2.34	0.9	2.2	4.81	0.75	3.38			7.67	321	509	13	268050	4021825		15
1381	1306	7.81	0.26	0.04	0.43	2.2	3.35	5.67	0.85	4.56			7.07	351.5	558	11	267825	4033750		15
1381	1306	16.9	0.15	0.03	0.57	1.45	1.5	3.32	0.3	2.87			7.81	203	323	11	268000	4030950		15
1381	1306	10.07	0.22	0.02	0.4	1.8	1.95	4.25	0.55	3.48			7.49	245	389	12	272450	4035200		15
1381	1306	9.33	0.17	0.03	0.33	1.3	2.2	3.59	0.35	3.07			7.41	228.7	363	11	273000	4031925		15
1381	1306	8.86	0.12	0.03	0.32	1	2.6	3.54	0.4	3.02			7.64	229.3	364	10	276000	4031375		15
Average		1306.4	72.4	2.99	88.71	133.8	212.9	411.08	60.25	282.43	0		512.24	25861.01	41005					
		19.50	1.08	0.04	1.32	2.00	3.18	6.14	0.90	4.22	0.00		7.65	385.99	612.01					

Appendix 8 Results of Water Quality Test (2001 -2006) (11/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1382	1306	34.32	5.4	0.1	4.08	2.7	5.3	11.17	1.6	4.17			7.08	701.8	1114	13	271905	4020200		15
1382	1306	40.56	0.71	0.04	2.28	0.9	2.5	4.86	0.7	3.45			7.54	324.4	515	12	268050	4021825		15
1382	1306	7.41	0.04	0.03	0.33	2	2.5	4.98	0.4	4.54			7.27	277.8	441	13	283100	4022250		15
1382	1306	44.33	3	0.04	4.34	1.65	3.85	9.41	1.1	5.31			7.22	285.9	930	12	263125	4023950		15
1382	1306	7.36	0.06	0.01	0.3	1.35	2.55	4.01	0.3	3.65			7.38	235.6	374	3	283875	4025275		15
1382	1306	13.97	0.24	0.04	0.65	1.55	2.7	345.74	0.5	345			7.68	269	427	12	266600	4026025		15
1382	1306	7.36	0.08	0.01	0.3	1.2	2.7	3.31	0.35	2.88			7.77	235	373	13	276000	4031375		15
1382	1306	6.84	0.23	0.04	0.43	2.6	3.8	5.66	0.95	4.48			7.56	363.5	577	13	267825	4033750		15
1382	1306	42.45	0.27	0.04	2.32	1.25	1.95	4.12	0.4	3.45			8.06	297	473	12	261800	4027150		15
1382	1306	13.23	0.17	0.03	0.58	1.45	2.55	4.34	0.4	3.77			7.45	265.8	422	13	268000	4030950		15
1382	1306	20.83	0.09	0.01	0.39	1.42	0.1	3.84	0.4	3.35			7.51	225.5	358	13	273000	4031925		15
1382	1306	9.09	0.1	0.03	0.39	1.3	2.9	4.72	0.35	4.27			7.24	265.8	422	13	272450	4035200		15
1382	1306	17.56	0.84	0.04	0.94	2.3	2.3	5.35	0.6	3.91			7.31	33.07	525	10	285910	4013415		15
1382	1306	16.17	0.35	0.04	0.78	2.2	2.05	5.33	0.4	4.58			7.87	286.6	455	13	288875	4014450		15
1382	1306	9.72	0.25	0.03	0.39	1.15	2.75	4.1	0.4	3.45			7.23	254.5	404	13	298300	4016800		15
1382	1306	19.02	0.54	0.04	0.97	2.05	2.25	5.26	0.55	4.17			7.58	311.24	94	12	282625	4012400		15
1382	1306	20.9	0.74	0.04	1.4	2.7	2.75	6.9	0.75	5.41			7.24	393.7	625	13	278550	4013400		15
1382	1306	9.09	0.71	0.04	0.61	2.8	3.7	6.76	0.9	5.15			7.17	420.8	668	13	291245	4017050		15
1382	1306	18.4	1.34	0.07	1.17	1.9	3.6	6.42	0.7	4.38			7.79	392.4	623	18	281000	4016075		15
1382	1306	3.23	0.13	0.02	0.11	1.15	2.75	3.98	0.5	3.35			7.33	241.9	384	22	285775	4019100		15
1382	1306	9.84	0.47	0.07	0.65	2.3	4.3	7.47	0.5	6.5			7.34	402	638	13	289660	4020300		15
1382	1306	9.84	0.47	0.07	0.65	2.3	4.3	7.47	0.5	6.5			7.34	402	638	13	289660	4020300		15
1382	1306	22.32	1.35	0.07	1.41	1.75	3.4	5.86	0.8	3.71			7.1	391	620	24	274050	4018650		15
1382	1306	34.04	3.23	0.1	4.7	3.1	6.2	11.2	2.6	5.37			7.1	674.7	1071	12	276800	4016800		15
1382	1306	23.76	0.67	0.04	1.3	2.4	1.9	4.68	0.4	3.61			7.29	315	500	18	285575	4011150		15
1382	1306	15.41	0.63	0.07	0.83	1.35	3.59	6.48	1.15	4.7			7.82	471.2	748	10	282700	4004350		15
1382	1306	9.33	0.06	0.03	0.33	1.15	2.35	3.61	0.25	3.3			7.74	224.3	356	13	288725	4007800		15
1382	1306	30.05	3.7	0.14	6.26	7	7.9	19.58	8.05	7.83			7.72	1228.5	1950	13	272350	4016650		15
1382	1306	28.97	0.78	0.07	1.5	0.5	3.35	4.64	0.35	3.51			7.77	320	508	18	280625	4010805		15
1382	1306	10.67	0.41	0.03	0.4	1.25	2.35	4.27	0.35	3.51			7.31	238.1	378	13	293975	4012625		15
1382	1306	34.87	4.01	0.1	4.13	3.45	4.45	10.99	0.95	6.03			7.84	665.3	1056	13	283150	4008325		15
1382	1306	12.09	8.4	0.2	6.31	13.95	33.4	28.11	15.85	3.86			7	2923	4640	10	277450	4008800		15
1382	1306	26.19	0.68	0.04	1.61	1.75	2.9	5.3	0.45	4.17			7.91	338.9	538	10	275775	4001202		15
1382	1306	27.47	0.26	0.07	2.07	2.05	3.6	6.17	0.4	5.51			7.57	424.6	674	24	286650	4007500		15
1382	1306	10.05	0.31	0.03	0.4	1.35	2.5	4.52	0.35	3.86			7.47	254.5	404	13	285625	4003855		15
1382	1306	33.78	5.32	0.1	3.65	2.6	4.75	10.6	1.7	3.58			7.49	634.4	1007	24	271905	4020200		15
1382	1306	33.47	0.73	0.07	2.37	1	3.85	6.34	0.7	4.91			6.23	372.3	591	24	268050	4021825		15
1382	1306	45.68	3.6	0.14	4.57	1.8	3.8	10.08	1.05	5.43			7.23	575.2	913	24	263125	4023950		15
1382	1306	8.45	0.12	0.03	0.33	0.95	2.95	3.58	0.35	3.11			7.24	240.7	382	25	276000	4031375		15
1382	1306	44.23	0.61	0.07	2.27	1	1.95	4.49	0.45	3.43			7.4	288.5	458	25	261800	4027150		15
1382	1306	7.82	0.08	0.04	0.35	1.6	3	5.13	0.35	4.7			7.21	267.7	425	14	283100	4022250		15
1382	1306	16.29	0.86	0.04	1.41	1.7	5.75	9.16	1	7.3			7.21	535.5	850	25	273000	4031925		15
1382	1306	9.09	0.18	0.01	0.39	1.35	2.65	4.33	0.3	3.85			7.17	240	381	25	272450	4035200		15
1382	1306	4.97	0.24	0.01	0.27	1.5	3.85	5.63	0.75	4.64			7.47	334	530	25	267825	4033750		15
1382	1306	7.67	0.17	0.01	0.31	1.25	2.6	4.22	0.25	3.8			7.44	228.7	363	24	283875	4025275		15
1382	1306	13.65	0.22	0.03	0.61	1.45	2.6	4.43	0.3	3.91			7.51	257	408	25	268000	4030950		15
1382	1306	9.19	0.33	0.03	0.41	1.2	3.15	4.74	0.5	3.91			7.37	283.54	450	24	266600	4026025		15
1382	1306	10.6	0.3	0.01	0.47	1.35	2.7	4.2	0.4	3.5			7.34	250.7	398	19	298300	4016800		15
1382	1306	17.73	0.87	0.03	0.94	2.35	2.15	5.27	0.6	3.8			7.77	315.6	501	19	282625	4012400		15
1382	1306	24.55	0.81	0.04	1.31	2.1	2.05	4.79	0.4	3.58			7.17	308.7	490	6	285575	4011150		15
1382	1306	13.96	0.67	0.03	0.7	2.25	2.25	5.08	0.4	4.01			7.11	290.4	461	6	288875	4014450		15
1382	1306	19.59	0.93	0.04	1.3	2.8	2.7	6.63	0.9	4.8			7.2	389.3	618	18	278550	4013400		15
1382	1306	18.33	0.74	0.04	0.97	2.2	2.3	5.23	0.55	3.94			7.31	309.3	491	6	285910	4013415		15
1382	1306	29.66	3.03	0.1	2.43	2.35	3.65	8.93	2.05	3.85			7.34	486.4	772	19	291245	4017050		15
1382	1306	15.61	1.51	0.04	1.07	2.75	3.25	6.53	0.7	4.32			7.2	386.2	613	18	281000	4016075		15
1382	1306	23.65	1.4	0.07	1.51	1.55	3.55	6.26	0.85	4.01			7.2	384.9	611	19	274050	4018650		15
1382	1306	18.24	0.87	0.04	1.02	1.9	2.85	5.96	0.45	4.64			7.27	324.4	515	19	276800	4016800		15
1382	1306	6.49	0.61	0.02	0.23	1.15	2.45	4.18	0.4	3.17			7.4	223	354	18	285775	4019100		15
1382	1306	8.71	0.31	0.01	0.4	1.9	2.4	4.56	0.35	3.9			7.77	258.9	411	24	289660	4020300		15
1382	1306	6.75	3.61	0.1	0.87	2.1	11.3	11.75	4.5	3.64			7.15	949.4	1507	5	277450	4008800		15
1382	1306	7.58	0.1	0.02	0.3	1.5	2.4	3.88	0.25	3.53			7.34	231.2	367	5	285525	4024850		15
1382	1306	26.92	1.01	0.1	1.41	1.35	2.75	4.57	0.35	3.21			7.37	306.2	486	19	280625	4010805		15
1382	1306	29.31	0.92	0.03	1.67	1.95	2.15	5.12	0.3	3.9			7.32	324.4	515	6	285625	4003855		15
1382	1306	4.6	0.2	0.03	0.3	1	5.85	7.29	0.5	6.59			7.41	412	654	6	282700	4004350		15
1382	1306	27.52	5.81	0.12	1.57	1.4	3.05	10.81	0.4	4.6			7.41	336.4	534	19	275775	4001202		15
1382	1306	32.07	0.49	0.12	1.91	1.4	2.9	5.99	0.9	4.6			7.34	362.2	575	5	269075	4019650		15
1382	1306	10.52	0.65	0.12	0.95	3	6.1	10.39	3.2	6.54			7.61	694	1101	6	288725	4007800		15
1382	1306	12.23	0.1	0.03	0.43	1.1	2.2	3.99	0.25	3.64			7.71	217	344	6	293975	4012625		15
1382	1306	27.18	7.73	0.12	1.97	2.1	3.5	14.03	0.45	5.85			7.37	410	651	5	286650	4007500		15
1382	1306	34.8	4.7	0.2	5.43	5.3	5.25	15.02	4.2	6.12			7.07	926	1470	5	272350	4016650		15
1382	1306	31.37	4.85	0.2	3.48	3.25	4.8	11.02	1.1	5.07			7.21	657.1	1043	5	283150	4008325		15
1382	1306	7.28	0.19	0.03	0.28	1.55	2.4	4.08	0.35	3.54			7.99	252	400	13	285525	4024850		15
1382	1306	30.88	0.55	0.07	1.27	1.2	1.8	4.54	0.5	3.49			7.57	296.1	470	13	285575	4011150		15
1382	1306	34.32	3.45	0.07	3.17	2.65	3.55	9.27	1.2	4.62			7.05	579.6	920	13	289660	4020300		15
1382	1306	18.9	0.53	0.07	0.99	2.2	2.35	5.23	0.55	4.15			8.11	315	500	7	282625	4012400		15
Average		1450.4	100.12	4.35	110.6	156.37	277.59	847.94	79.95	667.87	0		555.68	30808.35	49453					
		19.34	1.33	0.06	1.47	2.08	3.70	11.31	1.07	8.90	0.00		7.41	410.78	659.37					

Appendix 8 Results of Water Quality Test (2001 -2006) (12/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1306	12.51	0.59	0.01	0.65	1.48	3.15	5.09	0.38	4.12			7.64	340	564	7	268000	4030950		15
1383	1306	19.23	0.68	0.08	0.83	1.48	2.35	4.49	0.33	3.48			7.23	320	523	8	272450	4035200		15
1383	1306	13.67	1.03	0.01	0.78	1.81	3.19	5.49	0.74	3.72			7.72	370	622	7	267825	4033750		15
1383	1306	15.39	0.89	0.02	0.74	1.88	2.27	4.69	0.44	3.36			7.66	310	523	7	273000	4031925		15
1383	1306	9.74	0.52	0.01	0.43	1.41	2.67	4.35	0.27	3.56			7.88	290	487	8	276000	4031375		15
1383	1306	41.91	1.53	0.02	2.17	1.76	1.28	4.97	0.41	3.03			7.46	340	558	8	261800	4027150		15
1383	1306	18.74	0.96	0.03	0.95	1.41	2.83	5.01	0.53	3.52			7.36	330	557	10	266600	4026025		15
1383	1306	11.42	0.46	0.01	0.46	1.56	2.11	3.95	0.33	3.16			8.11	260	441	8	283875	4025275		15
1383	1306	46.92	6.26	2.08	6.83	4.17	5.91	18.54	4.36	7.92			8.02	1230	2046	10	263125	4023950		15
1383	1306	45.7	2.37	0.02	2.83	1.32	2.07	6.01	0.72	2.92			8.05	420	667	21	268050	4021825		15
1383	1306	38.93	2.34	0.1	2.22	1.72	1.92	5.76	0.74	2.68			1.92	400	633	21	271905	4020200		15
1383	1306	13.61	1.36	0.02	0.65	1.77	2.47	4.66	0.36	2.76	0.18		8.37	320	523	8	283100	4022250		15
1383	1306	11.4	0.51	0.01	0.48	1.48	2.35	4.09	0.33	3.25			7.33	280	468	10	289660	4020300		15
1383	1306	25.47	2.21	0.04	1.61	1.52	3.31	6.28	0.91	3.16			7.26	410	697	7	274050	4018650		15
1383	1306	21.14	2.13	0.07	1.39	2.04	3.39	6.65	1.24	3.28			7.28	440	739	7	276800	4016800		15
1383	1306	20.62	2.18	0.08	1.41	2.41	3.31	6.9	0.69	4.03			7.41	450	761	24	281000	4016075		15
1383	1306	30.79	3.56	0.2	2.82	2.56	4.23	9.48	1.21	4.71			7.34	660	1056	21	285775	4019100		15
1383	1306	13.92	2.3	0.04	1	3.01	3.43	7.37	0.96	3.95	0.16		8.38	480	794	24	291245	4017050		15
1383	1306	18.29	1.1	0.04	0.83	1.48	2.39	4.5	0.49	2.81	0.1		8.41	310	507	22	298300	4016800		15
1383	1306	25.57	1.49	0.03	1.27	2.41	1.36	4.79	0.66	2.52	0.12		8.39	330	542	10	278550	4013400		15
1383	1306	22.33	1.5	0.05	1.51	2.89	2.55	6.72	0.99	4.23			7.56	440	737	21	282625	4012400		15
1383	1306	22.43	1.97	0.02	1.22	2.27	2.03	5.39	0.66	2.64	0.12		8.39	370	602	8	285910	4013415		15
1383	1306	25.02	2.56	0.02	1.69	2.89	2.23	6.61	0.49	3.56			7.34	440	723	24	288875	4014450		15
1383	1306	29.05	1.58	0.04	1.56	2.04	1.87	5.27	0.49	3.2			7.55	360	597	24	285575	4011150		15
1383	1306	18.37	1.38	0.02	0.74	1.56	1.83	3.93	0.27	2.08	0.2		8.45	280	463	22	293975	4012625		15
1383	1306	32.96	2.41	0.03	2.13	2.29	2.11	6.33	1.16	2.64	0.12		8.39	420	704	22	288725	4007800		15
1383	1306	23.28	5.25	0.11	4.43	7.3	7.66	19.15	5.74	8.16			7.23	1200	2014	10	272350	4016650		15
1383	1306	34.3	0.68	0.02	2.65	1.81	3.31	7.45	0.85	5.92			7.34	480	818	10	269075	4019650		15
1383	1306	12.14	1.48	0.03	0.5	2.17	1.63	4.13	0.33	2.12	0.2		8.39	280	467	21	285525	4024850		15
1383	1306	16.76	5.56	0.03	1.54	2.04	5.75	9.11	1.27	2.16	0.12			620	994	24	277450	4008800		15
1383	1306	33.48	2.61	0.02	1.95	2.04	1.87	5.66	0.49	2.4	0.16		8.35	380	632	22	283150	4008325		15
1383	1306	29.89	6.1	0.03	3.13	3.25	4.15	10.28	1.1	2.88	0.2		8.37	690	1110	22	286650	4007500		15
1383	1306	10.82	1.37	0.02	0.78	1.76	4.79	7.25	1.32	4.4	0.16		8.37	470	788	22	282700	4004350		15
1383	1306	23.49	0.56	0.2	0.93	1.93	1.75	4.53	0.61	3.36			7.62	310	516	22	285625	4003855		15
1383	1306	23.35	1.94	0.02	1.22	1.2	2.87	5.06	0.44	2.48	0.2		8.41	350	566	24	275775	4001202		15
1383	1306	32.33	2.5	0.03	1.69	0.96	2.63	5.07	0.49	1.92	0.16		8.35	360	571	22	280625	4010805		15
1383	1306	18.77	0.28	0.1	0.78	1.04	2.75	4.46	0.91	3.27			7.8	300	497	14	268000	4030950		15
1383	1306	13.09	0.81	0.02	0.56	2	1.83	4.16	0.63	2.72			7.84	280	473	14	267825	4033750		15
1383	1306	8.62	0.27	0.01	0.34	1.72	1.99	3.82	0.24	3.31			7.78	270	445	12	283875	4025275		15
1383	1306	10.81	0.96	0.04	0.47	1.52	2.67		0.27		3.2		8.42	310	513	14	273000	4031925		15
1383	1306	8.28	1.91	0.01	0.47	3.25	2.07	5.49	0.22	3.36			7.49	370	611	14	272450	4035200		15
1383	1306	20.52	0.73	0.02	0.78	1.28	1.83	3.65	0.41	2.51			7.96	260	413	13	266600	4026025		15
1383	1306	14.55	0.88	0.02	0.54	1.32	1.95	3.61	0.33	2.4			8.13	260	418	14	276000	4031375		15
1383	1306	38.84	1.01	0.02	2.13	1.2	2.19	5.21	0.6	3.6			7.34	360	589	13	268050	4021825		15
1383	1306	18.76	2.1	0.05	1.21	2.08	3.39	6.34	0.49	3.75			7.11	430	706	1	276800	4016800		15
1383	1306	24.71	1.47	0.05	1.56	1.92	2.99	6.2	0.66	4.07			7.32	410	688	12	274050	4018650		15
1383	1306	28.91	1.31	0.04	1.86	3.01	1.67	6.24	0.82	4.11			8.23	410	691	1	281000	4016075		15
1383	1306	34.05	1.09	0.04	1.65	1.6	1.67	4.64	0.6	2.95			7.97	320	523	9	271905	4020200		15
1383	1306	11.04	0.21	0.01	0.52	1.24	3.03	4.59	0.38	4			7.87	310	509	9	283100	4022250		15
1383	1306	14.29	0.86	0.04	0.65	1.88	2.23	4.66	0.33	3.27	0.2		8.43	310	516	9	289660	4020300		15
1383	1306	33.65	2.28	0.02	2.6	2.69	2.47	7.52	0.93	4.31			8.21	500	836	7	285775	4019100		15
1383	1306	12.66	1.71	0.04	0.73	3.57	1.71	5.63	0.85	3.07			8.12	380	637	7	291245	4017050		15
1383	1306	10.45	0.89	0.02	0.43	2.32	1.51	4.32	0.24	2.91	0.28		8.41	280	471	7	298300	4016800		15
1383	1306	18.15	1.3	0.02	1	2.69	1.91	5.33	0.55	3.48			8.23	350	589	6	282625	4012400		15
1383	1306	24.27	1.62	0.02	1.3	2.2	1.91	5.09	0.44	3.03			7.73	350	578	6	285575	4011150		15
1383	1306	21.55	2.81	0.05	1.43	3.09	2.31	6.79	0.46	3.2	0.32		8.48	440	714	7	288875	4014450		15
1383	1306	17.48	1.76	0.03	1	2.69	2.15	5.48	0.49	3.23			8.16	370	613	6	285910	4013415		15
1383	1306	33.22	1.45	0.04	1.33	0.21	2.55	6.7	0.77	4.48			7.26	430	733	6	278550	4013400		15
1383	1306	8.27	0.11	0.11	0.32	1.28	3.51	5.05	0.74	4.2			7.27	330	556	6	282700	4004350		15
1383	1306	28.97	2.04	0.03	1.86	2.32	2.31	6.01	0.57	3.4			7.35	400	678	7	285625	4003855		15
1383	1306	25.63	1.73	0.04	1.47	1.12	3.27	5.54	0.33	3.48			8.17	390	631	1	280625	4010805		15
1383	1306	11.04	0.44	0.07	0.32	1.64	1.51	3.24	0.49	2.31			8.29	230	388	6	285525	4024850		15
1383	1306	35.65	1.08	0.03	1.56	1.56	1.31	4.14	0.38	2.68			8.23	290	479	1	275775	4001202		15
1383	1306	28.15	5.14	0.02	3.08	3.53	4.39	10.34	0.85	4.35			7.22	690	1133	6	283150	4008325		15
1383	1306	34.81	1.78	0.02	1.82	2.09	1.35	4.94	0.41	2.75			8.12	350	563	6	286650	4007500		15
1383	1306	10.47	0.58	0.01	0.45	1.88	2.07	4.19	0.3	3.31			7.72	280	469	7	293975	4012625		15
1383	1306	14.38	0.88	0.15	0.52	1.36	2.63	4.58	0.38	3.08	0.24		8.42	310	503	1	277450	4008800		15
1383	1306	9.73	0.52	0.01	0.45	1.88	2.39	4.49	0.41	3.56			8.16	310	511	7	288725	4007800		15
1383	1306	32.56	6.39	0.07	5.78	6.58	5.54	17.29	6.07	4.83			7.66	1080	1832	1				15
1383	1306	42.38	1.03	0.07	2.04	1.44	1.43	4.67	0.49	3.15			8.17	330	534	1	269075	4019650		15
Average		1563.7	123.35	4.95	101.03	148.28	185.51	419.42	55.84	238.22	6.44		538.4	28430	47050					
		22.34	1.76	0.07	1.44	2.12	2.65	5.99	0.80	3.40	0.09		7.69	406.14	672.14					

Appendix 8 Results of Water Quality Test (2001 -2006) (13/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1306	21.2	1.04	0.07	1.45	2.75	2.9	6.57	1	4.53			7.9	415.8	660	10	278550	4013400		15
1384	1306	17.54	0.97	0.04	0.97	2.2	2.55	4.92	0.55	3.4			8.12	333.9	530	18	285910	4013415		15
1384	1306	9.91	0.25	0.03	0.41	1.8	2.2	4.11	0.35	3.51			7.94	270.9	430	18	289660	4020300		15
1384	1306	9.99	0.9	0.04	0.67	2.85	3.55	6.9	0.95	5.05			7.54	434.7	690	18	291245	4017050		15
1384	1306	25.71	2.11	0.07	2.11	2.15	4.15	7.64	0.9	4.63			7.67	504	800	12	274050	4018650		15
1384	1306	18.92	0.63	0.04	0.87	2.25	1.65	4.22	0.35	3.24			8.02	283.5	450	18	298300	4016800		15
1384	1306	8.85	0.05	0.02	0.32	1.25	2.25	3.8	0.45	3.3			8.07	245.7	390	24				15
1384	1306	16.67	3.2	0.04	1.15	1.5	4.45	6.75	0.35	3.2			7.67	422.1	670	28	285775	4019100		15
1384	1306	25.04	1.83	0.04	1.63	2.6	2.4	5.78	0.5	3.45			7.94	384.3	610	27	283150	4008325		15
1384	1306	25.75	1.02	0.07	1.3	1.95	2	4.66	0.4	3.24			7.23	315	500	29	285575	4011150		15
1384	1306	34.46	0.91	0.1	2.24	1.25	3.2	6.35	0.6	4.84			7.77	396.9	630	25	269075	4019650		15
1384	1306	19.41	1.3	0.07	1.11	1.5	3.4	5.41	0.5	3.61			7.88	365.4	580	12	276800	4016800		15
1384	1306	18.94	0.43	0.07	0.97	2.3	2.15	4.59	0.55	3.61			7.33	327.6	520	11	282625	4012400		15
1384	1306	22.34	1.33	0.07	1.21	1.95	2.5	5.22	0.65	3.24			7.97	352.8	560	10	281000	4016075		15
1384	1306	45.26	0.51	0.11	2.37	0.75	2.25	4.71	0.75	3.45			7.59	333.95	30	25	268050	4021825		15
1384	1306	32.94	0.41	0.1	1.57	1.35	2.05	4.04	0.7	2.93			7.91	308.7	480	19	271905	4020200		15
1384	1306	12.73	0	0.3	0.32	1.55	2.7		0.3	4.12			7.44	264.6	420	28	283100	4022250		15
1384	1306	46.95	3.17	0.2	4.49	1.35	3.95	9.74	1.1	5.47			7.67	598.5	950	27	263125	4023950		15
1384	1306	12.84	0.12	0.03	0.67	1.7	3.05	4.12	0.45	3.55			7.91	289.8	460	25	266600	4026025		15
1384	1306	5.78	0.14	0.01	0.37	1.95	4.25	6.21	0.4	5.67			7.31	378	600	28	283875	4025275		15
1384	1306	42.2	0.58	0.04	2.15	0.85	2.15	4.28	0.4	3.3			7.3	321.3	510	11	261800	4027150		15
1384	1306	9.09	0.22	0.02	0.39	1.7	2.4	4.49	0.4	3.87			7.83	283.5	450	11	268000	4030950		15
1384	1306	28.78	1.81	0.07	1.87	2.35	2.45	6.07	0.65	3.61			7.33	403.2	640	24				15
1384	1306	28.04	1.2	0.07	1.45	1.05	2.85	5.44	1.1	3.14			7.84	321.3	510	13	280625	4010805		15
1384	1306	6.57	0.11	0.02	0.37	1.5	4.05	5.76	0.95	4.7			7.76	371.7	590	13	282700	4004350		15
1384	1306	26.98	3.97	0.14	4.83	6.6	6.85	18.18	5.5	8.71			7.41	1121.4	1780	19	272350	4016650		15
1384	1306	25.59	1.05	0.07	1.77	1.55	3.8	6.49	0.5	4.94			7.85	428.4	680	12	286650	4007500		15
1384	1306	9.31	0.15	0.02	0.37	0.95	2.85	3.9	0.45	3.3			7.76	258.3	410	10	277450	4008800		15
1384	1306	9.79	0.09	0.01	0.37	1.35	2.15	3.69	0.3	3.3			7.73	239.4	380	24	293975	4012625		15
1384	1306	23.97	0.63	0.04	1.3	1.6	2.65	5.56	0.5	4.43			8.13	352.8	560	10	275775	4001202		15
1384	1306	3.67	0.19	0.01	0.15	1.1	3.1	4.45	0.35	3.91			7.63	258.3	410	28	285525	4024850		15
1384	1306	23.66	2.97	0.1	2.07	3.8	3.2	10.94	0.55	7.42			7.91	548.1	870	18	288875	4014450		15
1384	1306	7.41	0.11	0.01	0.29	0.9	2.85	3.39	0.4	2.88			7.47	195.3	310	11	276000	4031375		15
1384	1306	7.45	0.17	0.01	0.3	1	2.85	4.44	0.5	3.77			7.57	270.9	430	25	273000	4031925		15
1384	1306	7.63	0.23	0.02	0.43	1.45	4	5.83	0.7	4.9			7.19	371.7	590	11	267825	4033750		15
1384	1306	9.2	0.07	0.01	0.37	1.2	2.55	3.77	0.35	3.35			7.57	245.7	390	11	268000	4030950		15
1384	1306	12.84	0.12	0.03	0.67	1.7	3.05	4.12	0.45	3.55			7.91	289.8	460	25	266600	4026025		15
1384	1306	8.43	0.78	0.02	0.33	0.85	2.95	4.37	0.4	3.19			7.87	252	400	3	276000	4031375		15
1384	1306	51.78	0.19	0.1	4.41	1.65	2.55	5.02	1	3.83			7.9	522.9	830	3	263125	4023950		15
1384	1306	7.79	0.35	0.01	0.37	1.55	2.95	5	0.45	4.2			7.97	283.5	450	3	268000	4030950		15
1384	1306	27.25	4.97	0.07	2.57	3.85	3.2	9.14	0.55	3.62			8	567	900	20	288875	4014450		15
1384	1306	19.33	0.97	0.07	1.02	2.15	2.4	5.34	0.65	3.72			7.46	340.2	540	14	285910	4013415		15
1384	1306	9.6	0.3	0.02	0.41	1.75	2.3	4.37	0.35	3.72			7.83	277.2	440	20	289660	4020300		15
1384	1306	6.98	0.05	0.01	0.23	1.4	1.8	3.43	0.35	3.03			7.93	220.5	350	21	298300	4016800		15
1384	1306	9.34	0.62	0.01	0.67	2.85	3.75	6.52	0.9	5			7.31	434.7	690	20	291245	4017050		15
1384	1306	20.25	3.51	0.04	1.28	1.4	3.8	6.25	0.35	2.39			7.75	396.9	630	13	285775	4019100		15
1384	1306	19.8	1.8	0.07	1.3	2.2	3.35	6.76	0.7	4.26			7.48	403.2	640	21	281000	4016075		15
1384	1306	19.47	0.94	0.07	1.03	2.05	2.5	5.53	0.6	3.99			7.33	333.9	530	12	282625	4012400		15
1384	1306	21.64	1.23	0.07	1.2	1.35	3.25	5.5	0.6	3.67			7.41	359.1	570	16	276800	4016800		15
1384	1306	10.54	0.22	0.02	0.41	1.45	2.2	3.97	0.35	3.4			6.81	233.1	370	21	293975	4012625		15
1384	1306	9.09	0.23	0.02	0.37	1.5	2.4	4.36	0.3	3.83			7.64	245.7	390	23	283100	4022250		15
1384	1306	28.16	1.26	0.1	1.37	1.8	1.95	5.06	0.45	3.35			7.93	321.3	5410	23	285575	4011150		15
1384	1306	30.66	4.21	0.14	5.43	8.1	4.5	17.18	5.95	7.02			7.63	1077.3	1710	14	272350	4016650		15
1384	1306	51.92	0.89	0.02	2.41	0.35	1.9	3.68	0.45	2.34			7.91	258.3	410	3	261800	4027150		15
1384	1306	34.06	0.55	0.1	1.63	1.15	2.2	4.28	0.75	2.98			7.57	308.7	490	14	271905	4020200		15
1384	1306	7.54	0.33	0.01	0.3	1.15	2.65	4.4	0.4	3.67			8.11	245.7	390	23	283875	4025275		15
1384	1306	29.53	2.48	0.14	2.71	4.2	2.6	6.6	0.5	3.62			8.11	384.3	610	18	283150	4008325		15
1384	1306	34.89	1.62	0.1	2.07	1.75	2.3	5.95	0.45	3.88			7.83	359.1	570	16	286650	4007500		15
1384	1306	11.04	0.54	0.04	0.45	1.65	2.3	4.27	0.75	2.98			7.71	270.9	430	3	267825	4033750		15
1384	1306	13.49	0.39	0.03	0.43	0.95	2	3.56	0.25	2.92			7.77	220.5	350	27	276000	4031375		15
1384	1306	21.4	1.33	0.07	1.4	2.55	2.85	6.91	0.9	4.68			7.47	409.5	650	12	278550	4013400		15
1384	1306	41.77	6.31	0.2	4.32	2.95	3.35	10.14	0.7	3.13			7.97	611.1	970	21	288725	4007800		15
1384	1306	12.16	0.34	0.04	0.41	0.9	2.35	3.72	0.25	3.13			8.03	214.2	340	3	272450	4035200		15
1384	1306	45.13	1.1	0.14	2.41	0.7	2.4	5.36	0.65	3.61			7.03	327.6	520	26	268050	4021825		15
1384	1306	14.63	0.39	0.01	0.71	1.05	3.15	4.4	0.45	3.56			7.13	296.1	470	27	266600	4026025		15
1384	1306	29.53	0.07	0.14	2.71	2.45	4.35	8.72	1.05	7.6			7.01	522.9	830	27	269075	4019650		15
1384	1306	13.96	0.63	0.02	0.41	0.4	2.25	3.71	0.4	2.68			7.47	214.2	340	9	277450	4008800		15
1384	1306	8.62	0.64	0.02	0.23	0.4	2.25	4.24	0.3	3.3			7.67	214.2	340	23	285525	4024850		15
1384	1306	34.18	2.14	0.07	1.41	0.6	2.25	4.73	0.3	2.29			7.77	277.2	440	17	280625	4010805		15
1384	1306	33.33	1.38	0.07	1.63	1.3	2.1	5.91	0.45	4.08			7.7	333.9	530	9	275775	4001202		15
1384	1306	9.33	0.27	0.01	0.34	1.3	2.1	3.85	0.45	3.13			7.93	233.1	370	21				15
1384	1306	11.17	0.4	0.03	0.41	0.8	2.7	4.5	0.8	3.3			7.67	270.9	430	17	282700	4004350		15
1384	1306	31.55	2.65	0.1	2.02	0.6	4	8.74	0.95	5.14			7.43	510.3	810	16	274050	4018650		15
Average		1502.8	80.07	4.41	96.16	130.7	209.3	412.01	51	285.36	0		560.61	26258.45	46070					
		20.59	1.10	0.06	1.32	1.79	2.87	5.64	0.70	3.91	0.00		7.68	359.70	631.10					

Appendix 8 Results of Water Quality Test (2001 -2006) (14/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1381	1307	54.3	0.37	0.04	2.93	0.45	2.05	5.84	0.6	4.87			7.28	345.87	549	9	304325	3941575		15
1381	1307	66.37	0.87	0.07	4.47	0.95	1.35	6.45	0.65	4.11	0.82		8.27	383.04	608	21	297950	3943275		15
1381	1307	14.85	0.27	0.03	0.65	1.2	2.7	4.98	0.4	4.31			7.85	260.2	413	9	294905	3942400		15
1381	1307	50.26	1.05	0.07	3.77	1.7	2.1	7.04	0.65	5.34			7.58	425.2	675	9	300850	3942425		15
1381	1307	8.7	0.24	0.03	0.37	1.2	3	4.96	0.35	4.37			7.52	262.7	417	9	293250	3941875		15
1381	1307	56.87	0.82	0.07	3.82	1.45	1.5	6.19	0.5	4.87			8.03	374.8	595	9	297500	3947475		15
1381	1307	55.78	0.25	0.07	3.84	1.75	1.35	6.3	0.4	5.65			7.81	353.4	561	9	299575	3938950		15
1381	1307	58.44	2.75	0.07	4.43	1.1	2.1	7.54	1.5	3.29			7.88	478.2	759	21	286425	3952575		15
1381	1307	46.01	0.91	0.04	3.07	1.05	2.6	6.83	0.8	3.78	1.34		8.32	425	675	19	290200	3950325		15
1381	1307	36.79	1.43	0.1	2.17	1.6	2.3	5.82	0.6	3.79			7.24	358	569	20	292925	3949025		15
1381	1307	11.81	1.35	0.04	1.58	9.6	2.5	5.17	0.65	3.17			7.87	344.6	547	20	291550	3948200		15
1381	1307	58.2	3.82	0.1	5.4	1.15	2.8	8.97	0.85	4.3			7.85	275.2	913	20	286050	3949450		15
1381	1307	45.75	2.55	0.07	3.43	2	2.15	6.78	0.75	3.48			7.86	464.3	737	19	290150	3952625		15
1381	1307	61.93	0.83	0.12	12	2.75	4.7	20.1	16.2	3.07			7.97	1430	2270	24	248000	3969450		15
1381	1307	46.04	5.88	0.12	5.64	2	4.75	10.68	1.1	3.7			7.86	730	1159	20	295395	3950975		15
1381	1307	35.16	4.94	0.1	5.54	4.05	6.35	9.35	1.8	2.61			7.97	987	1568	18	276300	3947390		15
1381	1307	26.15	0.71	0.04	1.27	1.35	2.35	5.01	0.4	3.9			8.17	282.9	449	19	290125	3945100		15
1381	1307	18.92	0.34	0.03	0.74	1.55	1.75	4.01	0.5	3.17			7.81	221	351	19	293750	3945350		15
1381	1307	45.95	3.28	0.14	4.28	0.8	4.4	8.78	1.4	4.1			7.63	644	1023	17	276250	3957500		15
1381	1307	57.05	2.4	0.01	5.3	1.45	2.55	6.98	1.3	3.28			7.85	587.8	933	18	286350	3955125		15
1381	1307	53.67	1.76	0.1	4.65	1.45	2.65	6.74	1.7	3.28			8.03	546.2	867	17	286125	3960450		15
1381	1307	43.4	0.19	0.03	2.04	1.3	1.4	4.59	0.5	3.9			7.83	271	430	21	300655	3947400		15
1381	1307	40.26	5.7	0.14	6.7	3.15	7	12	2.1	4.2			7.04	985	1564	18	272525	3952450		15
1381	1307	32.23	7.26	0.14	7.61	5.7	10.6	16.32	2.6	6.46			7.21	1354	2150	18	276550	3946675		15
1381	1307	65.24	6.93	0.2	22.6	5.35	6.8	31.11	16.9	7.28			7.44	2173	3450	17	275225	3963300		15
1381	1307	31.2	2.21	0.07	2.47	2.1	3.5	7.05	1	3.84			8.07	493	783	18	281365	3948850		15
1381	1307	29.37	2.28	0.07	2.3	2.05	3.65	7.68	1.2	4.2			7.75	496.4	788	18	282765	3951475		15
1381	1307	27.54	0.48	0.07	1.07	1.1	1.9	4.26	0.45	3.33			7.92	236.3	375	21	298200	3950075		15
1381	1307	33.65	2.11	0.1	2.74	2.1	3.5	7.51	1.3	4.1			7.53	490.7	779	18	279375	3953975		15
1381	1307	59.53	6.15	0.02	9.1	3.25	2.95	14.18	2.7	5.33			8.13	1075	1707	21	283000	3966925		15
1381	1307	49.12	5.7	0.1	6.32	3	3.65	13.08	2	5.38			7.74	826	1311	17	282250	3961000		15
1381	1307	33.33	3.07	0.1	3.4	3.5	3.5	9.54	1.5	4.97			7.73	600.4	953	21	277600	3968050		15
1381	1307	43.16	7.47	0.12	7.13	3.55	6	15.84	3.4	4.97			7.7	1021	1620	21	279750	3965425		15
1381	1307	49.22	0.52	0.1	3.05	1.4	1.85	6.39	0.7	5.17			7.97	380.5	604	6	300850	3942425		15
1381	1307	66.44	0.32	0.1	3.86	0.95	1.05	5.74	0.45	4.97			7.83	301.7	479	6	299575	3938950		15
1381	1307	60.66	8.97	0.12	12.37	3.6	4.5	28.9	16.35	3.58			7.05	1373	2180	17	248000	3969450		15
1381	1307	50.25	0.28	0.03	3	1.35	1.65	5.54	0.55	4.71			7.61	321.3	510	6	304325	3941575		15
1381	1307	52.26	5.04	0.1	6.85	1.5	4.85	12.88	2.1	5.74			6.91	824	1308	30	282250	3961000		15
1381	1307	49.85	2.27	0.07	4.95	2	3.05	8.47	2.1	4.1			7.11	585	928	30	272850	3960710		15
1381	1307	8.47	0.2	0.03	0.34	1.35	2.65	4.65	0.3	4.15			7	243	386	6	293250	3941875		15
1381	1307	15.54	0.09	0.03	0.66	1.35	2.4	4.64	0.3	4.25			7.27	250.7	398	6	294905	3942400		15
1381	1307	44.08	0.72	0.07	2.65	1.2	2.25	6.19	0.7	4.77			8.11	326	518	30	291550	3948200		15
1381	1307	27.52	0.83	0.04	1.27	1.1	2.35	4.71	0.45	3.43			7.24	270.3	429	31	293750	3945350		15
1381	1307	68.12	6.35	0.14	22.94	4.5	6.3	30.59	18.5	5.74			7.84	2085	3310	31	275225	3963300		15
1381	1307	30.32	2.44	0.07	2.41	2.7	3	7.74	1.3	4			7.99	456	724	31	279375	3953975		15
1381	1307	46.37	4.34	0.1	5.65	1.9	4.75	18.32	10.5	3.48			8.11	722	1146	7	290200	3950325		15
1381	1307	30.97	2.07	0.1	2.21	2.65	2.5	8.08	1.3	4.71			7.48	495.2	786	29	282765	3951475		15
1381	1307	42.79	1.85	0.1	3.34	1.7	2.9	6.4	0.65	3.9			7.25	454.2	721	7	290150	3952625		15
1381	1307	42.54	0.61	0.07	2.41	1.5	1.85	5.82	0.5	4.71			7.18	318.2	505	6	297500	3947475		15
1381	1307	41.33	0.92	0.1	3	2.15	2.25	7.05	0.8	5.33			7.98	418.3	664	7	295395	3950975		15
1381	1307	36.63	1.13	0.07	2.3	1.85	2.25	5.42	0.65	3.64			7.88	367.3	583	30	292925	3949025		15
1381	1307	54.65	3.72	0.12	4.88	1.7	2.45	9.17	1.2	4.25			8.07	535.5	850	7	286050	3949450		15
1381	1307	26.85	0.73	0.04	1.3	1.25	2.4	4.81	0.5	3.58			7.99	287.9	457	29	290125	3945100		15
1381	1307	26.95	1.31	0.1	2.15	3.25	2.85	6.77	1.15	4.31			7.24	483	767	29	281365	3948850		15
1381	1307	68.34	0.74	0.2	4.44	1.4	0.75	5.5	0.55	4.21			7.97	342	543	6	297950	3943275		15
1381	1307	54.96	7.9	0.2	30	9.5	15.25	35.72	25	2.82			8.2	3068	4870	31	279750	3965425		15
1381	1307	74.43	7.63	0.2	33.27	5.85	5.65	38.5	22.05	8.82			8.04	2778	4410	31	283000	3966925		15
1381	1307	33.52	4.04	0.1	3.58	3.3	4	11.07	1.8	5.23			7.93	623.7	990	31	277600	3968050		15
1381	1307	42.21	3.32	0.07	3.91	2.45	3	9.2	0.7	5.18			7.61	525.4	834	30	298200	3950075		15
1381	1307	42.12	0.19	0.07	2.04	1.1	1.8	4.69	0.5	4			7.81	272.7	433	30	300655	3947400		15
1381	1307	28	4.97	0.04	2.04	2.25	3.1	8.84	1.4	2.47			7.86	577.1	916	30	276250	3957500		15
1381	1307	57.85	1.82	0.04	4.49	0.9	2.4	7.17	1.5	3.85			7.52	465.5	739	31	286425	3952575		15
1381	1307	33.53	8.01	0.01	6.52	4.05	8.9	13.85	2.1	3.74			7.38	1108.8	176	29	276300	3947390		15
1381	1307	29.64	6.61	0.12	3.65	3.25	5.7	12.07	1.05	4.41			7.72	722.7	1147	29	276550	3946675		15
1381	1307	27.01	7.54	0.12	3.34	3.65	5.7	13.27	2.25	3.48			7.77	922.3	1464	29	272525	3952450		15
1381	1307	53.38	2.6	0.1	4.48	1.45	2.55	7.48	1.6	3.28			7.73	512.8	814	30	286125	3960450		15
1381	1307	59.88	3.37	0.1	4.9	1.4	1.95	7.64	1.4	2.87			7.9	524.2	832	30	286350	3955125		15
Average		2873.7	189.82	5.69	351.08	158.25	233.3	670.96	191.7	287.28	2.16		517.29	44142.51	68969					
		42.89	2.83	0.08	5.24	2.36	3.48	10.01	2.86	4.29	0.03		7.72	658.84	1029.39					

Appendix 8 Results of Water Quality Test (2001 -2006) (15/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1382	1307	50.75	0.53	0.17	2.87	1.25	1.7	5.87	0.5	4.84			7.14	338.3	537	20	304325	3941575		15
1382	1307	9.48	0.39	0.04	0.4	1.5	2.7	5.07	0.25	4.43			7.12	265.8	422	20	293250	3941875		15
1382	1307	62.88	1.01	0.17	13.04	3.1	4.7	20.86	16.55	3.3			7.99	1386	2200	13	248000	3969450		15
1382	1307	61.36	0.47	0.1	3.87	0.95	1.55	5.71	0.5	4.74			8.2	362.3	575	20	297950	3943275		15
1382	1307	13.26	0.41	0.03	0.65	1.4	3.05	5.08	0.4	4.27			7.33	297.9	473	20	293750	3945350		15
1382	1307	16.89	0.38	0.03	0.61	1.2	1.95	4.71	0.36	3.97			7.74	245.7	390	20	294905	3942400		15
1382	1307	46.12	0.73	0.1	3.58	1.7	2.6	7.87	0.8	6.34			7.21	456.1	724	20	290125	3945100		15
1382	1307	52.23	0.57	0.03	2.43	1.05	1.2	4.16	0.55	3.04			7.99	274	435	20	297500	3947475		15
1382	1307	59.42	0.47	0.07	3.81	1.2	1.45	5.97	0.35	5.15			7.27	338.9	538	20	299575	3938950		15
1382	1307	57.69	0.83	0.1	3.65	1.75	1	6.01	0.75	4.43			7.91	389.3	618	20	300850	3942425		15
1382	1307	27.36	1.22	0.07	2.34	2.35	4.05	7.22	1.2	4.8			6.97	495.1	786	20	281365	3948850		15
1382	1307	44.25	0.45	0.07	2.47	1.05	2.15	4.96	0.65	3.86			8.17	326.3	518	20	292925	3949025		15
1382	1307	44.12	2.65	0.1	3.65	2.15	2.6	7.11	0.6	3.86			7.13	470	745	11	286050	3949450		15
1382	1307	27.22	2.75	0.04	2.11	2.35	3.4	8.38	1.25	4.38			7.87	483	767	10	282765	3951475		15
1382	1307	32.04	4.15	0.13	3.83	2.65	5.75	9.82	1.5	4.17			7.17	704	1118	20	279375	3953975		15
1382	1307	32.02	3.4	0.14	3.04	2.25	4.5	8.46	1.15	3.91			8.11	745.3	1183	17	290200	3950325		15
1382	1307	29.49	0.81	0.04	1.57	1.7	2.15	4.56	0.65	3.1			7.71	347.7	552	20	291550	3948200		15
1382	1307	40.84	0.22	0.07	2.07	1.2	1.9	4.94	0.6	4.12			8.1	307	487	20	298200	3950075		15
1382	1307	37.74	8.55	0.12	6.7	3.9	7.35	15.55	1.9	5.1			8.3	1010	1603	20	276300	3947390		15
1382	1307	42.16	7.2	0.1	5.44	2.2	5.4	12.01	1.1	3.71			7.11	732.7	1163	11	290150	3952625		15
1382	1307	44.13	0.83	0.07	3.09	1.85	2.15	6.73	0.8	5.1			7.41	424	674	17	290200	3950325		15
1382	1307	49.52	1.42	0.1	4.51	1.3	3.4	7.09	1.45	2.78	1.44		8.26	535.5	850	7	286125	3960450		15
1382	1307	42.69	3.65	0.1	3.81	1.95	3.3	13.45	1.25	8.55			7.88	551	875	21	277600	3968050		15
1382	1307	55.65	3.7	0.14	5.13	1.6	2.6	9.01	1.5	3.81			8.03	576.4	915	11	286350	3955125		15
1382	1307	34.93	5.7	0.2	5.65	3.8	7.1	15.49	3.2	6.59			6.83	934.9	1484	7	279750	3965425		15
1382	1307	29.09	4.35	0.14	3.04	2.45	5.3	9.53	0.8	4.38			7.17	634.4	1007	20	276550	3946675		15
1382	1307	38.5	10.2	0.2	6.31	3.4	7	16.47	2.2	4.07			7.31	943.1	1497	20	272525	3952450		15
1382	1307	71.1	8.5	0.2	18.5	3.8	3.8	26.11	13.9	3.71			7.87	1600	2540	17	275225	3963300		15
1382	1307	38.14	4.7	0.1	4.34	2.6	4.6	10.78	1.55	4.53			7.07	658.3	1045		276250	3957500		15
1382	1307	23.92	10.8	0.14	6.87	5	17.3	33.16	15.25	7.11			7.1	2161	3430	7	283000	3966925		15
1382	1307	28.27	0.74	0.07	1.94	2.1	3	8.14	1.1	6.3			7.91	466	740	20	300655	3947400		15
1382	1307	48.99	4.7	0.14	5.91	2.8	3.5	10.46	2.15	3.61			7.71	747.8	1187	7	282250	3961000		15
1382	1307	52.93	2.35	0.14	5.82	1.75	3.55	9.38	2.5	4.53			7.4	660.1	1049	21	272850	3960710		15
1382	1307	22.81	0.49	0.03	1.27	1.2	3.2	5.16	0.45	4.22			7.07	319	507	12	290125	3945100		15
1382	1307	47.56	0.51	0.04	3.27	1.4	2.25	6.28	0.7	5.07			7.57	389.3	618	30	300850	3942425		15
1382	1307	42.71	0.3	0.03	2.43	1.2	2.1	4.86	0.55	4.01			7.27	307.4	488	30	297500	3947475		15
1382	1307	62.87	0.14	0.07	3.57	0.65	1.5	6.62	1	5.48			6.77	330.7	525	30	299575	3938950		15
1382	1307	59.09	1.62	0.14	12.5	3.15	5.6	23.98	16.45	5.91			7.21	1411.2	2240	31	248000	3969450		15
1382	1307	49.05	0.24	0.1	2.74	1.35	1.6	5.34	0.45	4.65			7.37	317.55	4	30	304325	3941575		15
1382	1307	7.83	0.17	0.01	0.33	1.1	2.9	4.58	0.3	4.11			7.18	245.7	390	30	293250	3941875		15
1382	1307	58.15	3.03	0.2	6.4	1.75	3	7.8	0.6	4.17			7.31	1143	1814	30	297950	3943275		15
1382	1307	12.28	0.27	0.02	0.47	1.15	2.35	4.35	0.65	3.43			7.67	258.9	411	30	293750	3945350		15
1382	1307	14.26	0.11	0.02	0.67	1.1	3.05	5.04	0.4	4.53			7.74	275.9	438	30	294905	3942400		15
1382	1307	23.45	0.67	0.07	1.63	1.75	3.8	5.95	0.75	4.53			7.37	407	647	12	291550	3948200		15
1382	1307	37.03	0.59	0.1	2.37	1.9	2.3	5.67	0.75	4.33			7.17	355.3	564	12	292925	3949025		15
1382	1307	50.54	1.15	0.2	4.45	1.05	3.5	7.99	1.2	5.64			8.1	510.9	811	16	286425	3952575		15
1382	1307	36.76	7.83	0.12	7	4.05	8.2	13.75	1.85	4.07			8.15	1028.8	1633	14	276300	3947390		15
1382	1307	56.75	9.5	0.1	5.74	1.7	2.75	15.3	0.95	4.85			7.18	850.2	921	13	290150	3952625		15
1382	1307	42.28	0.87	0.1	2.94	1.65	2.5	6.47	0.75	4.85			7.97	400	635	13	295395	3950975		15
1382	1307	30.86	7.5	0.1	4.52	3.3	7.05	13.57	1.85	4.22			8.08	829.1	1316	14	279375	3953975		15
1382	1307	37.39	0.33	0.07	2.02	1.1	2.4	5.36	0.6	4.43			7.21	313.7	498	30	298200	3950075		15
1382	1307	45.65	6.75	0.1	5.78	2.1	4.9	11.86	1.1	4.01			7.17	720	1143	13	290200	3950325		15
1382	1307	33.48	1.5	0.07	2.27	1.8	2.85	7.1	0.75	4.85			7.47	384.9	611	13	286050	3949450		15
1382	1307	27.34	0.67	0.1	2.27	2.6	3.7	8.25	2.15	5.43			7.63	522.3	829	30	300655	3947400		15
1382	1307	30.47	7.88	0.12	6.08	4.65	9.5	15.18	1.5	5.8			8.17	1050.8	1668	15	276550	3946675		15
1382	1307	27.18	3.05	0.1	2.27	2.2	4.15	9.16	1.1	5.01			7.08	491.4	780	13	282765	3951475		15
1382	1307	31.76	3.25	0.07	2.21	4.28	0.62	8.62	1.15	4.22			7.21	475.57	50	14	281365	3948850		15
1382	1307	51.07	3.05	0.1	4.44	1.35	3	8.3	1.45	3.8			7.84	514.7	817	16	286125	3960450		15
1382	1307	40.47	8.12	0.3	41.32	21.73	39.5	56.29	41	7.17			6.97	5884.2	9340	16	283000	3966925		15
1382	1307	32.7	3.05	0.1	3.52	2.15	5.3	10.29	1.75	5.49			7.44	635	1008	30	277600	3968050		15
1382	1307	38.94	7.61	0.14	6.3	3.2	6.9	13.56	2.1	3.85			7.51	934.9	1484	15	272525	3952450		15
1382	1307	66.25	7.77	0.2	7.28	3.36	0.45	15.39	3.4	4.22			7.77	993	1577	30	279750	3965425		15
1382	1307	55.62	2.9	0.12	5.52	1.7	2.8	8.3	1.7	3.7			7.63	607	964	16	286350	3955125		15
1382	1307	38.53	5.79	0.14	4.56	2.25	5.25	7.86	1.54	0.53			7.27	689	1094	16	276250	3957500		15
1382	1307	48.29	7.67	0.14	5.65	2.65	3.55	12.89	1.95	3.27			7.87	705.6	1120	16	282250	3961000		15
1382	1307	49.46	2.25	0.12	4.87	1.65	3.45	8.67	2.05	4.37			7.24	590.3	937	15	272850	3960710		15
1382	1307	79.29	7.48	0.2	22	1.7	4.1	30.03	15.85	6.7			7.74	1972	3130	15	275225	3963300		15
1382	1307	49.73	1.3	0.12	4.53	1.85	2.85	7.08	1.55	4.23			7.13	514	816	21	286425	3952575		15
Average		2783.1	214.24	7.22	338.24	163.07	290.67	717.02	191.6	309.74	1.44		512.02	48246.22	74955					
		40.93	3.15	0.11	4.97	2.40	4.27	10.54	2.82	4.56	0.02		7.53	709.50	1102.28					

Appendix 8 Results of Water Quality Test (2001 -2006) (16/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1307	31.8	4.81	0.04	3.26	2.41	4.67	10.04	1.79	2.76	0.68		8.45	650	1087	11	277600	3968050		15
1383	1307	38.88	8.62	0.04	5.76	3.69	5.43	14.57	3.31	2.44	0.2		8.37	950	1547	11	279750	3965425		15
1383	1307	39.42	18.48	0.19	17.65	6.58	20.84	44.66	19.86	6.04	0.28		8.41	2790	4593	11	283000	3966925		15
1383	1307	42	6.68	0.12	5.47	3.25	4.47	12.99	2.23	3.56	0.52		8.45	86014.28		11	282250	3961000		15
1383	1307	49.82	3.85	0.04	4.32	1.56	2.83	8.48	1.43	3.2			7.61	560	929	11	286125	3960450		15
1383	1307	54.56	4.56	0.02	5.06	1.84	2.39	8.98	1.38	2.92	0.12		8.38	600	987	11	286350	3955125		15
1383	1307	38.2	4.21	0.36	4.61	2.93	5.11	12.67	3.5	4.6	0.36		8.41	820	1372	17	276250	3957500		15
1383	1307	51.02	4.41	0.05	5.15	2.04	2.95	9.86	0.33	5.12			7.39	650	1074	17	272850	3960710		15
1383	1307	37.26	10.16	0.04	5.8	3.85	5.99	15.11	2.15	2.48	0.32		8.39	1020	1651	18	272525	3952450		15
1383	1307	31.36	8.12	0.11	3.8	3.57	4.99	12.03	0.99	2.24	0.68		8.45	800	1303	18	276550	3946675		15
1383	1307	52.88	1.15	0.09	3	1.64	1.11	5.52	0.69	3.56	0.12		8.37	380	638	29	300655	3947400		15
1383	1307	30.93	1.33	0.1	1.39	1.41	1.91	4.49	0.6	2.2	0.36		8.39	320	528	29	298200	3950075		15
1383	1307	32.1	4.02	0.04	2.82	2.69	3.35	8.57	2.07	2.12	0.36		8.41	560	932	18	279375	3953975		15
1383	1307	27.07	3.04	0.03	2.35	2.85	3.55	8.46	1.1	4.32			7.58	550	931	18	282765	3951475		15
1383	1307	31.14	3.96	0.03	2.43	2.69	2.75	7.53	1.05	2.24	0.28		8.39	500	846	18	281365	3948850		15
1383	1307	50.72	2.46	0.03	4.32	1.44	2.79	8.26	1.52	4.28			7.68	550	912	20	286425	3952575		15
1383	1307	43.89	7.12	0.02	5.17	2.25	4.39	11.47	0.99	3.36			7.41	780	1263	20	290200	3950325		15
1383	1307	43.1	3.46	0.04	3.35	1.76	2.71	7.54	0.6	3.48			7.82	500	838	20	286050	3949450		15
1383	1307	69.39	4.56	0.02	5.17	1.62	0.67	9	0.96	3.48			7.45	610	1012	20	290150	3952625		15
1383	1307	40.35	1.94	0.03	3	2.41	2.07	7.11	0.77	4.4			7.39	470	793	20	295395	3950975		15
1383	1307	49.26	1.63	0.02	2.3	1.32	1.07	4.42	0.55	2	0.24		8.38	300	506	30	292925	3949025		15
1383	1307	31.16	2.23	0.04	1.72	1.41	2.47	5.08	0.69	2.16			8.37	370	614	30	291550	3948200		15
1383	1307	27.43	0.91	0.02	1.5	1.52	2.51	5.23	0.52	3.8			7.43	350	589	30	290125	3945100		15
1383	1307	33.85	0.99	0.02	0.95	1.62	0.27	4.55	0.44	2.88	0.24		8.36	310	524	30	293750	3945350		15
1383	1307	16.99	1.33	0.05	0.82	1.64	2.59	4.77	0.44	2.56	0.44		8.44	320	543	29	297950	3943275		15
1383	1307	23.1	0.71	0.03	0.93	2	1.19	3.89	0.38	2.56	0.24		8.42	260	448	29	294905	3942400		15
1383	1307	45.91	0.82	0.02	2.56	1.16	1.88	5.34	0.52	4			7.48	360	607	29	304325	3941575		15
1383	1307	61.4	0.94	0.18	11.91	3.45	4.15	19.34	16.41	1.83	0.16		8.38	1200	2023		248000	3969450		15
1383	1307	0	0			2.15	1.85		0.5	4.3			8.14		440	24	294905	3942400		15
1383	1307	0	0.75			1.9	2	5.26	0.7	3.81			8.15		560	23	290125	3945100	0	15
1383	1307	0	0.45			0.65	1.65	3.51	0.7	2.36			7.85	252	400	7				15
1383	1307	0	0.07			0.9	2.95	4.23	0.3	3.86			7.94		410	24	293250	3941875		15
1383	1307	0	0.9			2	5.55	21.53	17.2	3.43			8.03		2300	26	248000	3969450		15
1383	1307	0	7.07			2.05	10.6	13.96	3.45	3.44			7.81		1900	7	272525	3952450		15
1383	1307	0	2.57			2.7	1.95	9.02	1.25	5.2			7.24		940	22	286425	3952575		15
1383	1307	0	5.28			2.55	3.45	10.36	1.75	3.33			7.83		840	16	279375	3953975		15
1383	1307	0	1.1			2.1	2.05	5.98	0.75	4.13			7.83		610	24	295395	3950975		15
1383	1307	0	4.1			2.05	3.35	8.1	1.75	2.25			7.97		890	24	277600	3968050		15
1383	1307	0	2.5			1.55	2.35	7.33	1.45	3.38			8.06		840	22	286125	3960450		15
1383	1307	0	7.07			2.5	7.05	28.79	15.65	6.07			7.31		3170	15	275225	3963300		15
1383	1307	0	3.6			1.85	2.3	8.5	1.15	3.75			7.55		910	24	290150	3952625		15
1383	1307	0	7.22			2.35	11.45	13.13	2	3.91			8.07		1810	16	276300	3947390		15
1383	1307	0	0.44			0.75	0.95	4.25	0.7	3.11			8.11		480	24	298200	3950075		15
1383	1307	0	2.75			0.9	2.95	7.79	2.25	2.79			7.91		910	15	272850	3960710		15
1383	1307	0	6.3			2.95	9.4	13.33	3	4.03			7.88		1970	16	276550	3946675		15
1383	1307	0	0.9			2.25	5.05	8.8	2.05	5.85			7.23		950	24	300655	3947400		15
1383	1307	0	1.97			1.9	3	6.19	1	3.22			7.74		670	16	282765	3951475		15
1383	1307	0	2.43			1.95	3.3	6.6	1	3.17			7.86		740	16	281365	3948850		15
1383	1307	0	6.3			2.8	14.65	23.75	11.75	5.7			7.3		3430	23	279750	3965425		15
1383	1307	0	4.67			2.6	3.6	8.74	1.5	2.57			7.97		1050	22	276250	3957500		15
1383	1307	0	6.75			3.15	10.1	21.57	10.15	4.67			7.7		2610	23	283000	3966925		15
1383	1307	0	5.27			2	5.05	11.6	2.2	4.13			8.2		1320	22	282250	3961000		15
1383	1307	0				1.9	2.85		1.25	4.99			7.77		930	22	286350	3955125		15
1383	1307	0	0.21			0.7	1.65	4.47	0.35	3.91			7.49		470	24	304325	3941575		15
1383	1307	0	0.86			1.25	1.1	5.26	0.7	3.7			8.03		560	24	300850	3942425		15
1383	1307	0	6.01			0.9	5.05	10.98	1	3.97			7.87		1110	24	295395	3950975		15
1383	1307	0	3.01			1.55	3.25	7.58	0.6	3.97			7		800	24	286050	3949450		15
1383	1307	0	0.61			1	2.2	5.24	0.6	3.33	0.7		8.27		510	23	292925	3949025		15
1383	1307	0	1.54			1.3	2.1	4.51	0.6	2.37			7.97		520	24	291550	3948200		15
1383	1307	0	0.55			1.55	2.6	10.62	6	4.07			7.83		500	21	293750	3945350		15
1383	1307	0	0.23			1.05	2	4.65	0.5	2.85	1.07		8.37		520	21	297950	3943275		15
1383	1307	65.34	7.66	0.14	18.56	4.45	5.47	28.15	15.93	4.12	0.44		8.42	1740	2954	17	275225	3963300		15
1383	1307	34.53	13.31	0.04	6.61	4.66	7.94	18.78	1.87	3.6			7.37	1260	2010	18	276300	3947390		15
1383	1307	54.55	1.98	0.05	3.6	1.44	1.6	6.4	1.54	2.44	0.44		8.47	430	713	30	297500	3947475		15
1383	1307	59.36	1.05	0.08	3.54	1.12	1.36	5.78	0.41	3.88	0.44		8.41	390	652	29	299575	3938950		15
1383	1307	58.72	1.75	0.02	3.28	1.36	0.96	5.31	0.44	2.92	0.2		8.37	370	613	29	300850	3942425		15
1383	1307	22.41	0.81	0.02	0.91	1.16	2.07	3.84	0.27	2.56	0.2		8.39	270	454	29	293250	3941875		15
1383	1307	53.45	0.41	0.2	3.13	0.9	2	4.71	0.6	3.7			8.19	321.4	510	21	297500	3947475		15
average						141.44	261.9	658.56	184.13	239.43			542.36		73066					
						2.08	3.85	9.68	2.71	3.52			7.98		1074.50					

Appendix 8 Results of Water Quality Test (2001 -2006) (17/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1307	58.68	0.34	0.1	2.74	1.2	0.8	4.09	0.55	3.2			8.2	277.2	440	9	304325	3941575		15
1384	1307	24.24	0.4	0.07	1.21	1.15	2.85	4.94	0.5	4.04			7.17	315	500	22	290125	3945100		15
1384	1307	18.73	0.12	0.03	0.65	1.4	1.55	3.29	0.4	2.77			7.99	214.2	340	9	294905	3942400		15
1384	1307	41.58	3.87	0.1	3.53	1.95	3.15	8.44	1.6	2.97			7.71	548.1	870	7	277600	3968050		15
1384	1307	52.74	8.21	0.4	29.4	8	18.7	37.96	22.25	7.5			7.45	3635.1	5770	7	283000	3966925		15
1384	1307	52.66	0.79	0.1	3.07	1.55	1.3	5.58	0.65	4.14			7.93	371.7	590	9	300850	3942425		15
1384	1307	49.05	6.58	0.25	5.43	1.95	3.95	11.03	1	3.45			8.13	711.9	1130	21	290200	3950325		15
1384	1307	62.01	0.31	0.12	2.9	0.8	1.05	3.99	0.65	3.03			8.2	302.4	480	9	300655	3947400		15
1384	1307	22.81	1.43	0.07	1.54	1.55	3.9	6.39	0.55	4.41			7.03	428.4	680	21	291550	3948200		15
1384	1307	37.43	8.1	0.3	6.1	5.35	5.35	12.4	1.8	2.5			7.81	970.2	1540	3	276300	3947390		15
1384	1307	61.06	0.94	0.3	11.85	3.3	4.45	20.13	15.95	3.24			7.21	1392.3	2210	6	248000	3969450		15
1384	1307	8.24	0.07	0.03	0.32	1	2.9	5.79	0.3	5.42			7.31	258.3	410	9	293250	3941875		15
1384	1307	14.43	2.07	0.03	0.67	1.7	2.45	4.42	0.6	1.75			7.34	403.2	640	21	292925	3949025		15
1384	1307	57.55	3.51	0.25	4.97	1.8	2.05	7.98	1.7	2.77			8.11	573.3	910	21	286350	3955125		15
1384	1307	60.58	8.1	0.35	10.1	3.35	3.45	14.23	3.2	2.93			7.94	1052.1	1670	30	275225	3963300		15
1384	1307	28.95	8.17	0.25	5.17	4.5	8.8	16.39	2.85	5.37			7.63	1096.2	1740	3	272525	3952450		15
1384	1307	41.61	5.8	0.25	4.31	2.2	4.2	10.11	1.5	2.81			7.97	655.2	1040	30	276250	3957500		15
1384	1307	50.25	7.11	0.3	6.87	5.2	1.9	13.29	2.25	3.93			7.88	844.2	1340	22	286125	3960450		15
1384	1307	56.65	2.4	0.2	4.44	1.35	2.2	6.68	1.35	2.93			7.93	491.4	780	2	282250	3961000		15
1384	1307	45.81	8.15	0.3	7.35	3.05	6	14.91	3.25	3.51			7.73	970.2	1540	7	279750	3965425		15
1384	1307	56.24	2.15	0.2	4.49	2	1.65	6.53	1.55	2.83			7.87	485.1	770	21	286425	3952575		15
1384	1307	63.64	0.91	0.2	3.65	1.1	1.1	5.91	0.5	4.5			8.2	359.1	570	9	297950	3943275		15
1384	1307	50.1	0.41	0.17	2.29	0.85	1.6	4.41	0.5	3.5			7.67	296.1	470	9	297500	3947475		15
1384	1307	55.37	4.32	0.25	5.27	1.35	3.1	9.71	0.95	4.44			8.2	592.2	940	21	290150	3952625		15
1384	1307	15.68	0.27	0.03	0.63	1.2	2.35	4.22	0.4	3.55			7.93	258.3	410	22	293750	3945350		15
1384	1307	26.08	7.93	0.2	4.21	4.95	7.55	14.19	1.65	4.61			7.03	951.3	1510	3	276550	3946675		15
1384	1307	13.19	0.11	0.01	0.37	0.55	1.95	3.08	0.3	2.67			8.2	176.4	280	9	298200	3950075		15
1384	1307	49.33	3.93	0.2	3.5	1.05	2.75	7.88	0.55	3.4			8.11	459.9	730	22	286050	3949450		15
1384	1307	33.25	3.09	0.17	2.37	1.45	3.65	9.85	2.15	4.61			7.3	630	1000	2	272850	3960710		15
1384	1307	27.34	2.24	0.12	2.1	1.75	4.15	7.87	1	4.63			6.93	497.7	790	2	282765	3951475		15
1384	1307	42.82	1.18	0.17	2.9	1.45	2.65	6.39	0.8	4.41			7.13	428.4	680	21	295395	3950975		15
1384	1307	46.5	1.42	0.2	3.45	2.8	1.4	6.83	0.3	5.11			8.05	333.9	530	9	299575	3938950		15
1384	1307	38.54	4	0.2	3.28	2.5	3.05	8.55	1.55	3			7.77	541.8	860	3	279375	3953975		15
1384	1307	45.9	20.71	2.81	20.26	8.43	18.76	48.11	21.8	5.6			7.19	3400	5510	4	283000	3966925		15
1384	1307	28.57	4	0.03	3.17	3.13	4.87	10.67	1.71	4.96			7.25	760	1280	2	277600	3968050		15
1384	1307	40.35	8.45	0.03	6.03	4.09	4.87	14.4	3.31	2.64			7.71	970	1617	2	279750	3965425		15
1384	1307	44.73	3.08	0.08	3.48	2.09	2.31	7.58	1.38	3.12			7.08	530	887	4	282250	3961000		15
1384	1307	33.52	5.48	0.08	3.71	3.05	4.47	10.56	1.32	3.76			7.04	720	1205	2	276250	3957500		15
1384	1307	37.2	12.85	0.03	7.13	5.54	6.55	18.33	2.92	2.56			7.67	1230	2040	5	272525	3952450		15
1384	1307	43.82	3.58	0.01	4.48	2.65	3.11	9.82	1.6	4.64			7.26	660	1131	24	286350	3955125		15
1384	1307	49.22	2.79	0.02	4.32	2.21	2.27	8.37	1.98	3.6			7.88	590	978	4	272850	3960710		15
1384	1307	40.75	0.66	0.06	2.08	1.36	1.75	4.91	0.49	3.76			7.55	360	581	6	300655	3947400		15
1384	1307	35.08	15.91	0.18	7.91	7.15	7.82	22.44	2.29	4.24			7.41	1500	2400	5	276550	3946675		15
1384	1307	39.77	3.21	0.04	4.08	2.97	3.27	9.62	1.93	4.48			6.98	680	1118	20	286125	3960450		15
1384	1307	56.96	9.29	0.11	9.34	3.37	3.77	15.87	3.14	3.44			7.18	1080	1752	2	275225	3963300		15
1384	1307	27.91	5.64	0.43	3.26	5.06	4.47	12.69	4.25	2.8			7.29	850	1416	6	298200	3950075		15
1384	1307	30.09	3.68	0.03	2.69	3.05	3.27	8.58	1.54	3.36			7.38	620	987	5	279375	3953975		15
1384	1307	32.49	16.35	0.03	7.13	5.54	9.34	21.23	2.32	2.56			7.58	1420	2290	5	276300	3947390		15
1384	1307	26.22	2.79	0.02	1.83	2.65	2.55	6.63	0.88	2.96			7.73	460	776	5	282765	3951475		15
1384	1307	23.79	2.62	0.02	1.78	2.97	2.79	7.19	1.13	3.44			7.31	480	803	5	281365	3948850		15
1384	1307	51.06	2.14	0.02	3.56	1.76	1.67	6.6	1.18	3.28			7.58	460	783	24	286425	3952575		15
1384	1307	43.12	6.02	0.02	4.65	2.25	3.91	10.37	0.99	3.36			7.86	730	1167	22	290200	3950325		15
1384	1307	38.77	3.18	0.03	2.91	2.25	2.39	7.1	0.72	3.2			7.76	500	827	24	286050	3949450		15
1384	1307	19.98	1.81	0.03	1.41	2.33	3.43	6.74	0.61	4.32			6.93	460	781	22	291550	3948200		15
1384	1307	28.92	2.58	0.02	2	2.73	2.23	6.52	0.66	3.28			7.58	440	766	22	292925	3949025		15
1384	1307	34.04	1.54	0.05	2.39	2.81	1.91	6.77	0.83	4.4			7.15	460	774	22	295395	3950975		15
1384	1307	44.38	5.16	0.02	4.58	2.33	3.43	9.89	1.05	3.68			7.61	700	1117	22	290150	3952625		15
1384	1307	66.73	0.4	0.14	3.57	0.9	0.95	5.11	0.3	4.41			7.42	296	470	6	299575	3938950		15
1384	1307	23.68	0.67	0.07	1.28	1.35	3	4.93	0.65	3.61			7.42	334	530	24	290125	3945100		15
1384	1307	48.64	0.47	0.1	2.41	0.95	1.7	4.58	0.5	3.61			7.48	309	490	6	297500	3947475		15
1384	1307	14.05	0.34	0.04	0.63	1.45	2.65	4.35	0.4	3.61			7.73	283.5	450	24	293750	3945350		15
1384	1307	52.89	0.87	0.2	3.28	1.55	1.55	5.71	0.7	4.14			7.87	359.1	570	6	300850	3942425		15
1384	1307	54.62	0.35	0.14	3.17	1.05	1.7	5.53	0.5	4.68			7.77	384.3	610	6	297950	3943275		15
1384	1307	58.7	0.63	0.12	2.58	0.9	1	4.43	0.5	3.3			8.03	277.2	440	6	304325	3941575		15
1384	1307	9.2	0.35	0.03	0.37	0.9	3.05	3.99	0.4	3.24			7.23	258.3	410	6	293250	3941875		15
1384	1307	66.83	1.21	0.2	15.11	2.85	4.75	21.4	16	4.19			7.27	1399	2220	7	248000	3969450		15
1384	1307	12.8	0.31	0.04	0.54	1.15	2.8	3.8	0.3	3.19			7.24	277.2	440	6	294905	3942400		15
average		2667.9	257.55	11.2	298.25	170.17	246.31	662.28	155.38	249.35	0		508.48	45758.4	73776					
		39.82	3.84	0.17	4.45	2.54	3.68	9.88	2.32	3.72	0.00		7.59	682.96	1101.13					

Appendix 8 Results of Water Quality Test (2001 -2006) (18/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1385	1307	50	3.21	0.05	4.04	1.6	2.39	7.67	1.43	3.03			8.24	520	857	6	282250	3961000		15
1385	1307	45.39	4.33	0.02	4.43	1.72	3.59	9.52	1.43	3.76			8.18	640	1054	13	286350	3955125		15
1385	1307	41.32	8.47	0.07	6.69	3.29	6.14	15.68	3.14	4.07			7.41	1040	1721	13	279750	3965425		15
1385	1307	31.12	5.33	0.05	4.21	2.81	6.46	13.15	2.31	5.51			7.49	840	1412	13	277600	3968050		15
1385	1307	46.82	28.91	5.06	27.69	9.43	16.96	57.94	23.03	6			7.72	3780	6090	6	283000	3966925		15
1385	1307	35.8	3.71	0.05	3.39	2.44	3.59	8.9	1.43	3.76			7.97	580	973	9	276250	3957500		15
1385	1307	42.45	8.39	0.05	6.52	3.49	5.3	14.95	2.48	4.08			7.51	980	1628	13	286125	3960450		15
1385	1307	50.11	3.37	0.02	4.47	1.88	2.55	8.55	1.98	3.2			8.03	560	941	6	272850	3960710		15
1385	1307	63.68	9.66	0.07	10.08	2.49	3.19	15.46	3.2	2.6			8.12	1080	1780	1	275225	3963300		15
1385	1307	38.57	10.1	0.06	6.21	3.69	6.14	15.47	2.09	3.28			8.14	1060	1752	2	272525	3952450		15
1385	1307	31.9	15.89	0.43	7.95	6.34	10.2	23.24	2.15	5.2			8.61	1580	2610	20	276550	3946675		15
1385	1307	33.66	4.83	0.04	3.47	3.05	3.75	9.8	1.54	3.43			8.11	640	1087	2	279375	3953975		15
1385	1307	47.08	3.27	0.05	3.95	1.44	2.95	8.62	1.6	3.11	0.64		8.42	540	911	13	286425	3952575		15
1385	1307	37.37	10.04	0.05	5.52	4.65	4.55	14.17	1.65	2.48			7.93	960	1583	2	276300	3947390		15
1385	1307	32.69	1.33	0.05	2.04	1.92	2.23	5.85	0.77	3.75			8.08	400	668	20	286050	3949450		15
1385	1307	49.35	4.21	0.05	4.56	1.76	2.87	8.9	1.09	3.6			7.16	580	984	19	290150	3952625		15
1385	1307	43.71	5.5	0.03	4.86	2.08	4.15	10.7	0.93	4.27			7.39	720	1193	19	295395	3950975		15
1385	1307	22.09	2.33	0.05	1.52	1.96	3.35	6.62	0.93	3.36			7.21	440	736	20	291550	3948200		15
1385	1307	63.98	1.54	0.14	12.47	3.29	3.59	19.61	15.67	2.4			7.67	1200	2030	5	248000	3969450		15
1385	1307	24.27	3.04	0.04	1.91	2.89	3.03	7.46	0.82	3.6			7.91	500	828	3	281365	3948850		15
1385	1307	29.63	2.66	0.04	2	2.24	2.47	6.39	1.02	2.71			7.86	440	721	3	282765	3951475		15
1385	1307	38.38	1.1	0.04	2.56	1.56	2.51	6.47	0.82	4.55			7.22	440	718	19	295395	3950975		15
1385	1307	30.84	3.04	0.08	2.1	2.08	2.55	6.5	0.35	3.11			7.04	460	738	20	292925	3949025		15
1385	1307	22.62	1.29	0.03	1.21	1.56	2.55	5.38	0.49	3.6			7.27	360	581	20	290125	3945100		15
average		952.83	145.55	6.62	133.85	69.66	107.06	307	72.35	88.46			186.69	20340	33596					
		39.70	6.06	0.28	5.58	2.90	4.46	12.79	3.01	3.69			7.78	847.50	1399.83					

Appendix 8 Results of Water Quality Test (2001 -2006) (19/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1308	0.244	4.22	4.71	0.01	0.36	1.04	3.3	0.19	0.19	3.84	0	7.9	280	437	3	3	708178	3914615	c2-s1
1383	1308	0.206	3.4	3.73	0.02	0.27	0.69	2.75	0.08	0.15	3.17	0	7.8	227	354	3	3	709040	3916303	c2-s1
1383	1308	0.58	3.94	4.11	0.02	0.75	0.79	2.55	0.25	0.14	3.55	0	8	239	373	3	1	714782	3908807	c2-s1
1383	1308	0.436	4.75	4.98	0.02	0.64	1.07	3.25	0.63	0.33	3.79	0	7.5	287	448	3	4	720222	3908902	c2-s1
1383	1308	0.452	5.26	5.82	0.02	0.72	1.53	3.55	0.56	0.2	4.5	0	7.8	332	519	3	1	714535	3913957	c2-s1
1383	1308	0.358	3.97	4.25	0.02	0.49	0.84	2.9	0.1	0.17	3.7	0	7.8	250	391	3	3	719385	3906305	c2-s1
1383	1308	0.261	4.99	5.35	0.02	0.41	1.37	3.55	0.24	4.35	0.2	0.2	8.2	310	485	3	1	715693	3900914	c2-s1
1383	1308	0.224	4.05	4.42	0.02	0.32	1.03	3.05	0.26	0.14	3.65	0	8	260	407	3	3	717877	3902553	c2-s1
1383	1308	0.198	4.97	5.25	0.02	0.31	1.17	3.75	0.5	0.2	4.27	0	7.95	300	468	3	1	710563	3901021	c2-s1
1383	1308	0.245	4.6	4.96	0.01	0.37	1.18	3.4	0.17	0.16	4.27	0	8	286	447	3	1	713482	3898011	c2-s1
1383	1308	0.1	3.96	4.09	0.01	0.14	0.84	3.1	0.18	0.13	3.65	0	7.9	244	381	3	3	700753	3911774	c2-s1
1383	1308	0.232	3.33	3.65	0.01	0.3	0.79	2.55	0.08	0.12	3.13	0	7.95	216	338	3	3	718439	3900281	c2-s1
1383	1308	0.216	3.22	3.65	0.01	0.28	1.01	2.35	0.24	0.15	2.83	0	8	219	342	3	4	744750	3896455	c2-s1
1383	1308	0.548	3.46	3.97	0.01	0.7	0.66	2.6	0.17	0.17	3.12	0	7.9	241	377	3	4	720505	3903721	c2-s1
1383	1308	1.85	6.4	6.61	0.02	2.61	1.33	2.65	1.6	0.3	4.5	0	7.8	361	564	3	2	733535	3905420	c2-s1
1383	1308	0.888	4.11	4.32	0.02	1.12	0.78	2.4	0.5	0.24	3.37	0	8.1	253	395	3	2	723735	3907090	c2-s1
1383	1308	0.37	3.73	3.86	0.02	0.48	0.76	2.6	0.21	0.29	0.21	3.02	7.5	231	361	3	4	740181	3902398	c2-s1
1383	1308	0.177	3.33	3.61	0.02	0.23	0.71	2.65	0.26	0.14	2.73	0.2	8.2	216	338	3	4	738956	3895488	c2-s1
1383	1308	0.283	3.1	3.43	0.02	0.35	0.76	2.3	0.25	0.21	2.64	0	8	208	325	3	4	737126	3900330	c2-s1
1383	1308	1.008	8.29	8.65	0.06	1.85	2.44	4.3	1.71	0.58	6	0	7.5	494	760	3	4	743930	3900860	c3-s1
1383	1308	0.659	5.75	6.14	0.01	1.05	1.53	3.55	0.78	0.41	4.56	0	7.5	353	551	3	4	721270	3914600	c2-s1
1383	1308	0.196	5.03	5.36	0.03	0.31	1.12	3.9	0.25	0.16	4.62	0	7.75	309	483	3	1	713780	3903247	c2-s1
1383	1308	0.146	3.72	3.95	0.01	0.2	0.89	2.85	0.08	0.14	3.5	0	7.95	233	364	3	3	702540	3916700	c2-s1
1383	1308	0.847	3.14	3.67	0.01	0.98	0.58	2.1	0.08	0.16	2.9	0	8.1	224	350	3	2	725157	3900679	c2-s1
1383	1308	0.499	4.45	4.66	0.02	0.7	0.94	3	0.31	0.21	3.93	0	8	269	421	3	2	725720	3901389	c2-s1
1383	1308	0.485	3.41	4.02	0.01	0.63	0.98	2.4	0.23	0.18	3	0	8	243	379	3	2	733070	3895843	c2-s1
1383	1308	0.19	3.1	3.43	0.01	0.24	0.73	2.45	0.13	0.13	2.84	0	8.15	204	319	3	2	727551	3895375	c2-s1
1383	1308	0.322	4.6	5.14	0.01	0.49	1.04	3.6	0.19	0.19	4.22	0	7.9	300	469	3	2	723050	3894485	c2-s1
1383	1308	0.302	4.41	4.9	0.01	0.45	1.04	3.4	0.15	0.33	3.93	0	8	292	456	3	2	723430	3891200	c2-s1
1383	1308	0.215	4.42	4.77	0.01	0.32	0.99	3.45	0.14	0.16	4.12	0	8.05	280	437	3	2	738650	3894605	c2-s1
1383	1308	0.273	3.66	4.06	0.01	0.37	0.78	2.9	0.1	0.15	3.41	0	7.9	246	384	3	1	708389	3908621	c2-s1
1383	1308	0.171	4.16	4.54	0.01	0.25	1.28	3	0.27	0.15	3.74	0	7.9	262	409	3	3	720654	3899355	c2-s1
1383	1308	0.664	5.35	5.56	0.02	1	1.09	3.45	0.85	0.23	4.27	0	7.8	320	500	3	2	734305	3901535	c2-s1
1383	1308	1.569	5.39	5.58	0.03	2.07	0.83	2.65	0.88	0.34	4.17	0	8	333	521	3	2	728977	3906429	c2-s1
1383	1308	0.218	5.28	5.55	0.02	0.35	0.93	4.25	0.27	0.13	4.88	0	8	321	501	3	2	725459	3890074	c2-s1
1383	1308	0.615	5.52	5.76	0.03	0.95	1.48	3.3	2.63	0.44	2.25	0.2	8.1	343	536	3	24	752752	3899514	c2-s1
1383	1308	0.214	3.55	3.98	0.01	0.29	1.03	2.65	0.42	0.15	2.98	0	8.2	236	369	3	24	748752	3897406	c2-s1
1383	1308	0.749	3.86	4.22	0.05	0.95	0.92	2.3	0.83	0.25	2.68	0.1	8.2	254	397	3	11	752206	3892241	c2-s1
1383	1308	0.269	4.66	4.84	0.02	0.4	1.32	3.1	1.04	0.22	3.4	0	8	280	437	3	24	760563	3895006	c2-s1
1383	1308	1.136	4.73	5.17	0.07	1.52	1.08	2.5	1.52	0.28	2.93	0	8.1	308	481	3	17	763866	3890804	c2-s1
1383	1308	0.472	2.98	3.29	0.02	0.55	0.72	2	0.23	0.2	2.35	0.2	8.2	198	310	3	24	749622	3897740	c2-s1
1383	1308	0.789	6.16	6.47	0.02	1.27	1.38	3.8	1.92	0.4	3.84	0	8.1	381	596	3	24	758789	3900700	c2-s1
1383	1308	0.574	7.15	7.49	0.02	1.03	1.79	4.65	3.06	0.3	3.79	0	8	432	675	3	17	764707	3897226	c2-s1
1383	1308	0.357	4.8	5.14	0.02	0.54	1.18	3.4	1	0.25	3.55	0	7.9	300	468	3	11	756298	3895744	c2-s1
1383	1308	1.015	3.76	3.87	0.04	1.17	0.56	2.1	0.73	0.19	2.64	0.2	8.2	228	356	3	27	767082	3894043	c2-s1
1383	1308	0.646	3.87	4.06	0.02	0.82	0.87	2.35	0.46	0.19	3.02	0.2	8.25	240	375	3	17	764752	3895407	c2-s1
1383	1308	0.318	3.56	3.92	0.02	0.42	0.93	2.55	0.23	0.16	2.97	0.2	8.2	232	363	3	17	759864	3892812	c2-s1
1383	1308	0.174	4.39	4.76	0.02	0.26	1.18	3.3	0.38	0.22	3.79	0	8	274	428	3	11	755182	3891377	c2-s1
1383	1308	0.302	3.28	3.56	0.02	0.38	0.86	2.3	0.19	0.21	2.88	0	8.1	211	329	3	11	762106	3892669	c2-s1
1383	1308	2.419	7.91	8.41	0.03	3.7	1.43	3.25	2.73	0.81	4.37	0	8	492	757	3	21	232797	3879143	c3-s1
1383	1308	1.296	4.6	5.1	0.06	1.68	1.06	2.3	0.92	0.31	2.97	0.4	8.5	302	472	3	18	767032	3887036	c2-s1
1383	1308	0.259	3.48	3.61	0.02	0.33	0.76	2.5	0.23	0.13	2.92	0.2	8.15	210	328	3	18	769492	3883039	c2-s1
1383	1308	0.445	6.64	6.99	0.07	0.78	1.49	4.65	0.5	0.33	5.81	0	7.4	401	626	3	18	772553	3883560	c2-s1
1383	1308	0.805	6.35	6.58	0.06	1.3	1.47	3.75	1.13	0.42	4.8	0	6.1	378	591	3	20	771354	3883952	c2-s1
1383	1308	0.739	8.99	9.29	0.03	1.46	2.5	5.3	0.96	0.54	7.49	0	7.1	525	807	3	18	769593	3879890	c3-s1
1383	1308	3.388	29.05	29.96	0.06	10.54	11.46	7.9	11.88	5.17	12	0	7.2	1679	2506	3	20	232525	3882383	c4-s1
1383	1308	1.729	5.3	5.83	0.07	2.28	1.18	2.3	1.31	0.68	3.31	0	7.7	348	543	3	17	768954	3889483	c2-s1
1383	1308	1.269	7.33	7.78	0.08	2.12	2.13	3.45	1.69	0.7	4.94	0	8.1	448	700	3	18	768851	3888166	c2-s1
1383	1308	2.118	5.89	6.54	0.07	2.85	1.12	2.5	1.8	0.54	3.55	0	8.05	388	606	3	17	768235	3889483	c2-s1
1383	1308	2.95	31.46	32.37	0.61	9.78	11.38	10.6	9.06	3.2	19.2	0	6.2	1679	2506	3	20	768615	3887014	c4-s1
1383	1308	1.687	5.04	5.3	0.02	2.12	0.86	2.3	1.44	0.28	3.12	0.2	8.3	313	489	3	17	232471	3882394	c2-s1
1383	1308	0.212	3.28	3.55	0.02	0.27	0.71	2.55	0.28	0.12	2.88	0	8.2	209	326	3	18	769492	3883039	c2-s1
1383	1308	1.016	17.06	17.24	0.18	2.72	4.44	9.9	3.29	1.29	12.48	0	6.7	937	1420	3	18	772266	3885214	c3-s1
1383	1308	0.323	4	4.34	0.01	0.45	1.03	2.85	0.27	0.18	3.55	0	8.1	254	397	3	22	772000	3871648	c2-s1
1383	1308	0.252	5.36	5.71	0.02	0.41	1.38	3.9	0.52	0.19	4.65	0	6.8	330	516	3	22	772745	3877160	c2-s1
1383	1308	3.106	39.66	40.42	0.92	11.6	9.85	18.05	8.44	5.49	25.73	0	7	2080	3104	3	21	227803	3891672	c4-s1
1383	1308	2.099	22.65	23.17	0.24	6.09	3.99	12.85	7.19	1.88	13.58	0	7.05	1246	1859	3	21	229501	3888864	c3-s1
1383	1308	0.846	4.17	4.36	0.02	1.08	0.76	2.5	0.44	0.23	3.5	0	8	254	397	3	22	230431	3872680	c2-s1
1383	1308	2.268	14.09	14.45	0.26	4.89	4.45	4.85	3.67	1.49	8.93	0	7.4	811	1229	3	21	231477	3893115	c3-s1
1383	1308	2.094	8.28	8.57	0.02	3.37	1.78	3.4	3.48	0.62	4.18	0	7.8	398	622	3	22	230157	3875714	c2-s1
1383	1308	2.628	15.09	15.98	0.13	5.87	2.93	7.05	8	1.81	5.28	0	7.5	937	1420	3	21	230721	3890510	c3-s1
1383	1308	3.349	26.03	26.88	0.04	9.78	10.96	6.1	7.73	4.38	13.92	0	6.8	1475	2202	3	20	231541	3882018	c3-s1
1383	1308	1.939	9.37	10.02	0.1	3.48	2.99	3.45	3.18	1.1	5.09	0	8.1	592	910	3	21	234549	3890852	c3-s1
average		62.498	506.3	533.73	4.12	121.61	132.95	275.05	107.67	46.78	346.53	5.32	570.6	30246	46507					
		0.86	6.94	7.31	0.06	1.67	1.82	3.77	1.47	0.64	4.75	0.07	7.82	414.33	637.08					

Appendix 8 Results of Water Quality Test (2001 -2006) (20/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1308	0.254	4.05	4.63	0.02	0.37	0.99	3.25	0.21	0.21	3.63	0	7.9	268	419	3	11	708178	3914615	c2-s1
1384	1308	0.212	3.44	3.78	0.02	0.28	0.73	2.75	0.17	0.12	3.15	0	8	223	348	3	11	709040	3916303	c2-s1
1384	1308	0.769	3.94	4.17	0.02	0.97	0.83	2.35	0.25	0.15	3.24	0.3	8.3	240	375	3	11	714782	3908807	c2-s1
1384	1308	0.412	4.62	4.86	0.02	0.6	1.09	3.15	0.48	0.34	3.8	0	8	287	448	3	11	720222	3908902	c2-s1
1384	1308	0.405	4.48	5.16	0.01	0.61	1.44	3.1	0.35	0.23	3.9	0	8.1	304	475	3	11	714535	3913957	c2-s1
1384	1308	0.373	3.99	4.27	0.02	0.51	0.84	2.9	0.23	0.15	3.61	0	8	252	393	3	8	719385	3906305	c2-s1
1384	1308	0.242	4.27	4.54	0.01	0.35	1.23	2.95	0.23	0.15	3.89	0	8.1	266	416	3	8	715693	3900914	c2-s1
1384	1308	0.264	4.55	5	0.02	0.4	1.13	3.45	0.23	0.19	4.13	0	8.1	293	458	3	8	717877	3902553	c2-s1
1384	1308	0.2	5.04	5.48	0.02	0.32	1.24	3.9	0.46	0.23	4.35	0	7.8	314	491	3	8	710563	3901021	c2-s1
1384	1308	0.245	4.56	4.96	0.01	0.37	1.23	3.35	0.25	0.16	3.85	0.3	8.15	286	447	3	8	713482	3898011	c2-s1
1384	1308	0.107	3.9	4.11	0.02	0.15	0.89	3.05	0.23	0.15	3.52	0	7.9	241	377	3	8	700753	3911774	c2-s1
1384	1308	0.332	3.86	4.31	0.01	0.46	0.99	2.85	0.23	0.19	3.14	0.3	8.25	257	401	3	8	718439	3900281	c2-s1
1384	1308	0.208	3.21	3.67	0.02	0.27	0.98	2.4	0.15	0.16	2.7	0.2	8.2	221	346	3	9	744750	3896455	c2-s1
1384	1308	0.497	3.48	3.97	0.01	0.64	0.72	2.6	0.19	0.18	3.11	0	8	241	376	3	10	720505	3903721	c2-s1
1384	1308	2.005	6.07	6.2	0.02	2.66	0.97	2.55	1.23	0.35	4.39	0.1	8.2	360	562	3	10	733535	3905420	c2-s1
1384	1308	0.679	3.95	4.17	0.02	0.87	0.83	2.45	0.29	0.21	3.45	0	7.9	243	380	3	10	723735	3907090	c2-s1
1384	1308	0.354	3.59	3.86	0.02	0.46	0.83	2.55	0.31	0.21	3.07	0	8	231	361	3	9	740181	3902398	c2-s1
1384	1308	0.171	3.31	3.56	0.02	0.22	0.72	2.6	0.23	0.14	2.74	0.2	8.15	214	335	3	9	738956	3895488	c2-s1
1384	1308	0.278	3.16	3.55	0.02	0.35	0.78	2.4	0.27	0.24	2.65	0	8.1	216	337	3	9	737126	3900330	c2-s1
1384	1308	1.026	8.45	8.82	0.06	1.9	2.31	4.55	1.79	0.58	6.08	0	7.6	498	766	3	9	743930	3900860	c3-s1
1384	1308	0.978	4.76	4.97	0.01	1.32	0.99	2.65	0.71	0.25	3.8	0	8.1	291	454	3	11	721270	3914600	c2-s1
1384	1308	0.246	4.46	4.93	0.02	0.37	1.09	3.45	0.25	0.21	3.7	0.3	8.2	289	452	3	8	713780	3903247	c2-s1
1384	1308	0.146	3.68	3.95	0.01	0.2	0.94	2.8	0.21	0.13	3.34	0	8	234	365	3	11	702540	3916700	c2-s1
1384	1308	0.814	3.23	3.75	0.01	0.96	0.68	2.1	0.21	0.17	2.65	0.2	8.2	227	355	3	10	725157	3900679	c2-s1
1384	1308	0.475	4.38	4.67	0.02	0.67	1.08	2.9	0.23	0.2	3.95	0	8	270	422	3	10	725720	3901389	c2-s1
1384	1308	0.708	3.26	3.74	0.01	0.85	0.88	2	0.23	0.18	2.65	0.2	8.3	224	350	3	10	733070	3895843	c2-s1
1384	1308	0.185	2.66	2.81	0.02	0.21	0.58	2	0.12	2.14	0.2	0.2	8.35	169	269	3	10	727551	3895375	c2-s1
1384	1308	0.315	4.56	5.13	0.01	0.48	1.09	3.55	0.23	0.16	4.17	0	8	299	467	3	10	723050	3894485	c2-s1
1384	1308	0.307	4.34	4.95	0.01	0.46	0.98	3.5	0.25	0.33	3.66	0.1	8.2	298	465	3	10	723430	3891200	c2-s1
1384	1308	0.222	4.33	4.79	0.02	0.33	1.09	3.35	0.27	0.17	3.79	0.1	8.2	280	437	3	10	738650	3894605	c2-s1
1384	1308	0.231	3.76	4.18	0.02	0.32	0.99	2.85	0.23	0.14	3.39	0	8	244	381	3	8	708389	3908621	c2-s1
1384	1308	0.176	3.83	4.3	0.01	0.25	1.19	2.85	0.29	0.14	3.2	0.2	8.3	248	388	3	8	720654	3899355	c2-s1
1384	1308	0.665	5.13	5.34	0.02	0.98	1.04	3.3	0.69	0.23	4.21	0	8	312	487	3	9	734305	3901535	c2-s1
1384	1308	1.265	4.85	4.97	0.02	1.63	0.87	2.45	0.94	0.2	3.51	0.2	8.2	292	457	3	10	728977	3906429	c2-s1
1384	1308	0.291	5.15	5.48	0.02	0.46	1.05	3.95	0.23	0.15	4.77	0	7.9	315	492	3	10	725459	3890074	c2-s1
1384	1308	0.721	3.75	4.04	0.02	0.9	0.92	2.2	1.19	0.34	2.02	0.2	8.2	248	388	3	20	752752	3899514	c2-s1
1384	1308	0.168	3.54	3.98	0.01	0.23	1.09	2.65	0.33	0.16	2.85	0.2	8.2	237	370	3	20	748752	3897406	c2-s1
1384	1308	0.28	4.54	4.71	0.02	0.41	1.13	3.15	0.85	0.23	3.46	0	7.85	278	435	3	20	760563	3895006	c2-s1
1384	1308	1.091	4.75	5.11	0.07	1.46	1.13	2.45	1.62	0.32	2.81	0	8	312	487	3	21	763866	3890804	c2-s1
1384	1308	0.491	2.93	3.29	0.02	0.57	0.75	1.95	0.19	0.2	2.54	0	8.15	197	308	3	20	749622	3897740	c2-s1
1384	1308	0.593	7.73	8.13	0.02	1.11	2.1	4.9	3.6	0.3	3.83	0	7.8	471	725	3	21	764707	3897226	c2-s1
1384	1308	0.376	4.56	4.86	0.03	0.55	1.13	3.15	0.92	0.26	2.88	0.5	8.4	285	445	3	20	756298	3895744	c2-s1
1384	1308	0.996	3.71	3.79	0.03	1.14	0.62	2	0.69	0.2	2.62	0.2	8.15	228	357	3	21	767082	3894043	c2-s1
1384	1308	0.673	3.83	3.98	0.02	0.84	0.82	2.3	0.5	0.19	2.94	0.2	8.2	236	368	3	21	764752	3895407	c2-s1
1384	1308	0.385	3.49	3.91	0.03	0.5	0.93	2.45	0.5	0.17	2.62	0.2	8.2	234	365	3	23	759864	3892812	c2-s1
1384	1308	0.17	3.98	4.24	0.02	0.24	0.98	3	0.29	0.14	3.55	0	8	245	383	3	20	755182	3891377	c2-s1
1384	1308	0.301	3.33	3.58	0.02	0.38	0.83	2.35	0.19	0.24	2.9	0	8	212	331	3	21	762106	3892669	c2-s1
1384	1308	2.189	7.83	8.14	0.03	3.37	1.49	3.25	2.65	0.8	4.38	0	8	492	757	3	21	232797	3879143	c3-s1
1384	1308	0.272	3.35	3.48	0.02	0.34	0.72	2.4	0.25	0.14	2.66	0.3	8.3	205	320	3	22	769492	3883039	c2-s1
1384	1308	0.422	6.47	6.8	0.07	0.73	1.55	4.45	0.71	0.36	5.4	0	7	390	610	3	22	772553	3883560	c2-s1
1384	1308	0.835	6.6	6.72	0.06	1.36	1.45	3.85	1.17	0.43	5	0	6.3	385	602	3	22	771354	3883952	c2-s1
1384	1308	0.844	9.22	9.64	0.04	1.68	2.52	5.4	1.17	0.55	7.5	0	7.25	536	824	3	22	769593	3879890	c3-s1
1384	1308	3.162		27.42	0.06	9.46	10.95	6.95	6.62	10.2	0	0	7.1	1566	2338	3	21	232525	3882383	c4-s1
1384	1308	2.003	5.27	5.97	0.07	2.58	1.07	2.25	1.44	0.7	3.13	0	8	349	546	3	23	768954	3889483	c2-s1
1384	1308	1.53	7.86	8.28	0.07	2.57	2.14	3.5	2.02	0.64	5.2	0	8.1	462	710	3	22	768851	3888166	c2-s1
1384	1308	2.354	6.08	6.79	0.06	3.15	1.08	2.5	1.98	0.54	3.26	0.3	8.2	391	611	3	23	768235	3889483	c2-s1
1384	1308	0.546	5.3	5.73	0.04	0.85	1.49	3.35	0.73	0.27	4.3	0	7.6	335	524	3	22	768615	3887014	c2-s1
1384	1308	0.211	3.33	3.57	0.02	0.27	0.73	2.55	0.29	0.14	2.9	0	8.05	213	333	3	22	769492	3883039	c2-s1
1384	1308	0.33	3.98	4.35	0.01	0.46	1.08	2.8	0.27	0.19	3.22	0.3	8.25	255	399	3	22	772000	3871648	c2-s1
1384	1308	0.255	5.47	5.88	0.02	0.42	1.39	4.05	0.42	0.21	4.84	0	6.75	341	533	3	22	772745	3877160	c2-s1
1384	1308	3.677	8.72	16	0.18	7.5	3.12	5.2	1.65	5.27	0.9	0.9	8.5	880	1333	3	23	227803	3891672	c3-s1
1384	1308	2.325	20.42	21.25	0.27	6.3	3.53	11.15	5.9	1.98	12.54	0	7.5	1117	1692	3	23	229501	3888864	c3-s1
1384	1308	2.288	7.32	7.74	0.03	3.37	1.34	3	2.08	1.37	3.87	0	8	438	685	3	22	230431	3872680	c2-s1
1384	1308	2.833	15.87	16.11	0.33	6.2	4.13	5.45	3.52	1.65	10.7	0	6.75	911	1381	3	23	231477	3893115	c3-s1
1384	1308	1.017	6.55	6.86	0.02	1.64	1.7	3.5	1.88	0.62	4.05	0	8	399	624	3	22	230157	3875714	c2-s1
1384	1308	2.165	27.1	27.15	0.28	6.85	5.12	14.9	6.65	1.73	18.72	0	6.5	1401	2091	3	23	230721	3890510	c3-s1
1384	1308	3.806	39.85	40.69	0.06	13.91	6.77	19.95	8.1	8.38	23.37	0	6.8	2139	3192	3	21	231541	3882018	c4-s2
1384	1308	1.677	8.93	9.45	0.1	2.99	3.01	3.35	2.78	0.99	5.16	0	8.1	566	870	3	23	234549	3890852	c3-s1
1384	1308	0.282	3.4	3.82	0.01	0.37	0.71	2.73	0.12	0.16	3.12	0	8	231	361	7	27	708178	3914615	c2-s1
1384	1308	0.221	3.45	3.75	0.02	0.29	0.71	2.73	0.18	0.15	3.12	0	7.9	220	343	7	27	709040	3916303	c2-s1
1384	1308	0.664	3.92	4.15	0.02	0.85	0.75	2.53	0.27	0.15	3.2	0.3	8.1	237	371	7	27	714782	3908807	c2-s1
1384	1308	0.385	4.4	4.5	0.02	0.54	1.06	2.88	0.58	0.19	3.63	0	8	256	400	7	27	720222	3908902	c2-s1
1384	1308	0.421	4.37	4.97	0.01	0.62	1.41	2.93	0.65	0.19	3.53	0	7.85	294	460	7	27	714535	3913957	c2-s1
1384	1308	0.395	4.01	4.3	0.02	0.54	0.81	2.93	0.31	0.17	3.53	0	7.9	250	390	7	27	719385	3906305	c2-s1
1384	1308	0.26	5.01	5.39	0.02	0.41	1.48	3.48	0.27	0.24	4.5	0	8	309	483	7	27	715693	3900914	c2-s1
1384	1308	0.243	4.14	4.51	0.02	0.35	1.06	3.08	0.27	0.15	3.72	0	7.9	259	405	7	27	717877	3902553	c2-s1
1384	1308	0.218	4.74	4.95	0.02	0.33	1.06	3.54	0.5	0.19	4.05	0	7.9	284	444	7	27	710563	3901021	c2-s1
1384	1308	0.251	4.69	4.99	0.01	0.38	1.17	3.43	0.08	0.42	4.19	0	8	292	456	7	27	713482	3898011	c2-s1
1384	1308	0.112	4.05	4.27	0.01	0.16	0.97	3.13	0.29	0.13	3.63	0	7.9	241	377	7	26	700753	3911774	c2-s1
1384	1308	0.329	3.84	4.37	0.01	0.46	0.87	3.03	0.17	0.18	3.49	0	8	255	399	7	26	718439	3900281	c2-s1
1384	1308	0.211	3.13	3.56	0.01	0.27	0.91	2.37	0.13	0.16	2.84	0	8.1	220	343	7	30	744750	3896455	c2-s1
1384	1308	0.511	3.49	4.01	0.01	0.66	0.71	2.63	0.2	0.17	3.12	0	8	240	375	7	27	720505	3903721	c2-s1
1384	1308	2.988	8.18	8.61	0.02	4.35	1.06	3.18	3.38	0.99	3.81	0	8	545	838	7	28	733535	3905420	c3-s1
1384	1308	0.711	4.07	4.21	0.02	0.91	1.01	2.27	0.47	0.21	3.39	0	7.9	244	381	7	27	723735	3907090	c2-s1
1384	1308	0.343	3.57	3.91	0.02	0.45	0.86	2.58	0.34	0.21	3.02	0	8.1	231	361	7	30	740181	3902398	c2-s1
1384	1308	0.185	3.46	3.64	0.02	0.24	0.65	2.73	0.29	0.15	3.02	0	8.1	215	336	7	30	738956	3895488	c2-s1
1384	1308	0.262	3.11	3.53	0.02	0.33	0.71	2.47	0.32	0.24	2.55	0	8	214	335	7	30	737126	3900330	c2-s1
1384	1308	0.998	8.43	8.79	0.06	1.85	2.44	4.44	1.76	0.57	6.1	0	7.45	500	769	7	30	743930	3900860	c3-s1
1384	1308	0.632	4.92	5.17	0.01	0.92	1.21	3.03	0.5	0.23	4.19	0	7.7	299	467	7	27	721270	3914600	c2-s1
1384	1308	0.24	4.47	4.88	0.02	0.36	0.91	3.59	0.33	0.23	3.91	0	8	292	456	7	26	713780	3903247	c2-s1
1384	1308	0.146	3.67	3.95	0.01	0.2	0.91	2.83	0.17	0.15	3.35	0	7.95	234	365	7	27	702540	3916700	c2-s1
1384	1308	0.831	3.24	3.77	0.01	0.98	0.61	2.17	0.19	0.16	2.79	0.1	8.05	224	350	7	28	725157	3900679	c2-s1
1384	1308	0.47	4.38	4.62	0.02	0.66	1.01	2.93	0.33	0.19	3.86	0	7.9	268	419	7	28	725720	3901389	c2-s1
1384	1308	0.385	3.33	3.74	0.01	0.49	0.87	2.37	0.26	0.14	2.93	0	8.1	224	350	7	28	733070	3895843	c2-s1
1384	1308	0.222	3.77	3.95	0.01	0.3	0.86	2.78	0.15	2.82	0.4	0.4	8.4	234	365	7	28	727551	3895375	c2-s1
1384	1308	0.327	4.47	5	0.01	0.49	1.02	3.48	0.17	0.19	3.81	0.3	8.15	291	455	7	28	723050	3894485	c2-s1
1384	1308	0.292	4.41	4.99	0.01	0.44	0.94	3.6	0.31	0.32	3.78	0	7.9	295	461	7	28	723430	3891200	c2-s1
1384	1308	0.243	4.15	4.5	0.01	0.35	0.81	3.33	0.3	0.17	3.48	0.2	8.3	275	429	7	28	738650	3894605	c2-s1
1384	1308	0.285	3.7	4.14	0.01	0.39	0.81	2.93	0.12	0.18	3.4	0	7.9	246	385	7	29	708389	3908621	c2-s1
1384	1308	0.178	3.5	3.89	0.01	0.24	1.01	2.63	0.33	0.1	3.07	0	8	226	353	7	29	720654	3899355	c2-s1
1384	1308	0.673	5.05	5.24	0.02	0.98	1.01	3.23	0.6	0.22	4.23	0	8	302	472	7	28	734305	3901535	c2-s1
1384	1308	1.594	4.95	5.21	0.02	2.01	0.76	2.42	0.75	0.34	3.86	0	7.9	316	493	7	27	728977	3906429	c2-s1
1384	1308	0.262	5.22	5.59	0.01	0.42	1.12	4.04	0.35	0.17	4.7	0	7.9	318	497	7	28	725459	3890074	c2-s1
1384	1308	0.713	3.76	4.03	0.02	0.89	0.87	2.25	1.19	0.34	2.23	0	7.7	248	388	7	18	752752	3899514	c2-s1
1384	1308	0.157	3.43	3.8	0.01	0.21	1.08	2.5	0.33	0.12	2.98	0	8	227	354	7	18	748752	3897406	c2-s1
1384	1308	0.255	5.06	5.34	0.02	0.4	1.42	3.5	1.35	0.22	3.49	0	7.7	310	484	7	18	760563	3895006	c2-s1
1384	1308	1.069	4.62	4.96	0.07	1.41	0.88	2.6	1.4	0.29	2.93	0	8	305	477	7	16	763866	3890804	c2-s1
1384	1308	1.036	3.27	3.58	0.02	1.14	0.77	1.65	0.5	0.31	2.46	0	7.95	216	337	7	18	749622	3897740	c2-s1
1384	1308	0.766	6.23	6.5	0.02	1.24	1.39	3.85	2.08	0.38	3.77	0	7.7	376	587	7	18	758789	3900700	c2-s1
1384	1308	0.778	6.02	6.34	0.02	1.24	1.63	3.45	2.17	0.35	3.2	0.3	8.2	365	571	7	17	764707	3897226	c2-s1
1384	1308	0.359	4.73	5.08	0.02	0.54	1.17	3.35	0.94	0.26	3.53	0	7.75	301	471	7	18	756298	3895744	c2-s1
1384	1308	0.798	3.81	4.03	0.03	0.98	0.82	2.2	0.48	0.21	2.92	0.2	8.3	233	364	7	18	767082	3894043	c2-s1
1384	1308	0.689	3.8	4	0.02	0.86	0.82	2.3	0.46	0.18	3.16	0	7.9	233	364	7	18	764752	3895407	c2-s1
1384	1308	0.328	3.08	3.23	0.02	0.39	0.92	1.9	0.23	0.11	1.54	1.2	9.2	180	285	7	17	759864	3892812	c2-s1
1384	1308	0.169	4.36	4.65	0.02	0.25	1.03	3.35	0.42	0.22	3.72	0	7.95	275	429	7	18	755182	3891377	c2-s1
1384	1308	0.427	3.65	3.9	0.03	0.55	0.82	2.5	0.54	0.22	2.69	0.2	8.4	230	359	7	17	762106	3892669	c2-s1
1384	1308	2.341	298	9.53	0.04	3.91	1.88	3.7	292	1.2	4.5	0.3	8.4	592	910	7	16	232797	3879143	c3-s1
1384	1308	0.439	6.3	6.65	0.06	0.75	1.34	4.5	0.65	0.35	5.3	0	7.25	382	597	7	17	772553	3883560	c2-s1
1384	1308	0.858	7.77	7.87	0.07	1.52	2.03	4.25	1.63	0.56	5.58	0	6.15	461	709	7	17	771354	3883952	c2-s1
1384	1308	3.128		18.59	0.04	7.39	5.31	5.85	3.67	4.7	0	0	7.5	1080	1636	7	16	232525	3882383	c3-s1
1384	1308	1.56	4.84	5.4	0.07	2.01	1.07	2.25	1.17	0.65	3.02	0	7.7	340	531	7	16	768954	3889483	c2-s1
1384	1308	1.643	7.5	7.43	0.06	2.55	1.72	3.1	2.92	0.63	3.95	0	8.1	462	710	7	16	768851	3888166	c2-s1
1384	1308	1.967	5.71	6.19	0.06	2.61	1.02	2.5	1.73	0.54	3.44	0	8.1	384	600	7	16	768235	3889483	c2-s1
1384	1308	0.537	6.25	6.84	0.04	0.92	1.93	3.95	1	0.51	4.74	0	7.4	399	624	7	17	768615	3887014	c2-s1
1384	1308	0.224	3.1	3.21	0.02	0.27	0.62	2.3	0.29	0.11	2.7	0	8.1	188	298	7	17	769492	3883039	c2-s1
1384	1308	0.343	4.27	4.58	0.01	0.49	1.08	3	0.25	0.17	3.85	0	7.8	261	408	7	17	772000	3871648	c2-s1
1384	1308	0.248	4.68	5.07	0.01	0.38	1.18	3.5	0.4	0.18	4.1	0	7.1	298	466	7	17	772745	3877160	c2-s1
1384	1308	3.168	19.94	20.36	0.31	7.83	3.32	8.9	10.2	3	6.74	0	7.9	1159	1756	7	16	229501	3888864	c3-s1
1384	1308	0.956	4.61	4.7	0.03	1.25	1.07	2.35	0.58	0.22	3.81	0	8.1	280	437	7	17	230431	3872680	c2-s1
1384	1308	2.502	18.54	18.85	0.37	6.2	4.53	7.75	5.52	1.72	11.3	0	7.9	1069	1620	7	16	231477	3893115	c3-s1
1384	1308	1.304	6.37	6.51	0.03	1.96	1.37	3.15	1.75	0.52	3.8	0.3	8.3	383	599	7	17	230157	3875714	c2-s1
1384	1308	2.21	15.85	16.56	0.18	5.22	3.36	7.8	5.44	1.53	8.88	0	6.8	942	1428	7	16	230721	3890510	c3-s1
1384	1308	3.365	26.9	27.71	0.05	10	10.06	7.6	9.73	5.77	11.4	0	6.7	1550	2314	7	16	231541	3882018	c4-s1
1384	1308	1.551	8.72	9.24	0.09	2.77	2.98	3.4	2.56	1	5.16	0	8	566	870	7	16	234549	3890852	c3-s1
1384	1308	0.276	3.34	3.78	0.02	0.36	0.7	2.7	0.21	0.13	3	0	8.1	228	357	7	1	708178	3914615	c2-s1
1384	1308	0.862	4.13	4.31	0.02	1.09	0.7	2.5	0.29	0.2	3.64	0	8	25700	257	7	1	714782	3908807	c2-s1
1384	1308	0.4	4.3	4.96	0.01	0.59	1.21	3.15	0.38	0.17	3.75	0	8.1	296	462	7	1	714535	3913957	c2-s1
1384	1308	0.226	4.27	4.6	0.01	0.33	1.26	3	0.27	0.13	3.87	0	8.05	268	418	7	1	715693	3900914	c2-s1
1384	1308	0.19	4.33	4.65	0.01	0.28	1.11	3.25	0.23	0.13	3.97	0	7.9	271	424	7	1	710563	3901021	c2-s1
1384	1308	0.1	3.88	4.11	0.01	0.14	0.76	3.2	0.27	0.11	3.5	0	8	242	378	7	1	700753	3911774	c2-s1
1384	1308	0.201	3.14	3.63	0.01	0.26	0.96	2.4	0.15	0.18	2.81	0	8.1	220	344	7	1	744750	3896455	c2-s1
1384	1308	2.002	5.84	6.03	0.02	2.61	0.75	2.65	0.98	0.43	4.43	0	7.9	362	566	7	1	733535	3905420	c2-s1
1384	1308	0.265	3.11	3.45	0.02	0.33	0.75	2.35	0.25	0.23	2.63	0	8.1	213	333	7	1	737126	3900330	c2-s1
1384	1308	0.953	4.53	4.77	0.01	1.26	0.9	2.6	0.46	0.23	3.84	0	8.05	283	442	7	1	721270	3914600	c2-s1
1384	1308	0.131	3.64	3.95	0.01	0.18	0.96	2.8	0.17	0.12	3.35	0	7.9	235	367	7	1	702540	3916700	c2-s1
1384	1308	0.451	4.29	4.55	0.02	0.63	1.05	2.85	0.23	0.16	3.9	0	7.9	265	414	7	1	725720	3901389	c2-s1
1384	1308	0.261	3.11	3.33	0.01	0.32	0.65	2.35	0.21	0.13	2.77	0	8.15	204	319	7	1	727551	3895375	c2-s1
1384	1308	0.287	4.36	4.94	0.01	0.43	1	3.5	0.25	0.33	3.78	0	7.85	298	465	7	1	723430	3891200	c2-s1
1384	1308	0.192	3.89	4.24	0.01	0.27	0.91	3.05	0.21	0.13	3.55	0	8	252	394	7	1	708389	3908621	c2-s1
1384	1308	0.652	4.9	5.12	0.02	0.94	1.01	3.15	0.44	0.22	4.24	0	8.2	303	474	7	1	734305	3901535	c2-s1
1384	1308	0.326	5.54	6.05	0.01	0.54	1.3	4.2	0.27	0.27	5	0	8	352	550	7	1	725459	3890074	c2-s1
average		117.48	1130.4	946.74	5.42	208.86	213.86	518.6	450.31	89.55	605.75	10	1196.5	80269	84580					
		0.78	7.49	6.27	0.04	1.38	1.42	3.43	2.98	0.59	4.01	0.07	7.92	531.58	560.13					

Appendix 8 Results of Water Quality Test (2001 -2006) (21/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1385	1308	0.672	3.78	4.07	0.02	0.85	0.85	2.35	1.25	0.32	2.21	0	8.15	258	403	7	25	752752	3899514	c2-s1
1385	1308	0.162	3.5	3.93	0.01	0.22	1.05	2.65	0.27	0.13	2.9	0.2	8.25	234	365	7	25	748752	3897406	c2-s1
1385	1308	0.275	4.47	4.64	0.02	0.4	1.17	3.05	0.9	0.2	3.37	0	8	278	435	7	25	760563	3895006	c2-s1
1385	1308	1.108	4.68	5.06	0.07	1.47	0.97	2.55	1.6	0.28	2.8	0	8	311	486	7	25	763866	3890804	c2-s1
1385	1308	0.406	3.02	3.3	0.02	0.48	0.85	1.95	0.21	0.17	2.44	0.2	8.2	198	310	7	25	749622	3897740	c2-s1
1385	1308	0.57	7.27	7.72	0.02	1.04	1.91	4.75	3.27	0.27	3.73	0	7.9	447	698	7	25	764707	3897226	c2-s1
1385	1308	0.352	4.59	4.9	0.02	0.52	1.16	3.2	0.9	0.23	3.46	0	8	293	458	7	25	756298	3895744	c2-s1
1385	1308	0.633	3.69	4.02	0.02	0.8	0.95	2.25	0.35	0.21	3.13	0	8.15	242	378	7	25	767082	3894043	c2-s1
1385	1308	0.715	3.64	3.85	0.02	0.87	0.86	2.1	0.29	0.15	3.2	0	8.15	225	352	7	25	764752	3895407	c2-s1
1385	1308	0.304	3.53	3.88	0.02	0.4	0.96	2.5	0.23	0.15	3.15	0	7.9	229	358	7	25	759864	3892812	c2-s1
1385	1308	0.163	4.29	4.62	0.02	0.24	1.06	3.3	0.27	0.19	3.83	0	8.1	273	427	7	25	755182	3891377	c2-s1
1385	1308	0.287	3.58	3.9	0.02	0.38	0.9	2.6	0.21	0.23	3.14	0	8	234	366	7	25	762106	3892669	c2-s1
1385	1308	2.239	8.75	9.19	0.03	3.7	1.71	3.75	3.12	0.98	4.65	0	7.8	572	880	7	27	232797	3879143	c3-s1
1385	1308	0.266	3.07	3.24	0.02	0.32	0.65	2.25	0.25	0.11	2.71	0	8.1	192	300	7	1	769492	3883039	c2-s1
1385	1308	1.074	13.78	13.99	0.16	2.55	3.73	7.55	4.08	0.39	9.31	0	6.4	803	1216	7	1	772553	3883560	c3-s1
1385	1308	0.866	7.04	7.3	0.07	1.47	1.86	3.9	1.44	0.51	5.09	0	6.2	422	659	7	1	771354	3883952	c2-s1
1385	1308	0.68	9.85	10.84	0.03	1.47	3.14	6.2	0.69	0.59	8.57	0	7	614	944	7	2	769593	3879890	c3-s1
1385	1308	3.11		26.96	0.06	9.24	10.66	7	6.25	9.87	0	0	7	1560	2328	7	27	232471	3882394	c4-s1
1385	1308	1.636	4.93	5.55	0.07	2.12	1.06	2.3	1.21	0.74	2.98	0	7.9	349	546	7	1	768954	3889483	c2-s1
1385	1308	2.099	6.55	7.11	0.06	2.99	1.41	2.65	2.26	0.51	3.78	0	8	408	637	7	27	768235	3889483	c2-s1
1385	1308	1.05	6.1	6.51	0.06	1.63	1.92	2.9	1.02	0.27	4.81	0	7.5	389	608	7	1	768615	3887014	c2-s1
1385	1308	1.551	4.97	5.13	0.02	1.95	0.91	2.25	1.38	0.27	3.32	0	8.25	312	488	7	28	232471	3882394	c2-s1
1385	1308	0.21	3.07	3.34	0.02	0.26	0.66	2.4	0.25	0.11	2.71	0	8.1	199	311	7	1	769492	3883039	c2-s1
1385	1308	0.502	5.26	5.63	0.03	0.78	1.12	3.7	0.31	0.32	4.63	0	7.5	353	552	7	1	772266	3885214	c2-s1
1385	1308	0.321	3.92	4.38	0.01	0.45	1.12	2.8	0.25	0.17	3.5	0	7.5	260	406	7	2	772000	3871648	c2-s1
1385	1308	0.247	10.64	11.24	0.03	0.57	2.29	8.35	0.25	0.16	10.23	0	6.1	645	992	7	2	772745	3877160	c3-s1
1385	1308	3.331	14.38	15.48	0.17	6.85	3.06	5.4	7.19	1.93	5.26	0	8	961	1456	7	27	227803	3891672	c3-s1
1385	1308	2.019	19.85	20.15	0.26	5.43	3.51	10.95	5.73	1.86	12.26	0	6.5	1114	1688	7	27	229501	3888864	c3-s1
1385	1308	2.49	7.48	7.58	0.03	3.53	1.22	2.8	2.17	1.92	3.39	0	7.9	489	752	7	2	230431	3872680	c3-s1
1385	1308	2.162	13.63	13.72	0.26	4.56	4.25	4.65	3.4	1.33	8.9	0	7.4	813	1232	7	27	231477	3893115	c3-s1
1385	1308	1.296	7.81	8.17	0.02	2.23	2.17	3.75	2.56	0.99	4.26	0	7.8	495	762	7	27	230157	3875714	c3-s1
1385	1308	3.366	25.02	25.25	0.04	9.45	7.76	8	10.35	5.59	9.08	0	7	1479	2208	7	27	231541	3882018	c3-s1
1385	1308	1.57	8.88	9.43	0.1	2.83	3.1	3.4	2.79	0.97	5.12	0	8.15	572	880	7	27	234549	3890852	c3-s1
1385	1308	0.216	3.4	3.66	0.02	0.28	0.66	2.7	0.17	0.09	3.14	0	8.1	219	342	7	4	709040	3916303	c2-s1
1385	1308	0.372	4.23	4.44	0.02	0.52	0.95	2.95	0.33	0.22	3.68	0	7.9	260	407	7	4	720222	3908902	c2-s1
1385	1308	0.382	3.96	4.24	0.02	0.52	0.75	2.95	0.21	0.15	3.6	0	7.9	255	398	7	4	719385	3906305	c2-s1
1385	1308	0.232	3.97	4.41	0.02	0.33	1.06	3	0.21	0.12	3.64	0	7.9	261	408	7	4	717877	3902553	c2-s1
1385	1308	0.217	4.61	6.53	0.01	0.38	1.2	4.94	0.25	0.16	4.2	0	8	291	455	7	4	713482	3898011	c2-s1
average		39.151	255.19	297.36	1.92	74.08	74.62	146.74	67.87	32.86	170.18	0.4	292.7	17509	26891					
		1.03	6.72	7.83	0.05	1.95	1.96	3.86	1.79	0.86	4.48	0.01	7.70	460.76	707.66					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1309	0.205	4.19	4.59	0.01	0.3	0.68	3.6	0.42	0.36	3.41	0	7.9	270	422	3	31	732405	3974231	c2-s1
1383	1309	0.562	10.57	11.28	0.13	1.25	2.5	7.4	3.24	1.86	5.47	0	7.6	664	1021	3	31	731563	3979933	c3-s1
1383	1309	0.201	5.3	5.99	0.28	0.33	1.08	4.3	0.81	0.6	3.89	0	7.8	362	565	3	31	732658	3977345	c2-s1
1383	1309	1.149	7.29	7.8	0.02	1.96	1.22	4.6	2.56	1.61	3.12	0	8	480	738	3	31	735040	3979040	c2-s1
1383	1309	2.617	6	6.55	0.01	3.32	0.62	2.6	2.43	0.3	2.87	0.4	8.4	391	611	3	31	737765	3980213	c2-s1
1383	1309	0.665	5.01	5.54	0.02	1	0.87	3.65	0.35	0.77	3.89	0	8.05	337	526	3	31	739608	3975555	c2-s1
1383	1309	0.994	5.74	6.22	0.02	1.52	0.83	3.85	2.13	0.35	3.26	0	8	372	582	3	31	742741	3977828	c2-s1
1383	1309	2.088	9.46	10	0.02	3.7	1.23	5.05	5.52	0.49	3.45	0	8.1	607	934	3	31	743729	3976811	c3-s1
1383	1309	1.326	9.4	9.97	0.02	2.55	1.45	5.95	5.15	0.51	3.74	0	7.9	602	926	3	31	744371	3979165	c3-s1
1383	1309	2.225	13.77	14.57	0.02	4.89	1.91	7.75	9.3	1.2	3.07	0.2	8.2	848	1285	3	31	747650	3978405	c3-s1
1383	1309	3.458	21.9	44.44	22.25	8.91	3.68	9.6	14.08	3.93	3.89	0	7.8	1283	1915	3	31	746936	3969763	c3-s1
1383	1309	0.172	3.59	7.63	3.82	0.23	0.73	2.85	0.38	0.09	3.12	0	8.15	225	351	3	31	750307	3984350	c2-s1
1383	1309	0.179	5.1	10.41	5.21	0.28	0.82	4.1	0.4	0.05	4.65	0	8	296	462	3	31	740264	3970897	c2-s1
average		15.841	107.32	144.99	31.83	30.24	17.62	65.3	46.77	12.12	47.83	0.6	103.9	6737	10338					
		1.22	8.26	11.15	2.45	2.33	1.36	5.02	3.60	0.93	3.68	0.05	7.99	518.23	795.23					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1384	1309	0.208	3.81	4.18	0.01	0.29	0.68	3.2	0.29	0.34	3.18	0	7.9	254	397	3	21	732405	3974231	c2-s1
1384	1309	0.582	10.71	11.41	0.13	1.3	2.93	7.05	3.62	1.7	5.39	0	7.7	638	982	3	21	731563	3979933	c3-s1
1384	1309	0.199	5.05	5.78	0.26	0.32	1.1	4.1	0.69	0.67	3.69	0	8	355	555	3	21	732658	3977345	c2-s1
1384	1309	1.161	7.64	8.03	0.02	2.01	1.3	4.7	2.65	1.86	3.13	0	8.05	501	770	3	21	735040	3979040	c3-s1
1384	1309	2.421	5.94	6.39	0.01	3.1	0.73	2.55	2.36	0.3	2.98	0.3	8.4	390	609	3	21	737765	3980213	c2-s1
1384	1309	0.601	5.08	5.62	0.02	0.92	1.03	3.65	0.37	0.84	3.87	0	8.05	341	533	3	21	739608	3975555	c2-s1
1384	1309	0.969	5.51	6.02	0.02	1.46	0.84	3.7	1.94	0.34	3.23	0	7.9	360	562	3	21	742741	3977828	c2-s1
1384	1309	2.041	9.56	10.02	0.02	3.64	1.21	5.15	5.68	0.51	3.37	0	7.9	612	942	3	21	743729	3976811	c3-s1
1384	1309	2.141	13.59	14.21	0.02	4.67	1.97	7.55	9.1	1.22	3.27	0	8.1	843	1277	3	21	747650	3978405	c3-s1
1384	1309	3.301	21.09	21.29	0.06	8.37	3.56	9.3	13.42	3.71	3.96	0	7.8	1251	1867	3	2	750307	3984350	c3-s1
1384	1309	0.212	3.96	4.31	0.01	0.3	0.67	3.33	0.35	0.35	3.26	0	7.7	257	401	7	11	732405	3974231	c2-s1
1384	1309	0.54	7.9	8.47	0.01	1.04	2.12	5.3	2.25	1.28	4.37	0	8.1	496	763	7	11	731563	3979933	c3-s1
1384	1309	0.193	5.35	6.1	0.28	0.32	1.01	4.49	0.77	0.72	3.86	0	7.75	369	577	7	11	732658	3977345	c2-s1
1384	1309	1.174	3011.4	7.89	0.02	2.01	1.11	4.75	2.7	1.7	3007	0	7.85	494	760	7	11	735040	3979040	c3-s1
1384	1309	2.593	6.04	6.61	0.01	3.32	0.75	2.53	2.52	0.3	2.92	0.3	8.4	395	617	7	11	737765	3980213	c2-s1
1384	1309	0.641	4.94	5.46	0.02	0.96	0.84	3.64	0.35	0.78	3.81	0	7.7	342	534	7	11	739608	3975555	c2-s1
1384	1309	0.985	5.71	6.3	0.02	1.52	0.97	3.79	2.16	0.34	3.21	0	7.9	371	580	7	11	742741	3977828	c2-s1
1384	1309	2.095	9.81	10.4	0.02	3.8	1.23	5.35	6	0.51	3.3	0	7.85	628	966	7	11	743729	3976811	c3-s1
1384	1309	1.284	9.64	10.11	0.03	2.5	1.52	6.06	5.28	0.55	3.81	0	7.55	612	942	7	11	744371	3979165	c3-s1
1384	1309	2.209	14.06	14.71	0.02	4.89	2.13	7.67	9.6	1.25	3.21	0	8	864	1309	7	11	747650	3978405	c3-s1
average		25.55	3166.8	173.31	1.01	46.74	27.7	97.86	72.1	19.27	3074.8	0.6	158.6	10373	15943					
		1.28	158.34	8.67	0.05	2.34	1.39	4.89	3.61	0.96	153.74	0.03	7.93	518.65	797.15					

Appendix 8 Results of Water Quality Test (2001 -2006) (22/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1385	1309	0.222	3.67	3.97	0.01	0.3	0.66	3	0.27	0.33	3.07	0	7.9	241	376	7	9	732405	3974231	c2-s1
1385	1309	0.533	7.89	8.35	0.01	1.02	2.27	5.05	2.26	1.53	3.9	0.2	8.2	509	783	7	9	731563	3979933	c3-s1
1385	1309	0.198	4.93	5.84	0.3	0.32	1.07	4.15	0.65	0.68	3.6	0	7.9	360	562	7	9	732658	3977345	c2-s1
1385	1309	1.114	7.34	7.74	0.02	1.9	1.32	4.5	2.82	1.49	3.03	0	8	478	735	7	9	735040	3979040	c2-s1
1385	1309	2.443	5.9	6.33	0.01	3.1	0.67	2.55	2.4	0.27	2.83	0.4	8.5	393	614	7	9	737765	3980213	c2-s1
1385	1309	0.547	9.39	10.17	0.03	1.16	1.83	7.15	1.77	1.97	5.65	0	7.7	614	944	7	9	739608	3975555	c3-s1
1385	1309	0.978	3.54	6.01	0.02	1.47	0.87	3.65	0.32	3.02	0.1	0.1	8.2	364	568	7	9	742741	3977828	c2-s1
1385	1309	2.022	9.96	10.65	0.02	3.75	1.33	5.55	6.22	0.49	3.25	0	8	645	992	7	9	743729	3976811	c3-s1
1385	1309	2.099	13.47	14.07	0.02	4.57	2.18	7.3	9.12	1.14	3.11	0.1	8.2	850	1288	7	9	747650	3978405	c3-s1
1385	1309	3.588	34.53	35.35	0.02	12.2	6.43	16.7	16.1	14.3	4.13	0	7.6	2112	3152	7	9	753068	3983644	c4-s2
1385	1309	3.224	22.23	22.39	0.07	8.48	3.74	10.1	14.45	3.78	4	0	7.7	1329	1984	7	9	750307	3984350	c3-s1
1385	1309	4.217	22.73	23.27	0.03	10.6	3.14	9.5	12.25	6.25	4.03	0.2	8.15	1453	2168	7	9	754627	3978600	c3-s2
average		21.185	145.58	154.14	0.56	48.87	25.51	79.2	68.63	35.25	40.7	1	96.05	9348	14166					
		1.77	12.13	12.85	0.05	4.07	2.13	6.60	5.72	2.94	3.39	0.08	8.00	779.00	1180.50					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1380	1310	0.189	21.28	21.18	0.09	0.6	5.04	15.44	3.63	0.35	17.3	0	6.4	1147.23	1821	6	20	379132	4059477	c3-s1
1380	1310	0.548	6.9	6.89	0.07	0.94	2.74	3.14	1.6	0.75	4.55	0	7.66	435.33	691	6	20	375932	4059055	c2-s1
1380	1310	0.172	24.26	23.21	0.09	0.58	4.21	18.33	3.56	0.4	20.3	0	6.27	1388.52	2204	6	20	379140	4059506	c3-s1
1380	1310	0.362	5.73	5.73	0.05	0.58	2.26	2.84	0.63	0.3	4.8	0	7.62	364.14	578	6	20	393917	4063361	c2-s1
1380	1310	0.238	5.05	5	0.03	0.36	1.72	2.89	0.35	0.3	4.4	0	6.97	298.62	474	6	20	401315	4069043	c2-s1
1381	1310	0.212	14.51	14.48	0.1	0.56	4.75	9.07	3.91	0.3	10.3	0	7.15	938.7	1490	12	15	379132	4059477	c3-s1
1381	1310	0.566	7.09	7.02	0.08	0.98	2.82	3.15	1.84	0.7	4.55	0	8.1	456.75	725	12	15	375932	4059055	c2-s1
1381	1310	0.181	24.9	24.8	0.12	0.63	5.46	18.6	4.1	0.4	20.4	0	7.6	1545.39	2453	12	15	379140	4059506	c4-s1
1381	1310	0.497	4.88	4.99	0.04	0.72	1.97	2.26	0.68	0.35	3.85	0	7.6	310.59	493	12	15	393917	4063361	c2-s1
1381	1310	0.287	5.06	5.08	0.04	0.44	1.98	2.63	0.21	0.2	4.65	0	8.2	309.96	492	12	15	401315	4069043	c2-s1
1381	1310	0.116	28.96	27.96	0.08	0.43	12.41	15.04	4.31	0.25	24.4	0	6.35	1525.86	2422	6	10	379132	4059477	c4-s1
1381	1310	0.429	7.19	7.28	0.07	0.77	2.94	3.5	1.84	0.8	4.55	0	7.75	457.38	726	6	10	375932	4059055	c2-s1
1381	1310	0.131	23.78	23.27	0.08	0.44	8.46	14.29	4.28	0.4	19.1	0	6.3	1256.22	1994	6	10	379140	4059506	c3-s1
1381	1310	0.296	5.97	5.78	0.04	0.48	2.06	3.2	0.77	0.3	4.9	0	7.5	359.73	571	6	10	393917	4063361	c2-s1
1381	1310	0.211	4.87	4.66	0.03	0.31	1.32	3	0.32	0.25	4.3	0	7.3	307.44	488	6	10	401315	4069043	c2-s1
average		4.435	190.43	187.33	1.01	8.82	60.14	117.38	32.03	6.05	152.35	0	108.77	11101.86	17622					
		0.30	12.70	12.49	0.07	0.59	4.01	7.83	2.14	0.40	10.16	0.00	7.25	740.12	1174.80					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1382	1310	0.148	22.02	21.86	0.07	0.48	8.99	12.32	4.07	0.25	17.7	0	6.65	1155	1834	12	15	379132	4059477	c3-s1
1382	1310	0.564	6.41	6.54	0.05	0.94	2.73	2.82	1.81	0.7	3.9	0	7.7	417	662	12	15	375932	4059055	c2-s1
1382	1310	0.164	25.32	24.66	0.05	0.57	5.36	18.68	3.87	0.45	21	0	6.5	1081	1716	12	15	379140	4059506	c3-s1
1382	1310	0.388	5.08	5.04	0.03	0.58	1.52	2.92	0.68	0.3	4.1	0	7.8	308	489	12	15	393917	4063361	c2-s1
1382	1310	0.291	3.87	3.94	0.01	0.39	1.32	2.22	0.37	0.3	3.2	0	7.8	234	372	12	15	401315	4069043	c2-s1
1382	1310	0.182	26.2	26.24	0.09	0.65	5.9	19.6	2.95	0.75	22.5	0	6.2	1370	2174	6	29	379132	4059477	c3-s1
1382	1310	0.203	20.6	21.24	0.09	0.65	4.9	15.6	2.85	0.45	17.3	0	6.6	1138	1807	6	29	379140	4059506	c3-s1
1382	1310	0.422	5.82	5.76	0.04	0.67	2.33	2.72	0.77	0.35	4.7	0	7.9	355	564	6	29	393917	4063361	c2-s1
1382	1310	0.286	5.35	5.22	0.03	0.44	1.72	3.03	0.45	0.5	4.4	0	7.9	300	477	6	29	401315	4069043	c2-s1
average		2.648	120.67	120.5	0.46	5.37	34.77	79.91	17.82	4.05	98.8	0	65.05	6358	10095					
		0.29	13.41	13.39	0.05	0.60	3.86	8.88	1.98	0.45	10.98	0.00	7.23	706.44	1121.67					

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1383	1310	0.158	23.12	23.11	0.08	0.53	3.5	19	4.02	0.1	19	0	6.3	1383	2195	12	23	379132	4059477	c3-s1
1383	1310	0.533	7.12	7.21	0.07	0.94	3.1	3.1	1.52	0.7	4.9	0	7.45	455	722	12	23	375932	4059055	c2-s1
1383	1310	0.188	19.47	19.55	0.08	0.58	3.9	15	2.87	0.4	16.2	0	6.6	1195	1897	12	23	379140	4059506	c3-s1
1383	1310	0.362	5.63	5.72	0.04	0.58	2.4	2.7	0.58	0.25	4.8	0	7.3	350	556	12	23	393917	4063361	c2-s1
1383	1310	0.504	4.78	4.85	0.03	0.72	1.6	2.5	0.63	0.35	3.8	0	7.3	304	482	12	23	401315	4069043	c2-s1
1383	1310	0.161	26.27	26.53	0.1	0.58	8.2	17.65	2.97	0.2	23.1	0	6.54	1431	2272	6	15	379132	4059477	c4-s1
1383	1310	0.559	7.03	7.19	0.06	0.98	3.05	3.1	1.63	0.8	4.6	0	7.69	463	735	6	15	375932	4059055	c2-s1
1383	1310	0.161	28.58	28.65	0.1	0.6	6.35	21.6	3.23	0.3	25.05	0	6.34	1516	2407	6	15	379140	4059506	c4-s1
1383	1310	0.374	5.7	5.8	0.05	0.6	1.6	3.55	0.6	0.25	4.85	0	7.36	362	575	6	15	393917	4063361	c2-s1
1383	1310	0.269	4.74	4.62	0.03	0.39	0.7	3.5	0.24	0.25	4.25	0	7.39	295	468	6	15	401315	4069043	c2-s1
1384	1310	0.162	26.23	26.36	0.08	0.58	8.9	16.8	3.48	0.4	22.35	0	6.37	1496	2375	12	21	379132	4059477	c4-s1
1384	1310	0.583	6.84	7.06	0.05	1.01	3	3	1.64	0.75	4.45	0	7.94	468	743	12	21	375932	4059055	c2-s1
1384	1310	0.161	26.3	26.66	0.08	0.58	4.95	21.05	3.05	0.25	23	0	6.33	1540	2444	12	21	379140	4059506	c4-s1
1384	1310	0.243	4.71	4.79	0.03	0.36	1.3	3.1	0.41	0.2	4.1	0	7.32	303	481	12	24	401315	4069043	c2-s1
average		4.418	196.52	198.1	0.88	9.03	52.55	135.65	26.87	5.2	164.45	0	98.23	11561	18352					
		0.32	14.04	14.15	0.06	0.65	3.75	9.69	1.92	0.37	11.75	0.00	7.02	825.79	1310.86					

Appendix 8 Results of Water Quality Test (2001 -2006) (23/23) (Source: WRMC)

Aquatic Year	code	sar	Anion	kation	K	Na	Mg	Ca	SO4	Cl	HCO3	CO3	PH	TDS	EC	Month	Day	UTM X	UTM Y	class
1381	1311	0.154	4.24	4.19	0.03	0.22	1.69	2.26	0.59	0.25	3.4	0	7.9	269.01	427	12	15	360103	4067970	c2-s1
1381	1311	0.139	3.3	3.21	0.03	0.17	0.47	2.54	0.24	0.2	2.86	0	7.82	206.64	328	6	31	362556	4069070	c2-s1
1381	1311	0.134	4.36	4.26	0.03	0.19	0.94	3.1	0.56	0.25	3.55	0	7.5	270.27	429	6	10	360103	4067970	c2-s1
1382	1311	0.168	4.18	4.29	0.01	0.24	1.41	2.63	0.53	0.25	3.4	0	8.1	256	407	12	15	360103	4067970	c2-s1
1382	1311	0.4	5.33	5.1	0.01	0.6	1.84	2.65	1.33	0.5	3.5	0	7.2	333	529	12	26	362556	4069070	c2-s1
1382	1311	0.168	4.18	4.29	0.01	0.24	1.41	2.63	0.53	0.25	3.4	0	8.1	256	407	12	10	360103	4067970	c2-s1
1382	1311	0.769	5.7	5.74	0.03	1.16	1.42	3.13	1.65	0.65	3.4	0	7.2	364	577	6	30	362556	4069070	c2-s1
1382	1311	0.154	3.27	3.47	0.25	0.19	0.71	2.32	0.42	0.35	2.5	0	7.35	204	324	6	30	360103	4067970	c2-s1
1383	1311	0.082	2.81	2.81	0.01	0.1	0.6	2.1	0.21	0.2	2.4	0	7.3	169	269	12	23	360103	4067970	c2-s1
1383	1311	0.205	4.38	4.32	0.03	0.29	1.4	2.6	0.68	0.2	3.5	0	7.61	273	434	6	15	360103	4067970	c2-s1
1384	1311	0.93	7.5	7.65	0.04	1.61	2.8	3.2	2.45	0.55	4.5	0	8.25	493	783	1	15	362556	4069070	c3-s1
1384	1311	0.132	3.42	3.48	0.01	0.17	1.2	2.1	0.47	0.2	2.75	0	7.74	217	345	12	21	360103	4067970	c2-s1
average		3.435	52.67	52.81	0.49	5.18	15.89	31.26	9.66	3.85	39.16	0	92.07	3310.92	5259					
		0.29	4.39	4.40	0.04	0.43	1.32	2.61	0.81	0.32	3.26	0.00	7.67	275.91	438.25					

SUPPORTING REPORT

PAPER 4

WATER QUALITY/ INITIAL ENVIRONMENTAL EXAMINATION (IEE)

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

SUPPORTING REPORT

PAPER 4 WATER QUALITY/INITIAL ENVIRONMENTAL EXAMINATION (IEE)

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Note: The Contents without any reference source were prepared by JICA Study Team.

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CHAPTER 1. WATER QUALITY AND NATURAL/SOCIAL ENVIRONMENT

1.1 WATER QUALITY

1.1.1 Environment Standard forWaters

General rules for setting standards are established by the Environmental Protection and Enhancement Act (1974). Standards are developed by Iranian Institution of Standards and Industrial Research (ISIRI), the Ministry of Energy and Department of Environment (DOE), and approved by the Environmental High Council. The DOE is responsible for enforcement.

In 2008, there are water quality standards for "drinking water", "sewage effluent" and "industrial discharge into sewage collection system" which is in force. There is no standard for classification of rivers, lakes and oceans.

1) Drinking Water Standard

The standard for drinking water were previously prepared and published by the Management and Planning Organization (1992, No 116). Iranian drinking water standard have been developed by the Iranian Institute of Standards and Industrial Research.

2) Sewage Effluent Standard

Sewage effluent standards include a long list of contaminants whereby maximum permissible limits are indicated for the quality of wastewater before its discharge into 1) surface water bodies, 2) absorbing wells and 3) irrigation canals for agriculture use.

3) Industrial Discharge into Sewage Collection System Standard

The industrial effluent quality, which is set by the Ministry of Industry, includes a list of contaminants with their corresponding threshold limits. These limits must be respected by the industries that wish to connect to the sewerage system.

The list of contaminants includes the following parameters: Temperature; pH; Total oil & grease; Sulfate; Suspended solids (SS); BOD; Phenol and creosol; heavy metals; and radioactivity.

1.1.2 Surface Water

River water qualities are measured at 99 points by WRMC. This water quality measuring stations are as same as those of flow meter station. Water quality indexes measured by WRMC are mostly positive and negative ion. Common water quality index for rivers and lakes, like BOD, COD, DO, SS, e-coli, Total-N, Total-P and some other harmful materials, are not measured here.

- Water quality index measured by WRMC: Potassium (K^+), Sodium (Na^+), Magnesium (Mg^{2+}), Calcium (Ca^{2+}), Sulfate ion (SO_4^{2-}), Chloride ion (Cl^-), Bicarbonate ion (HCO_3^-), Carbonate ion (CO_3^{2-}), pH, Electric conductivity (EC), Total dissolved solid (TDS).

Table 1.1.1 shows average and maximum value of Na, Cl, TDS and pH. Minimum value of pH is also listed. Location is selected to be as same as flow meter measuring point. Location of measuring point is shown in Figure 1.1.1. Duration of data is 1966 to 2004. Frequency of measurement is different from measuring stations, and some stations have monthly data. Minimum/Maximum/Average data are calculated using all the collected data.

Table 1.1.1 Water Quality in Sefidrud River

Location	Na (mg/L)		Cl (mg/L)		pH			TDS (mg/L)	
	Ave.	Max	Ave.	Max.	Ave.	Max.	Min.	Ave.	Max.
17-001	3.5	21.5	2.7	24.2	7.8	8.6	7.0	774	1,821
17-007	6.4	14.4	3.9	8.9	7.8	9.0	6.4	873	1,252
17-013	8.1	36.5	6.8	28.0	7.8	8.7	6.9	955	1,783
17-015	21.2	60.0	22.2	68.5	7.8	8.4	7.2	2,470	4,769
17-019	3.8	14.1	2.6	13.1	7.7	8.7	7.0	758	1,002
17-021	20.3	47.0	21.0	53.0	7.7	10.0	6.7	2,621	4,114
17-023	11.7	23.2	12.5	27.2	7.7	8.9	6.3	1,415	2,079
17-033	12.6	54.2	12.7	58.8	7.7	8.5	6.6	8,035	161,658
17-037	1.1	2.8	0.9	2.2	7.7	8.4	5.8	-	-
17-041	2.5	11.4	2.1	11.9	7.7	8.4	6.3	461	626
17-428	5.8	25.2	5.5	32.0	7.9	8.5	7.0	-	-
17-517	1.6	6.5	1.2	3.6	7.9	8.4	7.0	357	896

Source: WRMC, Basic Study Office

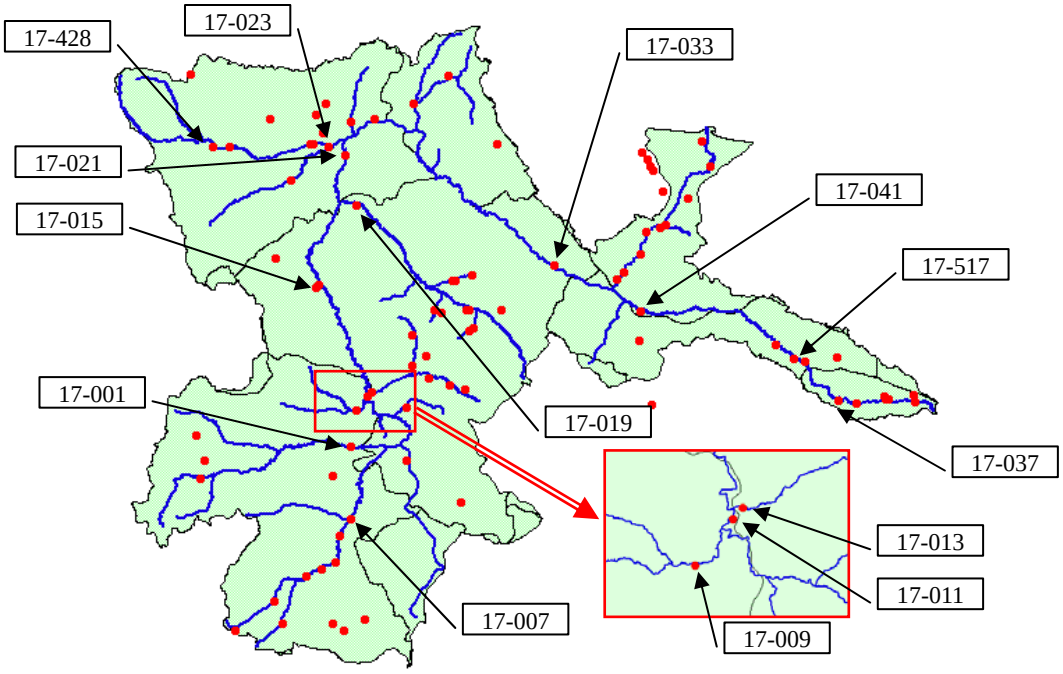


Figure 1.1.1 Location of Water Quality Measuring Station

1) Chloride (Cl)

Since surface water is used for agricultural use, damage by salt is evaluated by density of Cl ion. In Table 1.1.1, average density of Cl at measuring station are less than 25 (mg/l). Maximum Cl density is less than 70 (mg/l).

At measuring station No. 17-009 and 17-011, not listed in Table 1.1.1, Cl density ranges between 250 to 400 (mg/L) twice in each station in all the data. Location is near the border of Zanjan Province and Kordestan Province (Figure 1.1.1).

According to Kagawa Agricultural Division in Japan, rice or other agriculture product will be affected by salt when irrigation water contains Cl 200 - 250 (mg/l) or more. Since average density is quite lower than the range, and exceeding data is only a few, risk of damage by salt is considered to be low.

2) Sodium (Na)

Na density is restricted by drinking water standard to be less than 200 (mg/l). Average Na density in Table 1.1.1 is lower than 30 (mg/l) and maximum density is lower than 60 (mg/l). Although this is not standard for river water, it is considered that Na density is low enough.

3) pH

Water is relatively alkaline since average pH value ranges from 7.7 to 7.9. Recommended pH value for irrigation water ranges from 6.0 to 7.5. According to Japanese Standard for Classification of River, as a reference only, river water suitable for drinking water and fishery ranges from pH 6.5 to 8.5, river water suitable for industry ranges from pH 6.0 to 8.5. Sefidrud River water ranges from pH 6.5 to 8.5 in general.

4) Total Dissolved Solid (TDS)

Mean value of total dissolved solids (TDS) exceeds 500 (mg/l). It is hard to specify organic load and inorganic load without BOD measurement data. However, according to the general condition that river valleys are prone to sediment runoff and domestic sewage are discharged to rivers without treatment, both organic and inorganic loads are considered to be high.

According to hearing investigation, in 2008, Gilan and Ardebil Province do not have any sewage treatment plant, and one treatment plant is running in Kordestan Province. One treatment plant is under construction in Gilan Province with World Bank accommodation loan. It is considered that large portions of domestic sewer in our study area are discharged into river without treatment.

Mean value of TDS varies at site; less than 500 (mg/l) in Shah Rood River; less than 1000 (mg/l) in the upper stretch to middle of Ghezelozan River; and more than 1000 (mg/l) in the middle stretch to end of Ghezelozan River. If water quality is evaluated by index of TDS, water in full stretch of Shah Rood River and upper stretch to middle stretch of Ghezelozan River is suitable to irrigation water. Water in middle stretch to end of Ghezelozan River contains lots of TDS, which may require some purification like settlement of sand.

1.1.3 Groundwater

Groundwater is measured by WRMC. Location of measuring well and the monitoring systems are shown in Supporting Report Paper 3 Groundwater. There is some areas to control groundwater by monitoring well, which are divided from 1301 to 1311. Measurement of groundwater quality is done in all areas except for 1303 and 1305.

Water quality indexes for groundwater measured by WRMC are mostly positive and negative ion. Harmful materials which sometimes cause a problem in groundwater, like Cadmium (Cd) and Arsenic (As), are not measured here.

- Water quality index measured by WRMC: Potassium (K^+), Sodium (Na^+), Magnesium (Mg^{2+}), Calcium (Ca^{2+}), Sulfate ion (SO_4^{2-}), Chloride ion (Cl^-), Bicarbonate ion (HCO_3^-), Carbonate ion (CO_3^{2-}), pH, Electric conductivity (EC), Total dissolved solid (TDS).

Table 1.1.2 Groundwater Quality at Monitoring Well shows average and maximum value of Na, Cl and pH. Minimum value of pH is listed, too. Duration of data is 2001 to 2004. Although one control area has some monitoring well, these are summarized as in each control area to calculate average, maximum and minimum value.

Table 1.1.2 Groundwater Quality at Monitoring Well

No.	Province	Na (mg/l)		Cl (mg/l)		pH		
		Ave.	Max.	Ave.	Max.	Ave.	Min.	Max.
1301	Gilan	3.1	12.3	3.2	11.7	7.6	6.6	8.6
1302	Ardebil	10.0	109.6	9.9	117.6	7.6	6.7	8.3
1304	Zanjan	2.0	8.7	3.4	8.2	-	-	-
1306	Zanjan	2.0	14.0	4.0	8.7	-	-	-
1307	Kordestan	2.4	21.7	4.0	8.8	-	-	-
1308	Kordestan	1.5	13.9	0.6	10.2	7.9	6.1	9.2
1309	Kordestan	2.8	12.2	1.5	14.3	8.0	7.6	8.5
1310	Qazvin	0.6	1.0	0.4	0.8	7.2	6.2	8.2
1311	Gilan	0.4	1.6	0.3	0.7	7.7	7.2	8.3

Source: WRMC, Basic Study Office

1) Chloride (Cl)

Mean values of Cl density are less than 10 (mg/l) in all control area. Maximum values are less than 20 (mg/l) except for area 1302. In area 1302, there is a well named Khalkhal whose Cl density ranges from 100 to 120 (mg/l). In other wells in area 1302, Cl density is lower than 20 (mg/l).

2) Sodium (Na)

Na density is lower than 10 (mg/l) in average and 110 (mg/l) in maximum, which is lower than drinking water standard.

3) pH

Mean value of pH ranges from 7.0 to 8.0. Minimum and maximum value ranges 6.5 to 8.5 in general, except for area 1308 in Kordestan Province which ranges from 6.1 to 9.2. Although we cannot directly compare with river water standard in section 3.7.1, it can be said that water quality in area 1308 is a bit lower than those in other area.

1.2 NATURA L AND SOCIAL ENVIRONMENT

Vast nation of Iran contains a lot of different ecosystem like greenish land, wetland with lots of migratory birds, and semi-arid wild land. However due to human invasion to nature and pollution, good environment of nature is decreasing and living creature is also decreasing in number and diversity. In order to tackle the problem, Iranian government has set the protected area.

In this section, as a basic study for natural environment, details of protected area and protected species are mentioned. For fishes, which are vulnerable to water management and its effect to hydraulic circulation, living species in Sefidrud River and its river mouth or Caspian Sea are mentioned regardless of the risk of extinction.

And, as a basic study for social environment, livelihoods of local people are summarized. Fishermen who are vulnerable to hydraulic circulation and nomad who are one of socially vulnerable are described here.

1.2.1 Protected Areas

1) Classification of Protected Area

In order to protect biodiversity in Iran, four types of protected area have been regulated. These are “National Park”, “National Natural Monuments”, “Wildlife Refuges” and “Protected

Area", which are controlled by Department of Environment (DOE). Total areas were 7,563,983 ha in 1997 (1376 in Iran), and are expanded to 11,791,788 ha now.

a) National Park

National Park is the area to preserve ecosystem and habitat for wildlife and vegetation. Area of each National Park is relatively large. Excellent environment like forests, pastures, grasslands, waters and mountain are selected as National Park. Study and eco-tourism aiming at conservation are allowed.

b) National Natural Monuments

National Natural Monuments is the area to protect exemplary rare flora and fauna, remarkable land formations and landscapes, or even ancient trees. Area of each National Natural Monument is relatively small. Economic activity in this area is not allowed.

c) Wildlife Refuges

Wildlife Refuges is the area to protect wild animals and to regenerate its habitats, like forests, pastures, glass lands, waters and mountains. Area of each Wildlife Refuges is large enough to possess enough area for habitat. Study and eco-tourism aiming at conservation are allowed.

d) Protected Area

Protected Area is wildlife habitat like forests, pastures, grasslands, waters, mountains. According to definition of equivalent area in IUCN, these areas accept settlement of human beings, aiming at protection of landscape with human beings and wildlife. Area of each Protected Area is relatively large. Educational program, study, eco-tourism and other economic activities aiming at conservation are all allowed in these areas.

2) Protected Area in the Study Area

Within the study area, there are four (4) National Natural Monuments, four (4) Wildlife Refugees and five (5) Protected Areas. There is no National Park. Location is shown in Figure 1.2.1 and details for each protected area are listed in Tables 1.2.1 to 1.2.3.

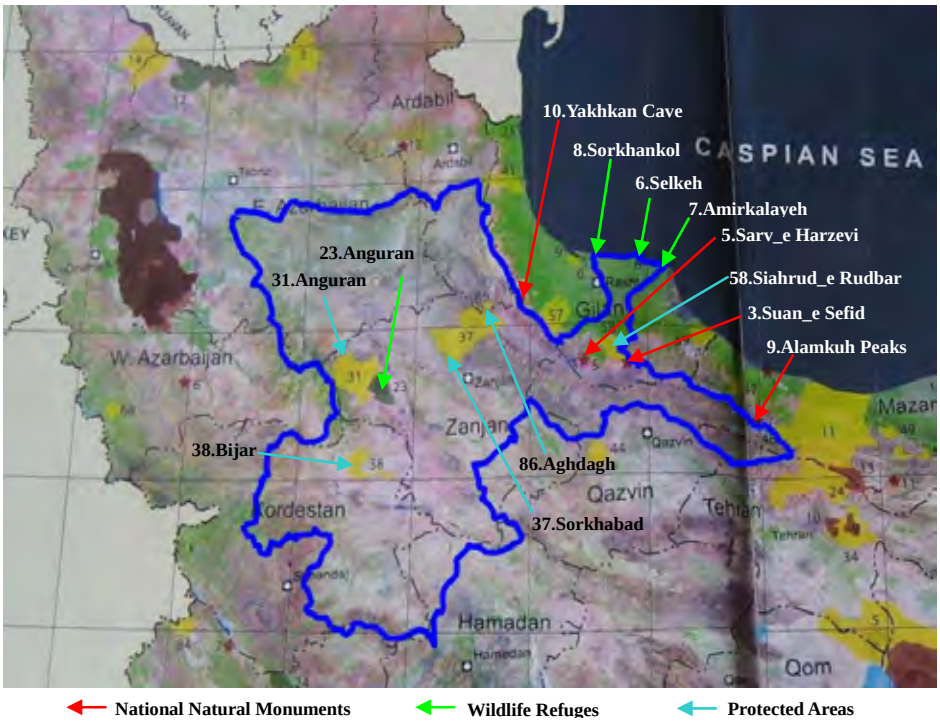


Figure 1.2.1 Protection Area on Natural Environment in the Sefidrud Basin

Table 1.2.1 National Natural Monument in Study Area

No.	Name	Area (ha)	Altitude (m)	Temp. (℃)	Rain (mm/y)	Protected Species
3	Susan_e Sefid	0.6	1,750 - 2,000	10	450	Rare ledebour lily
5	Sarv_e Harzevil	-	600	18	300	Old jumper tree (2000 years old)
9	Alamkuh Peaks	4,077	3,950 - 4,850	- 4	800	Wild goat, brown bear, leopard, Caspian snowcock, meadow viper living at the summits of Alamkuh, Siah Kaman and Takht-e Soleiman
10	Yakhkan Cave	1,217	2,200	-	-	Limestone cave

Source: Atlas of Protected Areas of Iran

Table 1.2.2 Wildlife Refugee in Study Area

No.	Name	Area (ha)	Altitude (m)	Temp. (℃)	Rain (mm/y)	Protected Species
6	Selkeh	366	- 25	16	1600	Wetland near Caspian Sea Birds: whooper swan, mute swan, teal, red-breasted goose, bustard, mallard, lesser white-fronted goose, white-tailed eagle Others: Caspian pond turtle, great cormorant
7	Amirkalayeh	1,084	- 25	16	1160	
8	Sorkhankol	1,214	- 25	16	1600	
23	Anguran	29,812	1,280 - 2,200	10	400	Mountain Animals: wild goat, brown bear, wolf, Eurasian lynx, striped hyena Birds: eagle, falcon Others: meadow viper

Source: Atlas of Protected Areas of Iran

Table 1.2.3 Protected Area in Study Area

No.	Name	Area (ha)	Altitude (m)	Temp. (℃)	Rain (mm/y)	Protected Species
31	Anguran	91,280	1,240 - 3,320	6	450	Refer to Anguran in Wildlife Refugee
37	Sorkhabad	119,225	500 - 2,900	11	500	Mountain Animals: Goitered gazelle, leopard, wild boar, large-toothed suslik Birds: eagle, falcon, houbara bustard Others: meadow viper
38	Bijar	31,769	1,600 - 2,100	10	350	Mountain Animals: Armenian sheep, wolf, fox, wild cat Birds: chukar partridge Others: spur-thighed tortoise
58	Siahrud_ eRudbar	28,289	220 - 2,220	14	800	Mountain Animals: red deer, roe deer, leopard, brown bear, jackal, common fox, weasel Birds: woodpecker, golden eagle
86	Aghdagh	4,436	500 - 1680	13	500	Mountain Animals: wild goat, Eurasian lynx, wolf, weasel Birds: golden eagle, goshawk Others: meadow viper, spur-thighed tortoise

Source: Atlas of Protected Areas of Iran

1.2.2 Endangered Species

Some endangered species listed in IUCN red list are living in the above mentioned protected area, which are shown in Table 1.2.4. Category of red list is as below.

- EX as Extinct
- EW as Extinct in the Wild
- CR as Threatened, Critically Endangered
- EN as Threatened, Endangered
- VU as Vulnerable
- LR as Lower Risk

Table 1.2.4 Endangered Species in Protected Area on Sefidrud River Basin

 Common name: Red-brested goose Binomial nameBranta ruficollis Category: EN	 Common name: Saker falcon Binomial name: Falco cherrug Category: EN	 Common name: Meadow viper Binomial name: Vipera ursinii Category: EN
 Common name: Lesser white-fronted goose Binomial name: Anser erythropus Category: VU	 Common name: Wild goat Binominal name: Capra aegagrus Category: VU	 Common Name: Houbara bustard Binomial name: Chlamydotis undulata Category: VU
 Common name: Lesser kestrel Binomial name: Falco naumanni Category: VU	 Common name: Goitered gazelle Binomial name: Gazella subgutturosa Category: VU	 Common name: Spur-thighed tortoise Binomial name: Testudo graeca Category: VU

Source of Photo: Wikipedia

In addition to above animals, there is another endangered species written in Etellart Newspaper in Iran, 24-Jun-2008. That is great bustard, or otis tarda in binomial name, whose number has decreased to 40 in entire land of Iran. This great bustard is migratory bird, living in wetland of Caspian Sea. IUCN category of this bird is VU.

1.2.3 Fishes in Sefidrud River

Sefidrud River runs into Caspian Sea. Since water in Caspian Sea contains 6 % of salt (seawater is 35%), freshwater fish and brackish-water fish are living in Sefidrud River and Caspian Sea.

At 100 km upstream of Sefidrud River from Caspian Sea, where Gezelozen River joins Shahrud and change the name into Sefidrud, there is a Manjil Dam. This Manjil dam doesn't have fish-way, which is the obstacle for migration of fish.

1) Fishes in Sefidrud River Downstream of Manjil Dam and Caspian Sea

Fishes living in Sefidrud River downstream of Manjil Dam and Caspian Sea are shown in Table 1.2.5.

Table 1.2.5 Fishes in Sefidrud River and Caspian Sea

 Order: Cypriniformes Common name: Common carp Binomial name: Cyprinus carpio	 Order: Cypriniformes Common name: Kutum, Caspian white fish[*1)] Binomial name: Rutilus frisii kutum	 Order: Cypriniformes Common name: Carp bream[*1)] Binomial name: Abramis brama
 Order: Cypriniformes Common name: Roach[*1)] Binomial name: Rutilus rutilus	 Order: Cypriniformes Common name: Barbel Binomial name: Barbus barbus	 Order: Cypriniformes Common name: Tench Binomial name: Tinca tinca
 Order: Mugiliformes Common name: Flathead mullet Binomial name: Liza cephalus	 Order: Mugiliformes Common name: Golden grey mullet Binomial name: Liza auratus	 Order: Mugiliformes Common name: Leaping mullet Binominal name: Liza saliens
 Order: Clupeiformes Common name: Alosa Binomial name: Shad	 Order: Salmoniformes Common name: Brown trout[*1)] Bonomial name: Salmo trutta caspius	 Order: Esociformes Common name: Northern Pike Binomial name: Esox lucius

*1) Endemic in Caspian Sea

a) Cypriniformes (Carps)

Many cypriniformes (hereinafter carps), especially common carp, live in Caspian Sea and Sefidrud River. Although carps normally live in fresh water, they can also live in brackish water of Caspian Sea. Some carps are endemic to Caspian Sea.

Carp is one of the fish eaten by local people. Carp cultured in fish pond is preferred to those in river because of little smell. Especially cultured kutum is tasty and expensive, which is eaten as a banquet. Carps caught in Caspian Sea are eaten by some people, but not by the others because of pollution.

b) Mugilformes (Mullet)

Mugilformes (hereinafter mullet) live in Caspian Sea and river mouth. Flocks of mullet sometimes migrate to rivers regardless of breeding season. Mullet is tasty and many people like to eat. There are many mullet living in Caspian Sea and Sefidrud River.

c) Clupeiformes (Herring)

Alosa, family of clupeiformes, normally lives in Caspian Sea. Alosa migrates to rivers for breeding then come back. It is called cheap fish which is not so tasty.

d) Salmoniformes (Salmon)

Brown trout is one of the salmoniformes (hereinafter trout) which is endemic in Caspian Sea. Brown trout normally lives in Caspian Sea, and many of them migrate to rivers for breeding. Brown trout is not normally eaten by local people. It is cultivated rainbow trout or lake trout which is frequently eaten as trout.

e) Esociformes (Pikes)

Northern Pike is one of the esociformes (hereinafter pikes), which can live in freshwater and brackish water. Northern pike is seen both in Caspian Sea and Sefidrud River and many people like to eat them.

f) Others

Several kinds of sturgeons and wels catfish lives in Caspian Sea. Numbers of sturgeons are drastically decreased due to too much hunting, which is now registered by IUCN red list as category EN (endangered). Sturgeons normally live in Caspian Sea and migrate to Sefidrud River for breeding. Since Manjil Dam prevents migration to upstream, sturgeons breed at downstream of river or at artificial breeding area.

2) Fishes in rivers Upstream of Manjil Dam

Some rivers upstream of Manjil Dam have fewer flow of water than downstream of the dam. Due to fewer flow, number of fish is relatively small. Carps are main creature living in rivers. Catfish lives in rivers, too.

1.2.4 Livelihood of Local People

Employed population aged 10 and over is shown in Table 1.2.6 in 1996 census (1375 in Iran). Populations are listed for each province. Employed population includes both employer and employee.

Agriculture and forestry are active in Gilan and East Azarbaijan with more than 200 thousand employed populations. In other 6 province, nearly 100 thousand people are employed for agriculture and forestry.

Fishery is active in Gilan with more than 3,000 employed populations. In Kordestan and Tehran, 100 to 200 people are working for fishery.

Mining and quarrying are active in Tehran with more than 20 thousand employed populations. In other 7 provinces, 500 to 2000 people are working for mining and quarrying.

Workers other than above, like manufacturing, electricity, construction, wholesale, public administration and others, are active in Tehran.

Table 1.2.6 Employed Population Aged 10 and Over

(people)

Province	Agriculture, Forestry	Fishing	Mining, Quarrying	Manufacturing	Electricity, Water
East Azarbaijan	233,962	16	1,771	240,980	6,108
Ardebil	96,638	49	420	30,261	1,514
Zanjan	82,826	4	1,128	38,933	1,495
Kordestan	104,637	123	932	35,736	1,690
Gilan	246,005	3,193	916	90,627	6,549
Hamedan	130,716	20	1,106	53,977	3,272
Tehran	81,676	220	20,832	606,831	29,140
Qazvin	62,077	8	588	54,500	2,435

Province	Construction	Wholesale	Public Administration	Others	Total
East Azarbaijan	91,452	104,496	68,741	167,320	914,846
Ardebil	40,097	30,254	19,457	50,169	268,859
Zanjan	23,337	18,215	16,721	35,490	218,149
Kordestan	56,380	35,702	37,435	54,692	327,327
Gilan	31,240	74,806	42,720	135,464	631,520
Hamedan	63,509	45,800	32,843	75,470	406,713
Tehran	245,859	521,768	390,876	783,183	2,680,385
Qazvin	18,394	23,356	18,912	45,356	225,626

Source: National census in 1996 (1375 in Iran)

Numbers of worker in Table 1.2.6 are shown as a ratio of work category in each province Figure 1.2.2). Ratio of agriculture and forestry is high in Gilan and Zanjan, which is nearly 40 %. Fishery which is active only in Gilan province is low in ratio, less than 1 % of total employed population. Manufacturing is active in all eight (8) provinces where 10 % or more people are working. As a whole, primary and secondary sector of economy are active in all provinces except for Tehran. Secondary and tertiary sector of economy are active in Tehran.

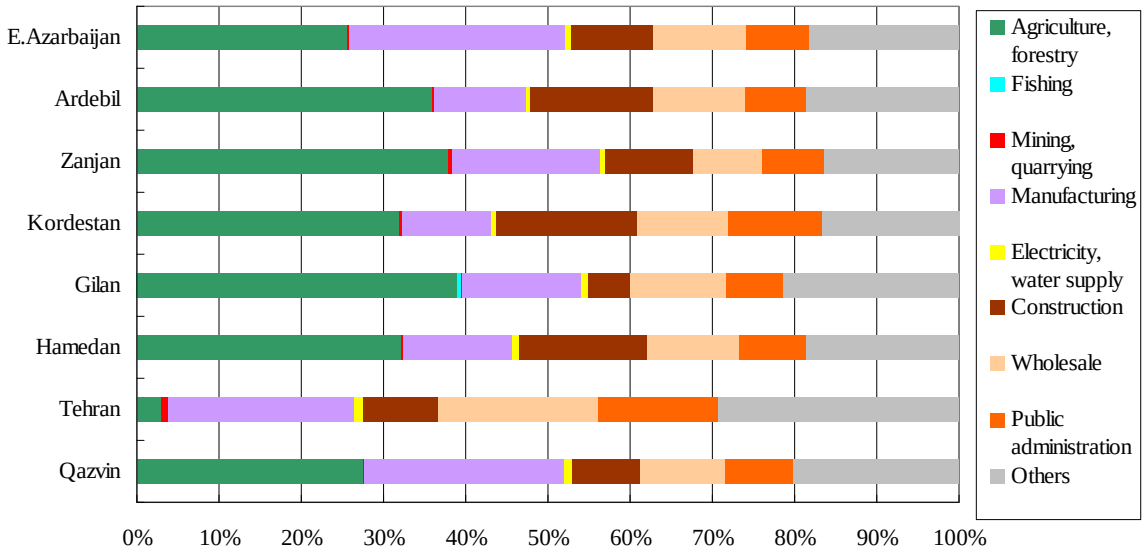


Figure 1.2.2 Ratio of Employed Population in Each Province

Fishery is one of the works closely related to hydraulic circulation. According to “Fisheries of Iran”, fishermen members of cooperatives are more than 6000 in Gilan province in year 2005 (1384 in Iran). Other 7 provinces are not listed in the table, where few fishermen are working.

Number of fishermen in Gilan province is listed in Table 1.2.7. Number of fishermen is 39624 in 1996 (1375 in Iran), which is doubled to 6555 in 2005 (1384 in Iran). These number are classified into each town, and most of the towns are located within the study area (Sefidrud River basin).

Table 1.2.7 Fishermen in Gilan Province

Year (Iranian Year)	Area	In or out of study area	Number of fishermen
1991 (1370)	Gilan Province	－	2542
1996 (1375)	Gilan Province	－	3624
2001 (1380)	Gilan Province	－	7356
2005 (1384)	Gilan Province	－	6555
	Astara	Out	100
	Astara Ashrafiye	In	1566
	Bandar Anzali	In	1781
	Talesh	Out	346
	Rasht	In	885
	Rudsar	In	1125
	Lahijan	In	305
	Langarud	In	447
	Within Study Area	－	6109
	Out of Study Area	－	446

Source: Fisheries General Department

1.2.5 Nomads

According to “Iran Nomad Tour”, there are 1 million nomadic pastoralists in Iran, organizing over 500 tribes. Nomads change their habitat in summer and winter. They live in cooler mountains in summer season, and moves to foot of mountains or other warmer places in winter season. Livelihood is mainly farming and raising livestock like goats, sheep and camels.

Within the study area, it is said that some nomads live in Zagros Mountain and mountain in East/West Azarbaijan. In the book of “Anthropology of Iran”, there is some descriptions of nomads in East /West Azarbaijan and Qazvin. In East/West Azarbaijan, there are nomads named Shettrenlu and Ghalakjanlu, in which 2000 and 150 families live respectively. In Qazvin, there are Chegini, Chisavand, Kakavand, Ilereshvand and Nuohi, in which 1000, 1200, 350, 350 and 600 families live respectively.

CHAPTER 2. INITIAL ENVIRONMENTAL EXAMINATION (IEE)

2.1 COLLECTION OF THE WATER QUALITY DATA

2.1.1 Introduction

Mahab Ghodss consulting engineers has studied the five water civil projects such as Ramin, Shahryar, Galabar, Talvar and Givi storage dams and irrigation-drainage networks in Sefidrud river basin. All the water quality data is collected from these projects. First of all, on the subject of assessing the water quality, the chemical quality data of hydrometer stations in these projects are studied. According to estimate the Physical, biological and bacterial parameters such as PH, TDS, Anion and Cation, ten points have been chosen as follows:

- Seven points at Givi storage dam and irrigation-drainage network in 2003
- One point at Sharyar dam in 2001
- Two points at Talvar dam in 2003

The water quality data is gathered for the purpose of assessing the water quality of other rivers. Samplings are carried out by Mahab Ghodss and other organizations in the study area. At last the water quality data is analyzed by Mahab Ghodss.

2.1.2 Galabar Storage Dam and Irrigation-Drainage Network

1) Location

The Galabar storage dam is located on the Sajas River in 52 Km of south-west of Zanjan. This dam is located in the east longitude degree of 48o 20' and the north latitude degree of 36o 20'. The Galabar irrigation-drainage network is located in Zarin-abad plain which is located in the east longitude degree of 48o 10' to 48o 28' and the north latitude degree of 36o 20' to 36o 29'. It might be noted that Galabar Storage dam and its irrigation network is under construction.

2) Description of the case study

The axis and storage of Galabar dam are located on Sajas River. The Sajas river is one the main fundamental tributaries of Khoeenrud. Sajasrud river basin is located on the south of Zanjan city/town and is one of the main tributaries of Ghezelozan River.

3) Water Quality

a) Hydrometric Stations

Hydrometric stations that were located in the Galabar's project area are Yengikand and Belubin qabchai. The results of chemical analysis of the water samples are shown in Table 5-1. The results show that the water quality of Sajasrud River as agricultural usage and drinking usage is in the range of acceptable-unsuitable. For classification of the water in order to determine its suitability for drinking, the diagrams of Shouler and for agricultural uses; that of Vicox are depicted. The diagrams of Shouler –Vilcox are shown in App. Fig. 1 and 2.

b) New Sampling

New sampling was not taken in the study area.

c) Sampling Stations of Other Organization.

The results of physic-chemical and biological parameters (Khoeenrud) have been come out by the Zanjan Environ.

Table 2.1.1 Chemical Water Quality of the Rivers

	Agriculture	Drinking water		
		Maximum	Average	Minimum
Yangikand	C1S1 - C4S4	unsuitable	acceptable	good
Bluebin	C2S1 - C4S3	bad	acceptable	good
Ghamchaghay	C1S1 - C4S4	bad	unsuitable	good

Hydrology report-Mahab Ghodss-1998

Table 2.1.2 Physical, Chemical and Biological Test Results of Khooninrud River

Test	pH	E.C		TDS	DO	BOD5	COD	T.CF
unit		ms/cm	oC	mg/l	mg/l	mg/l	mg/l	/100ml
max	7.7	25,000	25	20,096	12.5	2	15<	1,100
min	6.8	1000	7	700	10.5	0	0	50
ave	7.36	6890	14.8	7277.5	11.72	0.5	15<	422.5
No. of samples	10	10	5	10	5	10	10	10

Test	F.CF	NO_2^-	NO_3^-	NH_4^+	Pb^{2+}	Zn^{2+}	Cd^{2+}	Mn^{2+}
unit	/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	1,100	0.06	3.4	0.9	0.1	0.02	0.04	0.1
min	3	0.03	0.03	0.01	Trace	0.01	0	0.03
ave	131.3	0.046	1.7	0.31	Trace	0.013	Trace	0.065
No. of sample	9	3	5	3	3	3	3	2

Reference: the environmental research center of Azarbaijan

2.1.3 Ramin Storage dam

1) Location

Ramin dam is located on the Ramin River, in 17 Km of the south of Khavari. This dam is located in the east longitude degree of 48o 33' and the north latitude degree of 36o 33'.

2) Description of the case study

Ramin river basin is one of the tributaries of Ghezelozan which is located in the east longitude degree of 48o 27' to 48o 35' and the north latitude degree of 36o 33' to 36o 37', and is one of the sub-basin of Zanjanrud basin.

3) Water Quality

a) Hydrometric Station

Hydrometric station that was located in the Ramin project area is Ramin station.

b) New Sampling

New sampling was not taken in the study area.

c) Sampling Stations of Other Organization

The results of physic-chemical and biological parameters (Zanjanrud) have been come out by the Zanjan Environmental Research Center.

The results of chemical analysis of the water samples of Ramin dam and hydrometer stations show that the water quality on the subject of agricultural usage is in class C2S1 ,and on the subject of drinking usage is in the range of suitable-good. These results show that the water quality is suitable. The diagrams of Shouler –Vilcox are shown in App. Fig. 3 and 4.

Table 2.1.3 The Chemical Test Results of Ramin River

Type of Test	K^+	Na^+	Mg^{+2}	Ca^{+2}	TH	TDS	Cl^-	SO_4^{-2}	EC	pH	NO^{2-}	NO^{3-}
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µs/cm		mg/l	mg/l
Sample 1	2.5	50	14	96	300	487.5	19	197	$6.5*10^2$	7.3	ND	7
Sample 2	1.5	46.5	16	48	185	301	12	137	$4.3*10^2$	7.4	.05	ND

Sources: : The first phase studies of Ramin dam project-1995

Table 2.1.4 The Variation of Chemical and Physical Water Quality of Zanjanrud River

Type of Tests	pH	E.C	TH	TDS	SAR	HCO^{3-}	CL^-	SO_4^{2-}	Na^+	Mg^{2+}	Ca^{2+}	K^{2+}
Unit		µs/cm	mg/l	mg/l	%	meq/l	meq/l	meq/l	meq/l	meq/l	meq/l	meq/l
max	8.2	2148	655	1353	10.85	4.7	4.6	5.56	9.56	5.2	9.5	.179
min	7.16	257	115	162	.4	2	.15	.28	.43	.5	1.8	.01
Ave	7.7	1084	319.7	586	2.3	3.8	2.4	3.2	3.2	2.1	4.3	.07

Sources: : Environmental center, " The limnological report of Zanjanrud", 1997

2.1.4 Givi Storage Dam and Irrigation-Drainage Network

1) Location

This area is located in the east longitude degree of 48o 00' to 48o 45' and the north latitude degree of 37o 25' to 37o 55', on the southeastern part of Zanjan. The study area is located about 110 Km at south part of the Ardebil province, and 21 Km at northwest part of the Khalkhal city/town.

2) Description of the case study

Givi dam is located on the Givi-chay River. Givi river conjuncts to Firooz Abad River at downstream, after that conjuncts with Ghezelozan, and at last flows in to the Khazar sea.

3) Water Quality

a) Hydrometric station

Hydrometric station that was located in the Givi project area is Abgarm station and Firouzabad station in Firuzabad River.

b) New Sampling

Quality of the river was investigated in 7 points in Firuzabad River.

c) Sampling Stations of Other Organization

Activities (sampling) of other organizations was not investigated.

The results of chemical analysis of the water samples are shown in Tables 2.1.5. According to this table and Shouler –Vilcox diagrams, the water quality of river on the subject of agricultural usage is in good class (C2S1) to normal class (C3S1,C3S2). The diagrams of Shouler –Vilcox are shown in the appendix. Water quality is estimated at 7 sample points (G1-G7).

Table 2.1.5 The Water Classification of Rivers in Givi Area

River	Station	Water classification			
		Drinking water			Agriculture
		Minimum	Average	Maximum	
Givi	Abgarm	Good	Good	Acceptable	Good C2S1
Firouz abad	Firouz abad	Good	Good	unsuitable	Normal C2S1-C3S1

Sources: : The hydrology report, Mahab Ghodss, 1998

Table 2.1.6 Location of Sample Points of Givi River

Name	Location
G1	This point is located on Givi chay river about 6.25 Km after Khalkhal city
G2	At the distance of 6.5 Km from G1، this point is located on Givi chay river
G3	This sample point is located on Arya chay river, before the conjunction with Givi chay, at the distance of 1.5 Km from G2.
G4	This point is located on Givi chay, at the distance of about 1.7 Km from G2
G5	This point is located at the distance of 6.25 Km from G4
G6	This sample point is located on Givi chay river, and at the 1.5 Km distance from the G4.
G7	This sample point is located on Givi chay rud, at the end part of the case study, at the distance of 26.5 Km from the G6 and at the Firouzabad hydrometer station.

Table 2.1.7 Results of Sampling at G1 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.38	476	287	81.6	187	19.5	55	163.8	3.5
min	7.14	320	214	32	54	11.7	18	40.5	3.1
Ave	7.27	390	252	49.6	108	16.4	34.8	98.4	3.3
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	8.5	8.6	.32	1.8	-	1100	-	-	-	-
min	7.2	4.7	.15	.4	-	150	-	-	-	-
Ave	7.85	7.2	.21	.9	64	625	.332	.278	.213	.0776
No. of Sampling	2	3	3	3	1	2	1	1	1	1

Table 2.1.8 Results of Sampling at G2 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
Unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.42	390	323	39	91.7	17.5	5	92.5	2.8
min	7.26	270	207	28.4	19.2	12.2	18	34	2.8
Ave	7.37	331	253	33.7	51.7	14.3	35	68.5	2.8
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
Unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	7.7	9.5	.25	.42	-	1100	-	-	-	-
min	6.9	3.7	.11	.31	-	210	-	-	-	-
Ave	7.3	7	.16	.35	48	655	0	.2601	.209	.0986
No. of Sampling	2	3	3	3	1	2	1	1	1	1

Table 2.1.9 Results of Sampling at G3 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
Unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.57	307	586	121	58	15.8	68	264	6.8
min	7.17	239	214	31.9	4.8	3.6	33.7	41	2.1
Ave	7.45	270	383	64.7	33.6	9.8	46	124	4.5
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
Unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	11.2	4.7	.32	1.2	-	120	-	-	-	-
min	6.1	0	.15	.34	-	50	-	-	-	-
Ave	8.7	2.6	.21	.78	15	80	.0307	.296	.239	.0452
No. of Sampling	2	3	3	3	1	2	1	1	1	1

Table 2.1.10 Results of Sampling at G4 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
Unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.65	331	287	32	130	22	40.7	97	3.1
min	7.35	164	177	7.1	9.6	10.2	24	3.9	2.8
Ave	7.46	240	209	19.5	46	13.8	31.8	51	3
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
Unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	7.2	5.6	0.2	0.9	-	240	-	-	-	-
min	5.5	2.7	0.1	0.3	-	48	-	-	-	-
Ave	6.4	4.2	0.14	0.5	64	144	0.29	0.258	0.214	0.0387
No. of Sampling	2	3	3	3	1	2	1	1	1	1

Table 2.1.11 Results of Sampling at G5 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
Unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.35	685	488	142	345	15.8	48	365	3
min	7.16	280	256	10.6	4.8	2.9	19	25.3	2.5
Ave	7.26	429	340	51.4	93	11.7	34	128.6	2.75
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
Unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	7.1	12.3	0.3	8.7	-	210	-	-	-	-
min	6.7	2.8	0.1	0.22	-	48	-	-	-	-
Ave	6.9	7.1	0.18	0.45	64	129	0.033	0.293	0.214	0.0294
No. of Sampling	2	3	3	3	1	2	1	1	1	1

Table 2.1.12 Results of Sampling at G6 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
Unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.61	340	299	42.5	177.7	109.4	53	113.6	2.5
min	7.32	266	189	31.9	21.6	9.7	34	47	1.8
Ave	7.42	305	230	38	97	36.8	46.8	72	2.1
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
Unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	5.2	13.7	0.42	2.1	-	1,100	-	-	-	-
min	4.7	2.9	0.11	0.2	-	210	-	-	-	-
Ave	4.9	7.4	0.24	1.1	75	655	0.016	0.293	0.526	0.0421
No. of Sampling	2	3	3	3	1	2	1	1	1	1

Table 2.1.13 Results of Sampling at G7 Station

Type of Test	pH	TDS	HCO^{3-}	CL^{-}	SO_4^{2-}	Mg^{2+}	Ca^{2+}	Na^{+}	BOD_5
Unit		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	7.57	481	311	49.6	245	22	56	141.7	7.1
min	7.45	304	195	28.4	43	13	36	60.7	2.3
Ave	7.49	383	250	36.6	132	15.7	49	93	4.7
No. of Sampling	4	4	4	4	4	4	4	4	2

Type of Test	COD	NO_3^{-}	NO_2^{-}	PO_3^{-}	F.CF	T.CF	Fe	Mn^{2+}	Zn^{2+}	Hg
Unit	mg/l	mg/l	mg/l	mg/l	/100ml	/100ml	mg/l	mg/l	mg/l	mg/l
max	14.8	14.8	0.48	1.1	-	150	-	-	-	-
min	6.1	0.13	0.22	0.22	-	39	-	-	-	-
Ave	10.5	7.9	0.27	0.55	75	94.5	0.046	0.259	0.209	0.0591
No. of Sampling	2	3	3	3	1	2	1	1	1	1

2.1.5 Sharyar Storage Dam (Ostor)

1) Location

The Ostor dam is located at the 39 Km of the northeastern part of East Azerbaijan province. This case study is located at the northwest part of Iran at the east longitude degree of 48o 02' and the north latitude degree of 37o 30.

2) Description of the Case Study

The Ostor dam is located at the 39 Km of the northeastern part of Miane city, and on the Ghezelozan River (the major tributaries of Sefidrud River).

3) Water Quality

The water quality of Ghezelozan River at the Ostor hydrometer station on the subject of drinking water usage is in the class of good-normal and on the subject of agricultural usage is in the C3S1 class. The diagrams of Shouler- Vilcox are shown in App. Fig. 9 and 10.

Table 2.1.14 Physical, Chemical and Biological Test Results of Ghezelozan River

Type of Test	pH	E.C	T	TDS	DO	BOD_5	COD	T.CF
Unit		µs/cm	oC	mg/l	mg/l	mg/l	mg/l	/100ml
max	7.6	30,000	24	23,020	12	1	15<	1,500
min	6.6	425	6	305	10.2	0	0	150
ave	7.13	9,533.1	14.4	7,652.6	11.12	0.5	15<	617.7
No. of Sampling	11	11	5	11	5	5	9	11

Type of Test	F.CF	NO_2^-	NO_3^-	NH_4^+	Pb^{2+}	Zn^{2+}	Cd^{2+}	Mn^{2+}
Unit	/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
max	75	0.09	8	2.8	0.27	0.03	0.05	0.12
min	0	0	0	0.03	Trace	0.02	0	0.03
ave	22.8	0.0475	2.4	0.96	Trace	0.023	Trace	0.08
No. of Sampling	10	4	6	3	3	3	3	3

Refrence: Environmental center of Azarbijan province, 2003

Table 2.1.15 Physical, Chemical and Biological Test Results of Shahryar Ddam

Type of Test	Tsample	TW	pH	E.C.	Turbidity	TH	TSS	TDS
Unit	OC	OC		µs/cm	N.T.U	mg/L	mg/L	mg/L
max	25.8	25	8.05	4253	1839.5	752.5	4127	3100
min	6.7	23	7.425	1904	1.1	357.5	26.5	0
ave	15.65	24.57143	7.8	2978.67	748.27	549.8	1975.5	1793.5
No. of Sampling	12	12	12	12	12	12	12	12

Type of Test	CL^-	SO_4^{2-}	NO_2^-	PO_3^-	DO	BOD_5	COD	MPN
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
max	996	366.5	13.7	0.275	11.15	52.5	90	68,000
min	392.5	125.5	3.625	0.02	0	3.06	0	0
ave	695.4	236.78	8.3	0.15	7.12	25.3	49.22	36,163.79
No. of Sampling	12	12	12	12	12	12	12	12

2.1.6 Talvar Storage dam and irrigation-drainage network

1) Location

This dam will be constructed in the east longitude degree of 47o 28' and the north latitude degree of 35o 47', at 152 Km of the southwest of Zanjan and about 30Km of southeastern part of Bijar city on the Talvar river. The Talvar irrigation-drainage network is located at the east longitude degree of 48o 37' to 48o 26' and the north latitude degree of 35o 46' to 36o 01'.

2) Description of the case study

This river originates from the Zagros and flows in to the Ghezelozan River.

3) Water Quality

a) Location

Hydrometric station that was located in the Talvar project area is Salamat-abad station.

b) New Sampling

Water quality of the Talvar River, stand point of physic-chemical and biological parameters in dam construction site and diversion tunnel, were investigated.

c) Sampling Stations of Other Organization

Other organization was not considered.

The results of physic-chemical and biological parameters (Zanjanrud) have been come out by the Zanjan Environmental Research Center.

According to the results of Vilcox diagrams, the water quality of this river is classified in C3S2-C3S1 class, and also according to the Shouler diagram the water quality at the stations is good- unsuitable. The chemical quality of water at the Salamat abad station is shown in Table 2.1.16. The diagrams of Vilox- Shouler are shown in App. Fig. 11 and 12.

Table 2.1.16 The Water Classification of Talvar River at the Salamat Abad Station

River-Station	Drinking water			Agricultural water
	Minimum	Average	Maximum	
Talvar-Salamat Abad	good	acceptable	unsuitable	C3S2-C3S1

Table 2.1.17 Test Result of Sampling at Talvar Dam

Type of Test	pH	Color	Turbidity	EC	TDS	TH	F^-	CL^-	SO_4^{2-}
Unit	-	Pt-Co	N.T.U	s/cmμ	mg/l	mg/l	mg/l	mg/l	mg/l
Amount	7	-	22	1112	715	316	0.5	129	176

Type of Test	NO_3^-	NO_2^-	CO_3^-	HCO_3^-	PO_4^{3-}	Ca^{2+}	Mn^{2+}	Na^+	K^+
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Amount	0.03	5	0	302	0.85	73	32	130	1

Table 2.1.18 Test Result of Sampling at Talvar Diversion Tunnel

Type of Test	pH	Color	Turbidity	EC	TDS	TH	F^-	CL^-	SO_4^{2-}
Unit	-	Pt-Co	N.T.U	s/cmμ	mg/l	mg/l	mg/l	mg/l	mg/l
Amount	7	-	2	481	290	242	0.2	18	20

Type of Test	NO_3^-	NO_2^-	CO_3^-	HCO_3^-	PO_4^{3-}	Ca^{2+}	Mn^{2+}	Na^+	K^+
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Amount	0	8	0	235	0.47	64	19	22	0.4

2.1.7 Standard

Table 2.1.19 Water Quality Regulation for Consumption

Type of Test	Public Quality Criterion	Drinking		Agriculture		Aquaculture		Demand of Beasts	
		Iran	WHO	Iran	WHO	Iran	EPA	Iran	EPA
pH	5.5- 8.6	6.5-9.2	5.5- 8.6	5.5- 8.6	-	6-9	-		6-9
SAR	-	-	-	-	0.3	-	-		
EC	1190	-	-	-	0.7	-	-		
TDS (mg/L)	750	2000	1000		450	-	-		
TDS (mg/L)	-	-	-	100	-	-	30		
TDS (mg/L)	-	500	500		-	-	-		
DO	5	-	-	2	-	-	6-9		
BOD (mg/L)	10	-	-	100	-	-	30		30
COD (mg/L)	-	-	-	200	-	-	-		
TOC	-	-	-	-	-	-	-		
Ca 2+	-	75-200	-	-	-	-	-		30
Mg 2+	-	50-150	-	100	-	-	-		
Na -	-	-	200	-	3	-	200		
Nitrate	2/5	45	50	-	-	-	-	100	
Phosphate	-	0/1-0/2	-	-	-	-	-		
Sulfate		400	400	500	-	-	-		
Chloride		-	0/2	600	-	-	-		
Nitrite		1.0		-	-	-	-	10	
Potassium				-	-	-	-	-	
Chrome		0.05	0/05	1	-	03.0	-	1	
Cobalt		-	-	0/05	-	-	-	1	
Cadmium		01.0	003.0	-	-	03.0	-	Mic g/l50	
Copper		1	2	2.0	2.0	0.1	-	.50	
Plumb		05.0	0.01	1	5	0.03	-	0.1	
Nickel		-	0.02	2	-	0.02	-	-	
Zinc		15	5	2	2	0.03	-	25	
Iron		1	3.0	3	-	-	-	Trace	
Manganese		5.0	5.0	1	-	-	-	Trace	
Arsenic		05.0	01.0	0/1	0/1	-	-	0.2	
Mercury		001.0	001.0	Trace	-	0.05	-		

Table 2.1.20 Water Quality Standards for River

Type of Test	Unit	Different Classes				
		4	3	2	1B	1A
Temperature(0c)	-	30>	25-30	22-25	20-22	20<
pH	-	5.5< OR 5. 9>	5-9.5.5	5.5-8.6	5.5-8.6	5.5-8.6
DO	g/lit	30<		3-5	5-7	7>
DO	-	50<		50-70	70-90	90>
BOD5	mg/lit	25>	10-25	5-10	3-5	3<
COD	mg/lit	80>	40-80	25-40	20-25	20<
SO4	mg/lit	250>			250	
NH4	mg/lit	8>	2-8	5-2.0	5.1-0.0	1.0<
NO3	mg/lit	100>	44-100	05.001-0.0	44<	
Phenol	mg/lit	>0.5	5.05-0.0			001.0<
PO_4^{4-}	mg/lit		7.0>	5.2-0.0	7.4-0.0	4.0<
MBAS	mg/lit	>0.5				2.0<
CN	mg/lit	>0.05			05.0<	
Cr	mg/lit	>0.05			05.0<	
F	mg/lit	7.1>			7.7-1.0	7.0<
Pb	mg/lit	>0.05			05.0<	
Se	mg/lit	>0.01			01.0<	
Cu	mg/lit	1>		05-1.0	-	05.0<
Zn	mg/lit	5>			3-5	3<
As	mg/lit	1.0>		1.05-0.0		05.0<
Fe	mg/lit	5.1>		5.1-1	5-1.0	5.0<
Mn	mg/lit	5.0>		5.25-0.0	1-0.25.0	1.0<
Cd	mg/lit	005.0>			005.0<	
EC	µmg/lit	3000>	1500-3000	750-1500	400-750	400<
CL-	mg/lit	1000>	400-1000	200-400	100-200	100<

Sources: Kerenekel, Novotony, 1980

2.2 ENVIRONMENTAL IMPACTS ANALYSIS OF THE DAMS

Based on the conducted studies (Talvar 2007, Galabar 2004, Givi 2004, Ramin 2004 and Ostor 2005) information as to environmental impacts that have been loaded on environmental media such as air, water, soil, fauna and flora were aquintc were collected. Tables 2.2.1 and 2.2.2 indicate negative and positive impacts that have been resulted from construction and operational phase of the projects. Based on Tables 2.2.1 and 2.2.2 comparative and regional – based analysis of the environmental impacts are carried out as follows:

2.2.1 Construction phase

1) Socio-economic and cultural impact analysis

Out of the assessed environmental factors, socio-economic and cultural impacts and impacts on local economy had been focused. These factors were assessed for all the projects. Out of the afore-mentioned projects, Galabar, Ramin and Givi had server positive impact on local economy. For Talvar and Ostor, their impacts on local economy had been moderate and poor positive impacts, respectively.

As to the displaced human population; out of the afore-mentioned projects, two projects (Talvar and Galabar) had been assessed. The results indicated that construction phase of the Talvar project had incurred a moderate positive impacts on displacing the human population while the Galabar had the most adverse negative impact on human population displacement. For other project the human population displaced was hot considered.

Standpoint of the incurred impacts on poor people and ethnic groups; out of the afore-mentioned, the Ostor project was assessed so that its construction phase had moderate positive impact on poor people and ethnic groups. Regional conflicts and water rights were investigated in none of the projects.

As to public hygiene, three projects (Talvar, Galabar and Ostor) were assessed. The results indicated that the Talvar project had incurred slight positive impacts on the public hygiene. The Ostor project has imposed moderate positive impacts For the Galabar project, no impact on the public hygiene was assessed during its construction phase.

Environmental impacts of the afore-mentioned projects on land use during construction phase were assessed for two projects, namely Ramin and Givi. Table 2.2.1 shows the results of the Environmental assessment. It suggests that the Ramin and Givi projects had incurred weak negative impacts on land uses.

Environmental impacts – incurred by the projects' construction phase on land value and social acceptance were considered in none of the afore-mentioned projects, except the Ramin project. As to the Ramin project, a weak negative impact was assessed that had been incurred on the Environment.

2) Impact Analysis on Natural Environment

As to Environmental impacts, which incurred on marine and coastal Environments during construction phase, three projects (Talvar, Givi and Ostor) have been assessed. Table 2.2.1 indicates that the Givi project had weak negative impacts during construction phase. Moderate negative impacts were imposed by the Ostor project. Although Environmental impacts of the Talvar project were considered, quantitative Environmental assessment was not carried out. In construction phase, quality of the river water would be decreased because of increasing the turbidity. Severity of the impact is sometimes very high and would cause mortality of the aquatic species and to limit suitable habitat. As to the Ostor project, construction phase had been lasted two years. The construction practices would affect migration of trout.

Environmental impact assessment of the projects on animal, plant and biological diversity indicated that all the projects (Talvar & Ostor) had weak negative impacts on them, while impacts of the Galabar and Ramin were not considered during quantitative environmental assessment. It could be originated from earthworks (cut and fill) in construction site of the dams and adjacent areas. It would cause to degrade vegetation cover and habitat. Transportation and use of heavy vehicles would also incur noise pollution so that it might be considered as a stressing factor for abandon the study area.

Impact of the afore-mentioned projects on conservative plant and animal species was assessed. The results show that the Givi project had weak negative impacts. This is while impacts of the Galabar and Ramin were considered but quantitative environmental assessment was not done for it. As to the Talvar, non-impact on conservative plant and animal species was assessed. This is why vegetation in the effected area was very poor, and in turn it would be able support poor wildlife there.

Environmental impacts of the projects on downstream fauna and flora was investigated in the Givi Project but environmental quantification was not carried out. This impact was associated with increasing the turbidity and compactness the river bed through passing the different vehicles.

As to impacts of the projects on aquatics and bent hoses, Table 2.2.1 indicated that the Givi projects had weak negative impacts on them. A moderate negative impact was assessed for the impact that was incurred on environment by the Ostor project. These kinds of impacts were

assessed for the Galabar project but no quantitative assessment has been done for the project. It was also not considered for the Talvar project. It could be originated the fact that there were not fish in the Talvar river.

Standpoint of the impacts on micro-climate, none of the project, except the Galabar project, was considered in the environmental impact statement. Because, during the construction of the dam, there will not be the artificial lake that could be able to affect the humidity in the study area.

3) Impact Analysis on Physico – chemical Environment

For the Ramin and Givi projects impact on hydrological regime was assessed. Table 2.2.2 indicates that the Ramin project had moderate negative impacts on the hydrological regime, while the Givi project has incurred weak negative impact on it.

As to water pollution, Table 2.2.2 shows that the Talvar and the Ostor projects had moderate and severe negative impacts on water quality, respectively. In addition three other projects (Ramin, Givi and Galabar) had weak negative impact on the water quality.

Air pollution – incurred by construction phase of the projects was assessed weak, while that of the Givi project was not considered. Noise pollution that had been resulted from the projects, which was assessed moderately negative impacts.

Solid waste – induced pollution was assigned as negative weak impact for the Talvar and Ostor. It was not investigated for the Givi and Ramin projects. No-impact was assigned for the Galabar project since no large-scale solid waste is generated during operational phase of the project.

2.2.2 Operational Phase

1) Impact Analysis on Socio-economic and Cultural environment

The projects had impacts varying between -3 to -5 on human population displacement. The Talvar and Ostor project have caused to create a critical impact (-5) on it. This is while that the Ramin and Givi projects has incurred severe negative impact (-3) on human population displacement. Table 6-3 indicates impacts of the projects in the operational phase on displacing human population. It shows that the operational phase of the Ostor and Talvar had caused the most human population displacement comparatively.

As to impacts on local economy, it might be mentioned that the projects had imposed environmental impacts, which had varied between +5 (for the Ostor project) to +2 (for the Talvar project) in the Sefidrud river basin. Table 6-3 shows impacts of the projects on employment during operational phase. Impact of the projects on local economy was assessed based on those, which affected on local people income individually.

Concerning impacts of the projects on the poor and ethnic groups the afore-mentioned factor was assessed in the Talvar project as severe positive impact. These impacts were investigated through those that were incurred the quality of life such as improvement of the hygienic conditions, transportation and educational opportunities individually.

None of EIS have investigated impacts of operational phase the project on regional conflicts.

Impact of the project on water rights was investigated in the Talvar project so that it was assessed as moderate positive impact.

As to effect of the project on public hygiene, it might be mentioned that positive moderate impact and positive severe impact were incurred by the Talvar and Givi projects.

Weak negative impact was incurred by the Givi and the Ramin projects on landuse, while The Ramin project had no impact on land use since the submerged land uses (75 ha.) by the artificial lake was assessed minor impact.

Impact of the project on land value was investigated in two projects, namely Talvar project and the Ramin project (moderate positive impact)

Social acceptance of the projects was assessed in the Talvar and Ramin projects. The results showed that the Talvar project had moderate social acceptance (+2), while the Ramin project had assessed that has social acceptance without quantification of the impact.

2) Impact Analysis on Natural Environment

Impacts of the projects on coastal and marine environments was investigated SD that it had varied from weak positive impact (+1) for the Givi project to critical negative impact (-5) for the Ostor project. Table 2.2.4 summarizes the impacts of the project on natural environment.

As to impact of the projects on animal, plant and biological diversity, the Ostor project has incurred a positive weak impact (+1), while the Talvar and Givi have imposed positive severe impact on them. As to animal/wildlife species diversity, it might be mentioned that regulation of river flows would cause a continuous development of the vegetation, and increase of the density. The later would cause to emerge and develop the riparian vegetation and in turn, increase of diversity. As to plant species diversity, creating the micro-climate would increase the humidity in the study area. Increase of the humidity would cause the growth period of the grass plants to extend more, and it would provide the ecosystem more production. The later would decrease grazing pressure on those grass plants that have of high importance standpoint of conservative and ecological values.

Impact of the project on the conservative plant and animal spaces was investigated in the Givi project as positive weak impact (-1). These impacts were incurred by artificial lake behind the dam. The artificial lake would degrade the transitional pathways of the wildlife species.

Concerning the downstream fauna and flora, the related impact was assessed as positive severe impact (+3) for the Talvar project and positive weak impact for the Givi project for the Galabar, positive impact was identified but not assessed quantitatively. Meeting the water rights through regulation of the river flow would affect downstream land uses such as agriculture and grassland. It would facilitate a permanent riparian vegetation to be established. Releasing the river flow would create a permanent aquatics habitat for birds, as well.

As to aquatics and bent hoses, moderate positive impact had been associated by the Givi. For the Ramin and Talvar, positive impact was quantitatively assessed. In this matter, river flow regulation would provide a suitable habitat for aquatics and bent hoses.

Concerning the micro-climate, the Talvar and Galabar had incurred weak positive impact (+1) on the micro – climate, while for the Ostor project it was assessed as moderate positive impact (+2). Table 2.2.3 described the impacts of the projects on the plant species and terrestrial ecosystems in the Sefidrud basin. It might be mentioned that the operational phase of the projects has incurred negative impacts on the marine and coastal (riparian) environments. All the environmental impact statements have focused on the impacts of the projects on the riparian ecosystems rather than on the marine and coastal ecosystems because of significant distance of the project to the afore-mentioned ecosystems. For example, as to the Ostor project, about 40 Km of the riparian ecosystem had been submerged by the artificial lake behind the dam.

3) Analysis of Physico – Chemical Impacts

For hydrologic regime, the impact that was incurred by the project had been varied from weak positive impact (+1) for the Givi project to severe positive impact (+4) for the Ostor project. For the Ramin project impact on the hydrological regime was not considered and assessed.

As to water pollution, the Talvar had moderate positive impact (+2), while it was assessed as weak positive impact (+1) for the Ramin and Ostor projects.

For air pollution, moderate positive impact (+2) was assessed for the impact that the Ostor project incurred on air. This impact was not considered and assessed for the Talvar and Ramin

project. For the Galabar was considered as non-impact. Concerning noise pollution, for the Talvar, Ramin and Ostor, this impact was not considered and assessed. For the Givi project, quantitative assessment was not carried out. Non-impact was assessed for the Galabar project, since the air pollution of the construction machines were in minor.

This impact was related to operation /transport of heavy vehicles or construction machines and air pollution that was emitted by them. Table 2.2.3 summarized impacts of the projects on plant species and terrestrial ecosystems in the Sefidrud basin.

Impact of the project on solid waste was not considered for the Talvar and Ramin projects. For the Ostor and Galabar, it was not considered and assessed. This impact was qualitatively assessed for the Givi project.

Table 2.2.1 Environmental Impacts Incurred by the Projects in Construction Phase

		Talvar	Galabar	Ramin	Givi	Ostour
Socio-Economic and Cultural Impacts	Human population displacement	+2	-3	-	-	-
	Local economy	+2	+3	+3	+3	+1
	Poor people and ethnic groups	-	-	-	-	+2
	Regional conflicts	-	-	-	-	-
	Water rights	-	-	-	-	-
	Public Hygiene	+1	*	-	-	+2
	Land use	-	-	-1	-1	-
	Land value	-	-	-	-	-
	Social acceptance	-	-	-1	-	-
Natural Environmental Impacts	Marine and coastal environments	*	-	-	-1	-2
	Animal/ plant and biological diversity	-1	*	*	-3	-1
	Conservative plant and animal species	*	*	*	-1	-
	Downstream flora and fauna	-	-	-	*	-
	Aquatics and benthoses	-	*	*	-1	-2
	Micro-climate	-	*	-	-	-
Physico-Chemical Environmental Impacts	Hydrological regime	-	-	-2	-1	-
	Water pollution	-2	-1	-1	*	-3
	Air pollution	-1	-1	-1	-	-1
	Noise pollution	-2	-2	-2	-	-1
	Solid waste	-1	*	-	-	-1

- Impact was not considered/studies in the report.
× Non-impact
* Impact was studies but not assessed.

Table 2.2.2 Environmental Impacts Incurred by the Projects in Operational Phase (1/2)

		Talvar	Galabar	Ramin	Givi	Ostour
Socio-Economic and Cultural Impacts	Human Population Displacement	-5	-	-3	-3	-5
	Local economy	+2	-	+3	+3	+5
	Poor people and ethnic groups	+3	-	-	-	-
	Regional conflicts	-	-	-	-	-
	Water rights	+2	-	-	-	-
	Public Hygiene	+2	-	2	-	+3
	Land use	-	-	*	-1	-
	Land value	-	-	+2	-	-
	Social acceptance	+2	-	*	-	-
Natural Environmental Iimpacts	Marine and coastal environments	*	-	*	+1	-5
	Animal/ plant and biological diversity	+3	*	*	+3	+1
	Conservative plant and animal species	-	-	-	-1	-
	Downstream flora and fauna	+3	*	-	+1	-
	Aquatics and benthoses	*	+1	*	+2	*
	Micro-climate	+1	+2	-	+2	-
Physico-Chemical Environmental Impacts Socio-Economic and Cultural Impacts	Hydrological regime	+3	-	-	+1	+4
	Water pollution	+2	-	+1	*	+1
	Air pollution	-	*	-	*	*
	Noise pollution	-	*	-	*	-
	Solid waste	-	*	-	*	*

- Impact was not considered/studies in the report.
× Non-impact
* Impact was studies but not assessed.

Table 2.2.3 Environmental Impacts Incurred by the Projects in Operational Phase (2/2)

Project	Construction Phase			Operation Phase			Social Acceptance (%)
	Population Displacement (Person)	Employment	Landuse (ha)	Population Displacement	Employment	Landuse (ha)	
Ramin	-	300	-	1083	500	-	100
Galabar	-	-	-	736	-	850	100
Talvar	-	-	-	578	-	1200	100
Ostour	-	300	-	17000	-	8455	92
Givi	-	200-500	-	50	-	6000	100

-: No figure was mentioned in the reports.

Table 2.2.4 Ecological Impacts Incurred by the Projects in Construction Phase

Project	Plant Species	Animal Species	Aquatics
Ramin	• To degrade delivering pass of plant species such as celtis australis and Prangos ferru laceae	• To degrade some part of habitat of some species such as large – toothed sousili and Vipera albicornuta	---
Galabar	• Severe damage to Thymus caucasicus, Astragalus aures and Amygdalus lyaoides	• To doerease significant part of species such as Ulpera lebetina	• To Increase turbidity in aquatic habitat of Capoeta aculata and Barbus brachycephalus
Talvar	• Partial damage to Riparian habitates	---	---
Ostour	• To decrease fish migration to upstream during construction phase • Negative impact on riparian vegetation	---	---
Givi	• To incure impact on the threatened species such as: • Astragalus spp. • Amigdalus spp.	---	---

2.3 SUGGESTION

Regional Analysis of environmental Impacts that has incurred on the environment would provide us with a knowledge how much extend all the human activities has caused to degrade the environment at sub-basin or basin scale.

Accordingly, regional analysis of the environment would be able to classify the extend of the afore-mentioned environmental degradation with aim of prioritization of the sub-basin / basin in order to allocation more / stop allocation of more development projects. Necessities of the afore-mentioned task is too access baseline data and information as to environmental status and human activities in cross the region.

In order to conduct regional environmental impact assessment of all the human activities (projects) in the Semidried basin, it is proposed to study environmental degradations based on landscape degradation model (LDM) aiming to determine the extend of the environmental destruction in sub-basin scale in the Semidried basin.

The findings of the above – mentioned study would guide environmental planners and managers to know how much the sub-basin of the Semidried basin has been degraded comparatively. It would also provide us the required information and data for allocation of further out the development strategy for the Semidried basin.

2.4 CONCLUSION

There is not any limitation for the water quality of Khoein-rud in comparison with the drinking, agricultural and river quality standards, and it is almost in class A1. The amount of electricity currencies and Total dissolved solids at this river is more than standards, and it is in class 4.

There is not any limitation in comprising the results of Ramin and Zanjanrud river with the standards. The electricity currencies at these rivers are 65 and 1084 $\mu s/cm$ respectively, therefore the Ramin river is in class B1 and Zanjanrud river is in class 2.

The results of Comparison of Ghezelozan river with the standards show that this river on the subject of EC and TDS is in class 4 and there is not any limitation for other parameters.

The results of Quzel ozan river at the Shahryar dam in comparison with the standards show that this river according to SO42- ،CL-,and EC is in class 3 and there is not any limitation for other parameters.

Comparison the results of Talvar river at the Talvar dam with the standards, show that this river according to EC parameter is in class 2 , CL parameter in class B1, and Mn2+ parameter is in class 4. There is not any limitation for other parameters and is categorized in class A1.

There is not any limitation for Talvar river at the Talvar dam diverted tunnel in comparison with the standards, and they are categorized in Class A1. Just EC and Mn2+ parameters are categorized in Class B1 and 4 respectively.

The results of sampling at 7 points of Givi river show that the water quality of Givi river at the G1, G3 and G7 stations according to the BOD parameter, is in class B1, and at the G5, G3 stations according to CL- is in class B1. The water quality of Givi river at the G1, G2, G4, G6, and G7 stations according to phosphate and mercury parameters is not suitable for drinking usages, and the water quality of Givi river at the G1, G2, and G7 stations is not suitable for aqua-culturing.

2.5 REFERENCES

1. Givi Environmental Impact Statement, Mahab Ghodss, 2004
2. Galabar Environmental Impact Statement, Mahab Ghodss, 2004
3. Ostour Environmental Impact Statement, Mahab Ghodss, 2005
4. Ramin Environmental Impact Statement, Mahab Ghods, 2004
5. Talvar Environmental Impact Statement, Mahab Ghodss, 2007

Appendix for Chapter 2

App. Tab. 1 Chemical and Biological Test Results in Khooninrud River

Row	Unit	Type of Test	1380				1381					1382
			7/17	6/12	8/30	9/17	1/24	3/1	5/1	7/1	10/11	1/20
1		pH	6.7	7.5	1.7	6.8	7.7	7.5	6.9	6.7	7.5	4.7
2	ms/cm	E.C	15000	25000	1700	1800	1700	16000	2800	2000	1900	1000
3	^{o}C	T (Environment)										
4	^{o}C	T (Water)	21	25	11	7	10	-				
8	mg/l	TDS	10356	20096	1082	1230	1190	10100	19050	1400	1330	700
9	mg/l	DO	10.5	10.6	12.5	12.5	12.5	-				
10	mg/l	BOD_5	0	0	0	0	0	0	2	2	0	0
11	mg/l	COD	15<	15<	15<	15<	15<	15<	15<	15<	0	8
12	/100ml	T.CF	50	240	460	460	460	210	240	1100	460	240
13	/100ml	F.CF	4	7	28	11	28	7	11	1100	75	
22	mg/l	NO_2^-			0.06	0.05	0.03					
23	mg/l	NO_3^-	03.0	04.0	2.3	3.4	1.8					
24	mg/l	NH_4^+	01.0	02.0	9.0							
29	mg/l	Pb^{2+}	0.1	Trace	Trace							
30	mg/l	Zn^{2+}	01.0	02.0	0.01							
31	mg/l	Cd^{2+}	Trace	04.0	0							
37	mg/l	Mn^{2+}	03.0	-	0.1							

Sources: : Environmental center of Zanjan province-2003

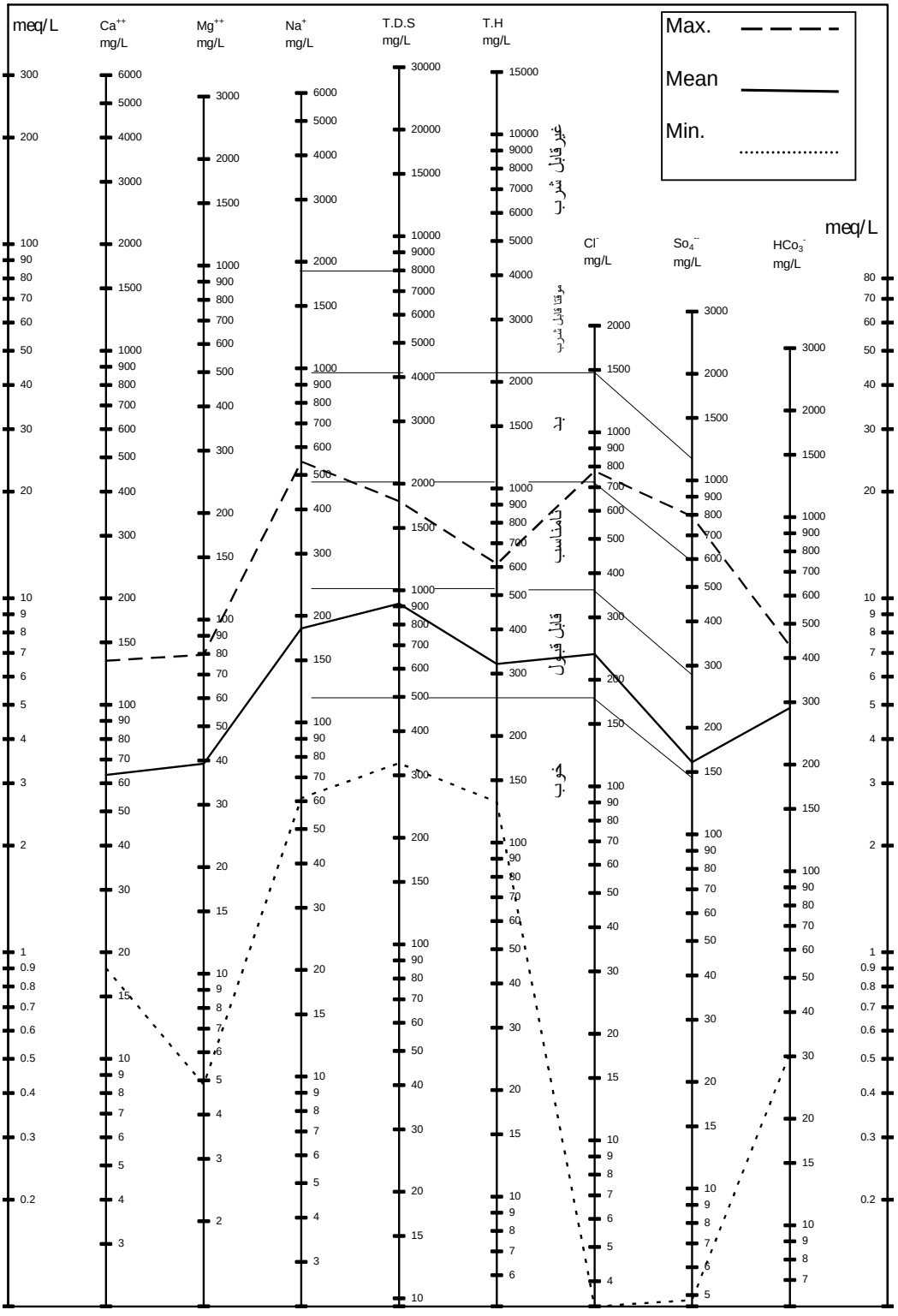
App. Tab. 2 Chemical and Biological Test Results in Ghezelozan River

Row	unit	Type of Test	1380					1381					1382
			2/12	7/17	8/30	9/17	9/17	1/24	3	5	7	10/11	1/20
1		pH	7.3	7.4	6.9	6.9	7	7.6	6.7	6.6	7.3	7.2	7.5
2	Ms/cm	E.C	28000	8900	4400	3400	425	1600	1230	30000	12000	3000	550
4	^{o}C	T (Water)	24	22	11	6	-	9	-	-	-	-	
8	mg/l	TDS	23020	6859	2850	2345	305	1095	8400	20400	8400	2100	385
9	mg/l	DO	10/2	10/4	11/5	11/5	-	12					
10	mg/l	BOD_5	0	-	-	-	-	-		0	1	0	0
11	mg/l	COD	15<	15<	15<	15<	15<	15<	15<			0	7
12	/100ml	T.CF	1100	1500	460	460	460	460	210	240	1100	150	240
13	/100ml	F.CF	21	11	75	28	0	28	7	7	11	11	
22	mg/l	NO_2^{-1}	-	-	0.08	0.09	0	0.02					
23	mg/l	NO_3^{-}	0	0	2.7	2.8	8	0.9					
24	mg/l	NH_4^{+}	0.04	0.03	2.8								
29	mg/l	Pb^{+2}	0.27	Trace	Trace								
30	mg/l	Zn^{+2}	0.03	0.02	0.02								
31	mg/l	Cd^{+2}	0.05	Trace	0								
37	mg/l	Mn^{+2}	0.03	0.09	0.12								

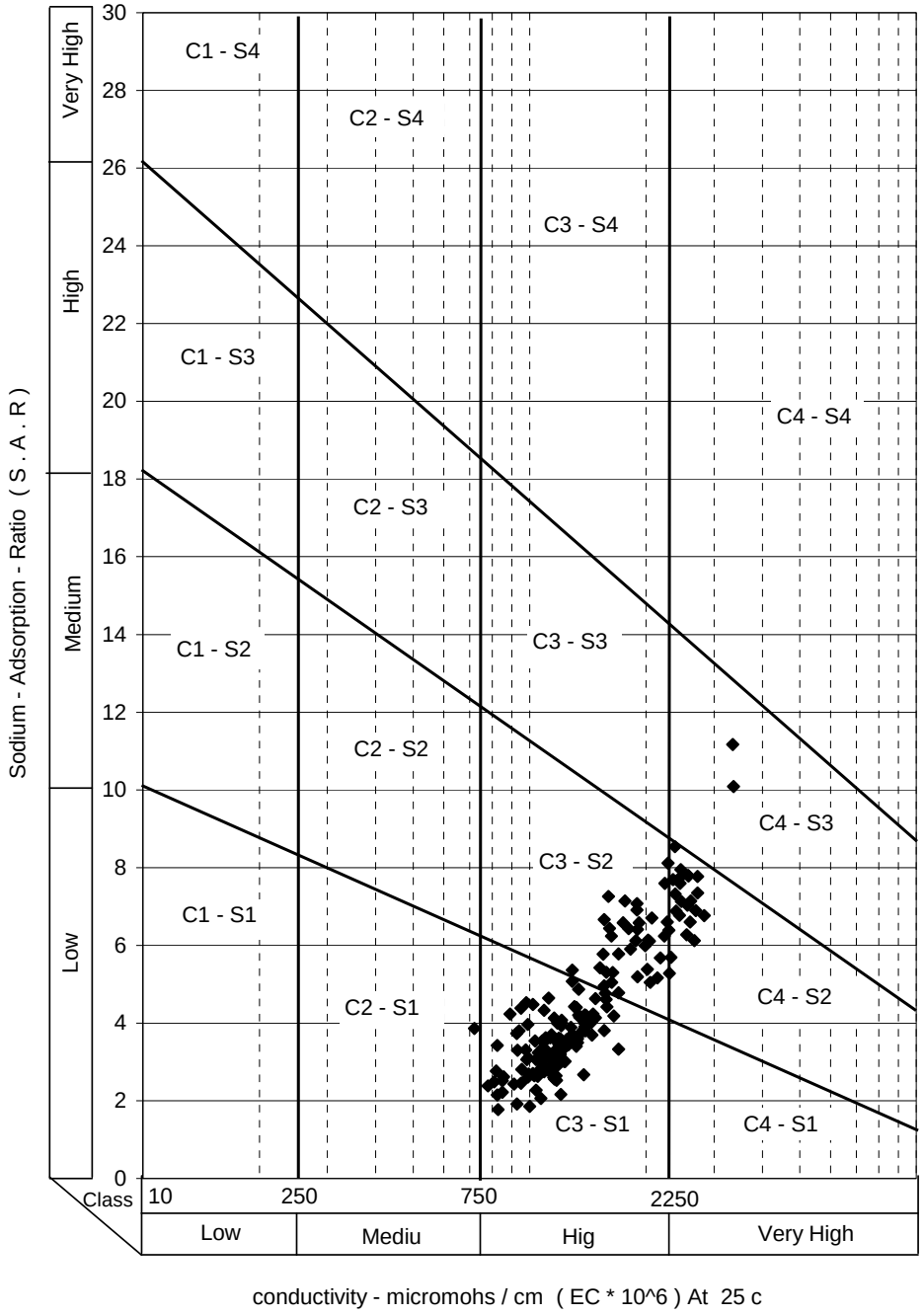
Sources: : Environmental center of Zanjan province-2003

App. Tab. 3 Chemical and Biological Test Results in Shahryar Dam

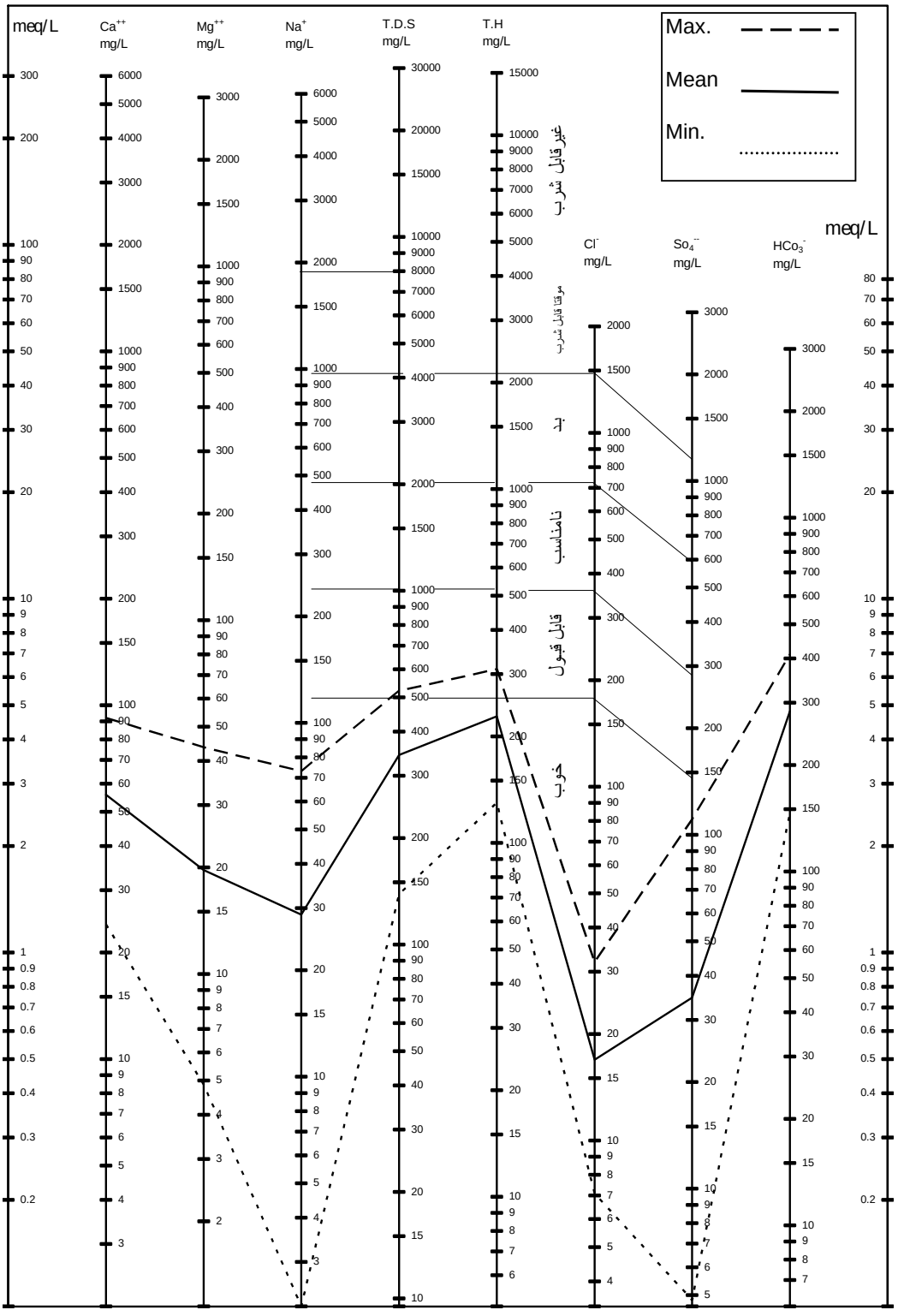
		1380											1381
		2/17	3/21	4/17	5/19	6/23	7/16	8/17	9/19	10	11	80/12	1
		Ave	Ave	Ave	Ave	Ave	Ave	Ave	Ave	Ave	Ave	Ave	Ave
Tsample	^{O}C	11.5	18.55	21.65	25.8	20.2	-	-	-	6.7	-	9.35	11.5
T_W	^{O}C	23	25	25	25	25	25	25	25	25	25	25	25
pH		7.845	7.425	7.55	7.6	7.85	7.65	7.7	7.75	8	7.95	7.95	8.05
E.C.	Ms/cm	3382.8	3613	3911.5	4003	4253	3931.5	3514.5	3741.5	2706	3088	2684	1904
Turbidity	N.T.U	177.6	1.1	2.3	19	24	20.75	1.35	241.5	860.5	259.5	208	1839.5
TH	mg/L	545	697.5	697.5	752.5	752.5	750	718.5	620	540	602.5	537.5	357.5
TSS	mg/L	1175	26.5	40.5	50	137	117	56.25	679.5	1382.5	-	2196	4127
TDS	mg/L	2249.1	2354	2552	2691	2800	2734	2319.5	2478	3100	2454.5	0	1533.5
Cl^-	mg/L	873	894.5	907.15	897	996	898	926.5	972.5	640.5	786.5	588	392.5
SO_4^{2-}	mg/L	269	260.5	299.5	267	338	366.5	311	293.5	207.5	246.5	245	125.5
NO_3^-	mg/L	4.35	4.2	3.625	5.9	5.6	5.2	6.2	13.7	6.8	6.44	6.8	8
PO_4^{3-}	mg/L	0.065	0.02	0.055	0.1	0.09	0.02	0.095	0.135	0.275	0.13	0.14	0.12
DO	mg/L	6.5	8.18	8.07	7	7.6	9.75	11.15	10.05	11.15	0	10.2	9.6
BOD_5	mg/L	12	3.4	3.06	8	13	14.5	15	52.5	14	21.5	10.75	25.8
COD	mg/L	72.32	35.5	24	28	28	30	41	90	66.4	0	41.5	70
MPN		0	655	> 2400	> 2400	0	0	0	0	45000	68000	45000	45000
Coliform		0	0	+	+	0	0	0	0	+	0	0	0
F.C.		0	0	+	+	0	0	0	0	+	0	0	0



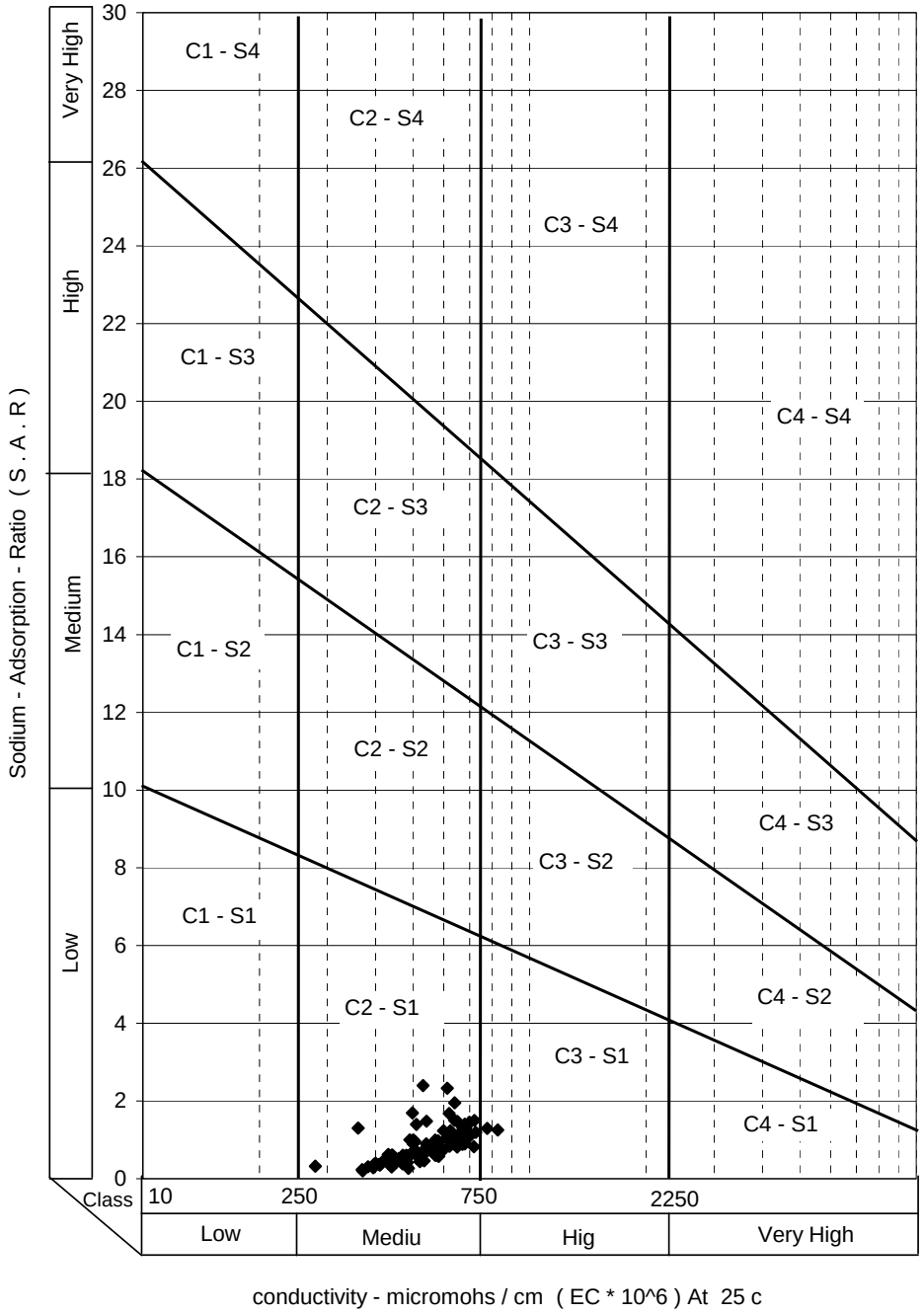
App. Fig. 1 Water Quality of Sajas River in Yangikand Station as Drinking Water



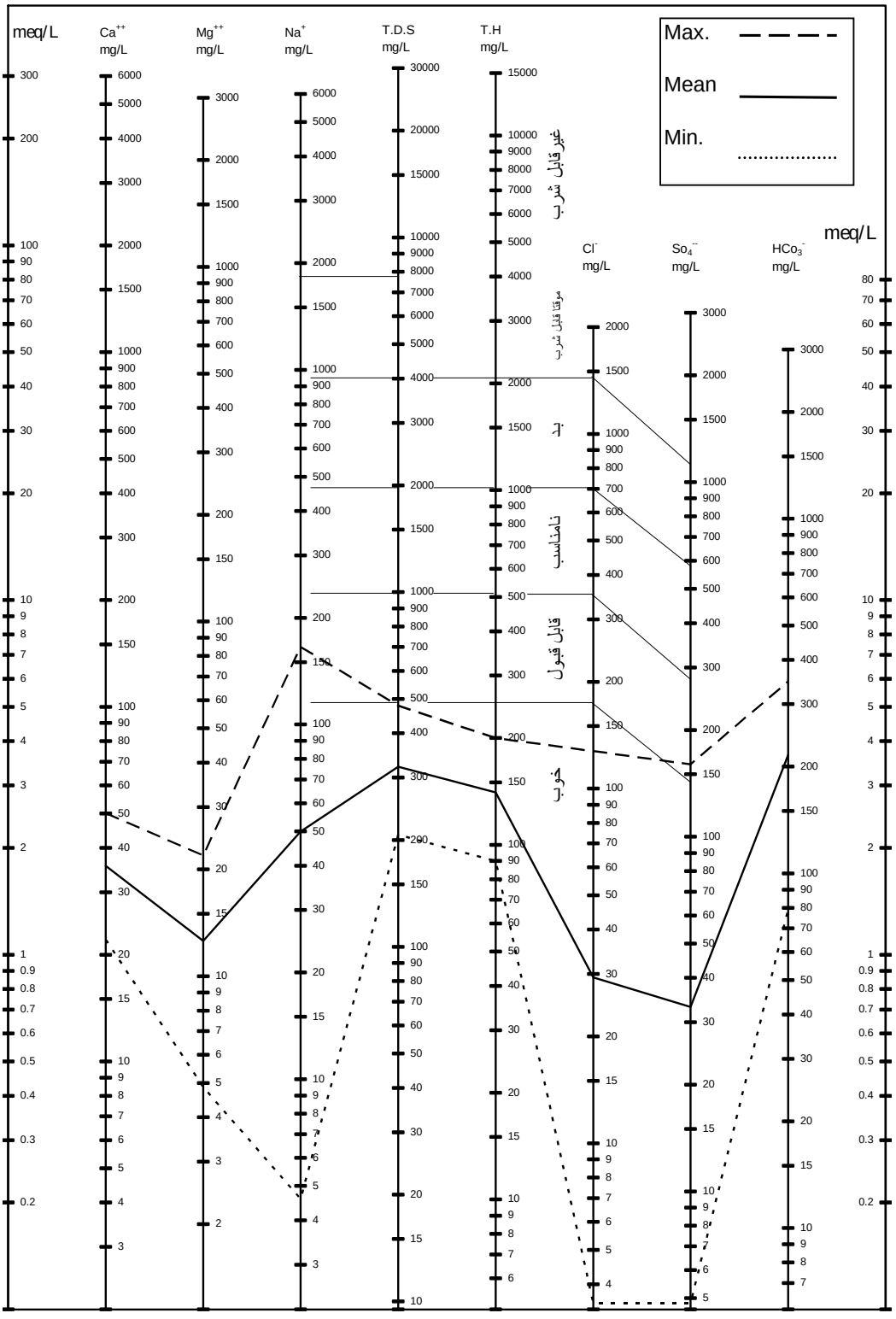
App. Fig. 2 Classification of Sajas River Water Quality for Agricultural Purpose



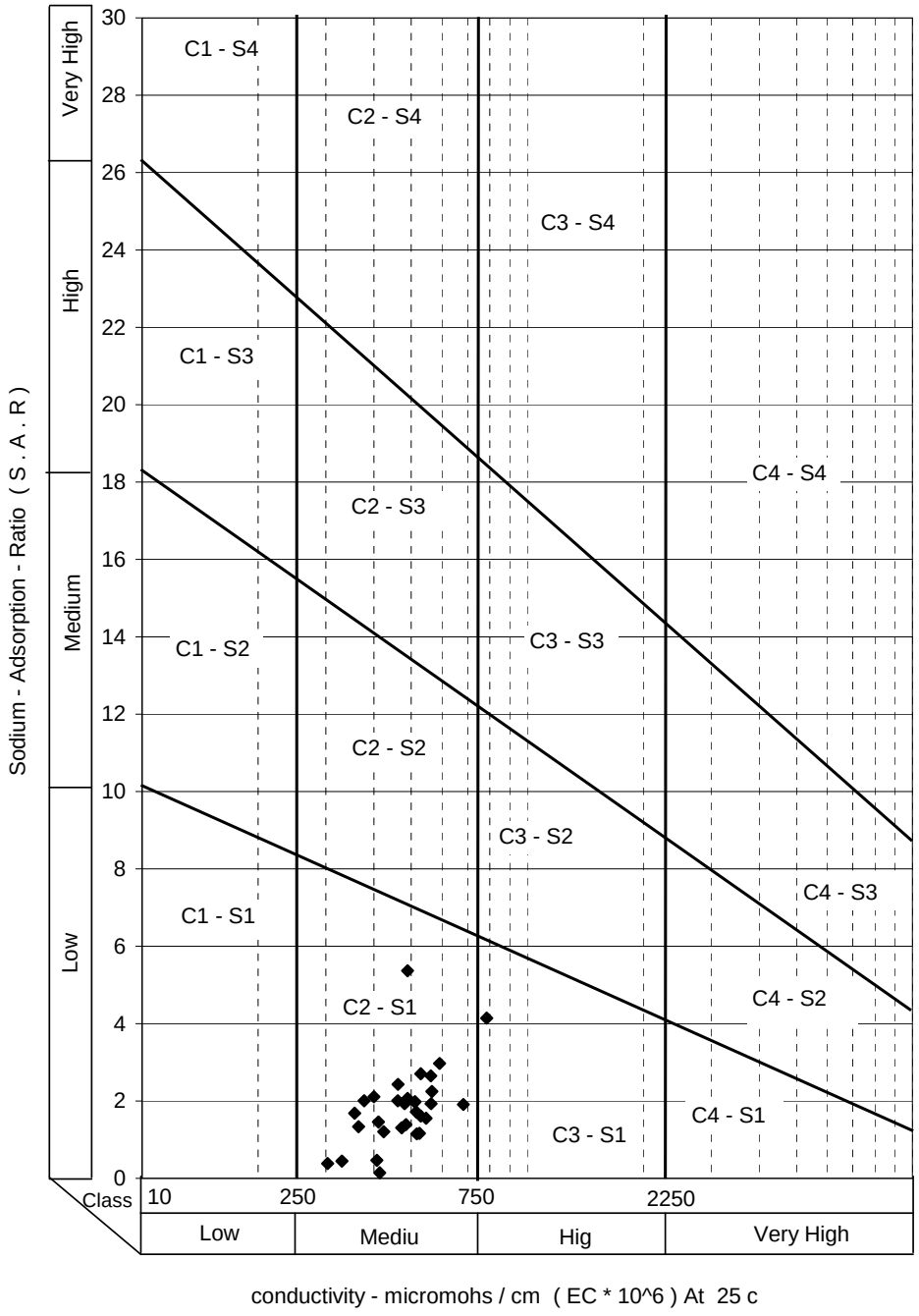
App. Fig. 3 Water Quality of Ghezelozan River at Ramin Station as Drinking Water



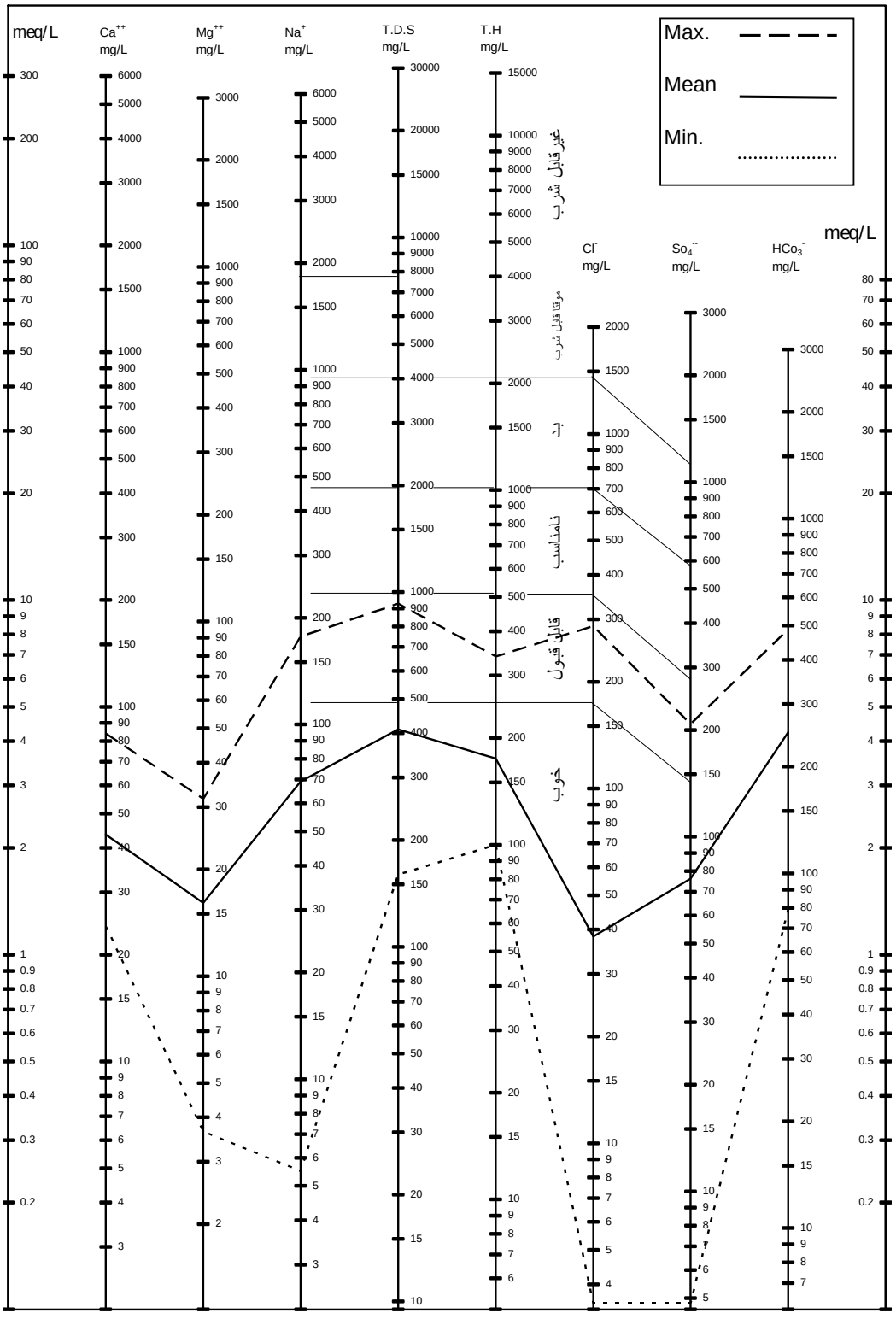
App. Fig. 4 Classification of Ghezelozan River Water Quality for Agricultural Purpose



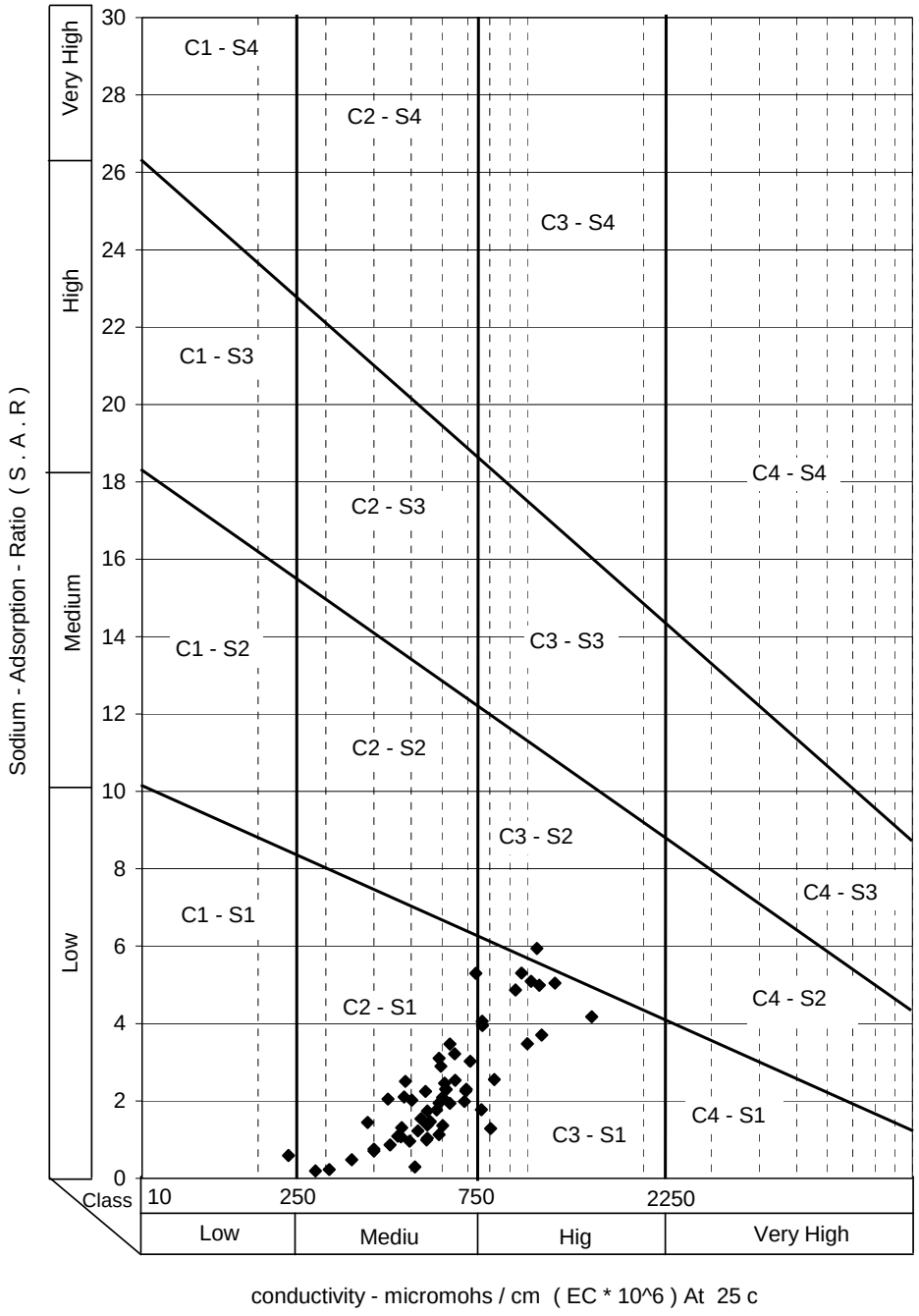
App. Fig. 5 Water Quality of Heroochay River at Abgarm Station as Drinking Water



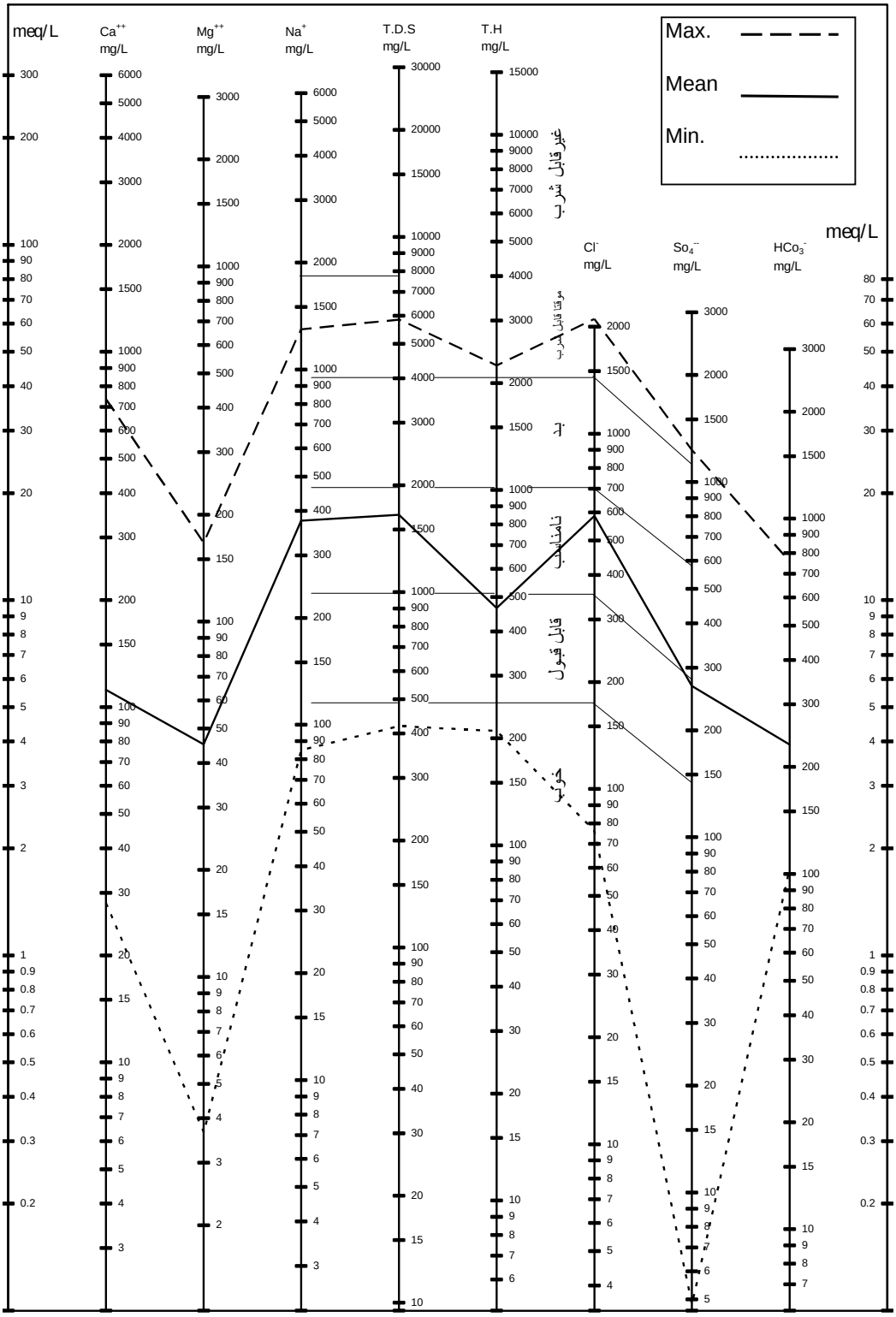
App. Fig. 6 Classification of Heroochay River Water Quality for Agricultural Purpose



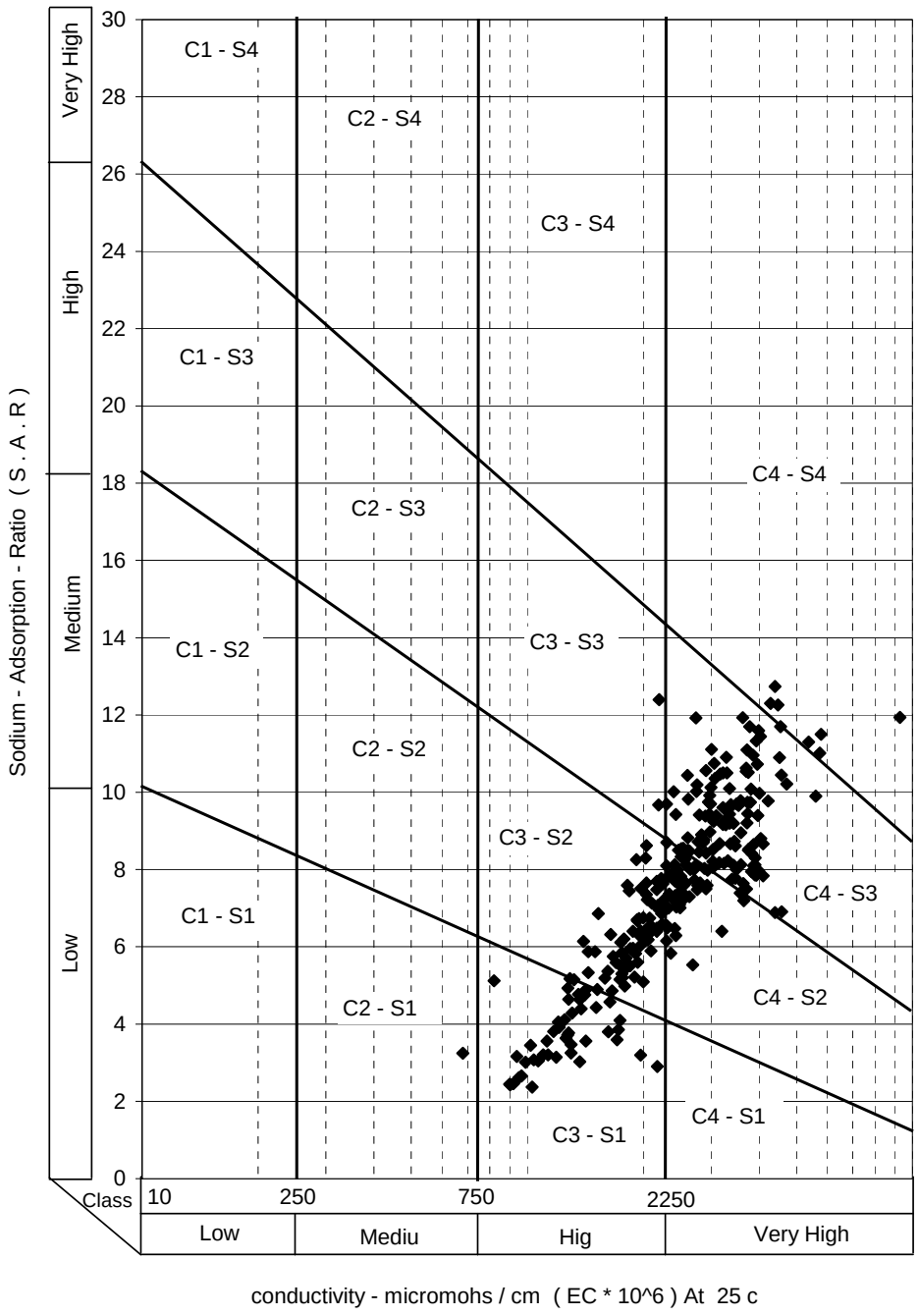
App. Fig. 7 Water Quality of Ariachay River at FirouzAbad Station as Drinking Water



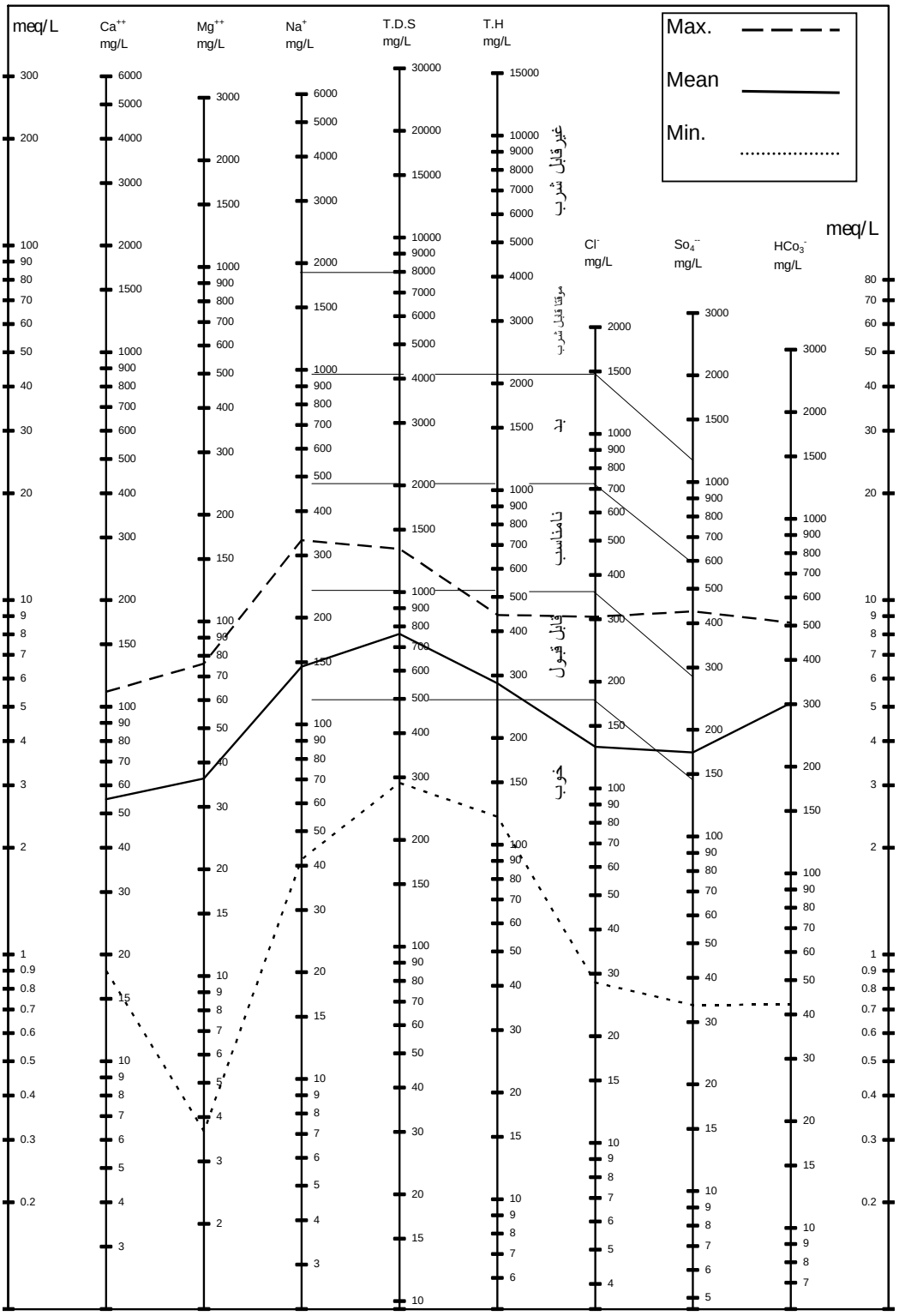
App. Fig. 8 Classification of Arpachay River Water Quality for Agricultural Purpose



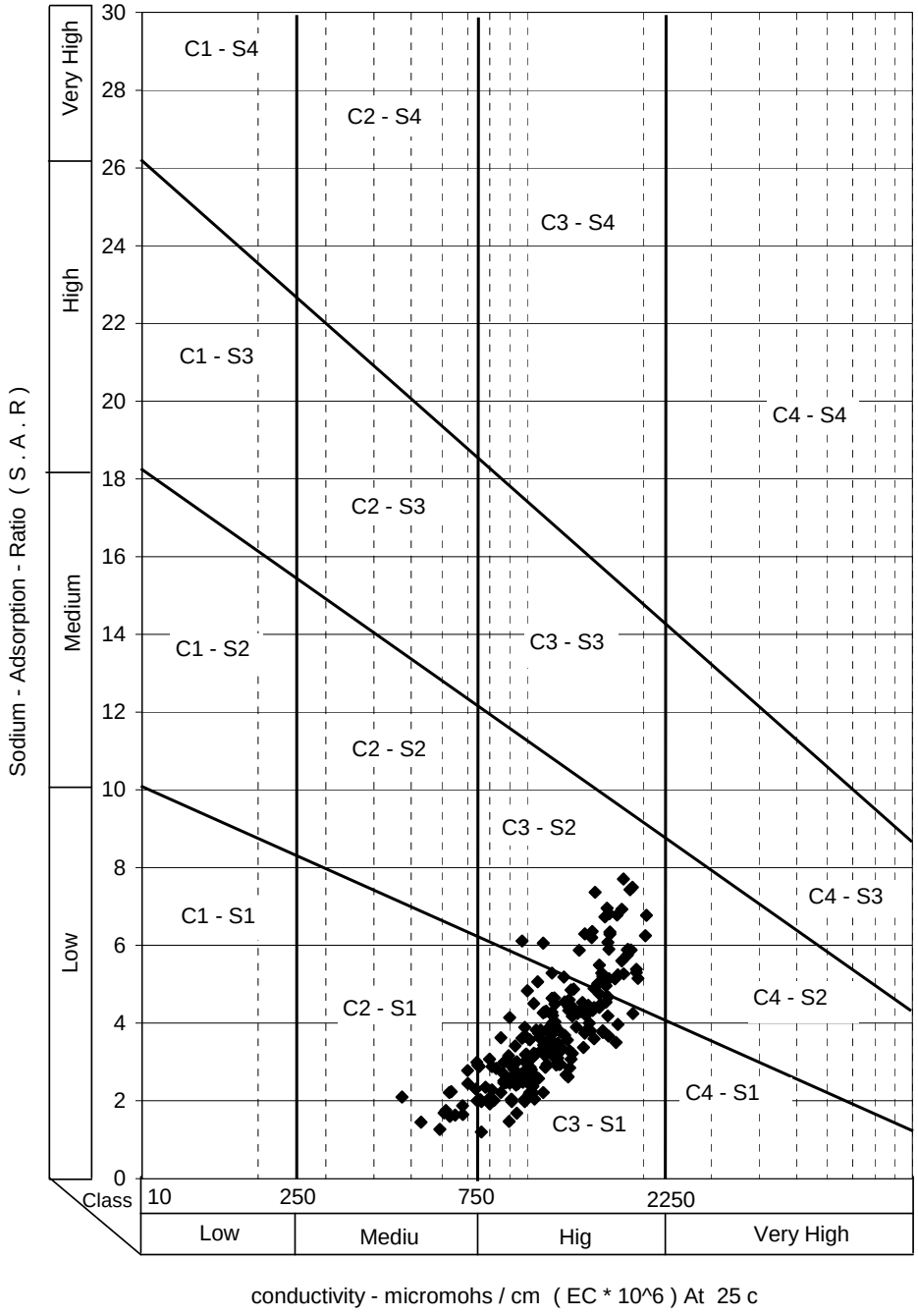
App. Fig. 9 Water Quality of Ghezelozan River at FirouzAbad Station as Drinking Water



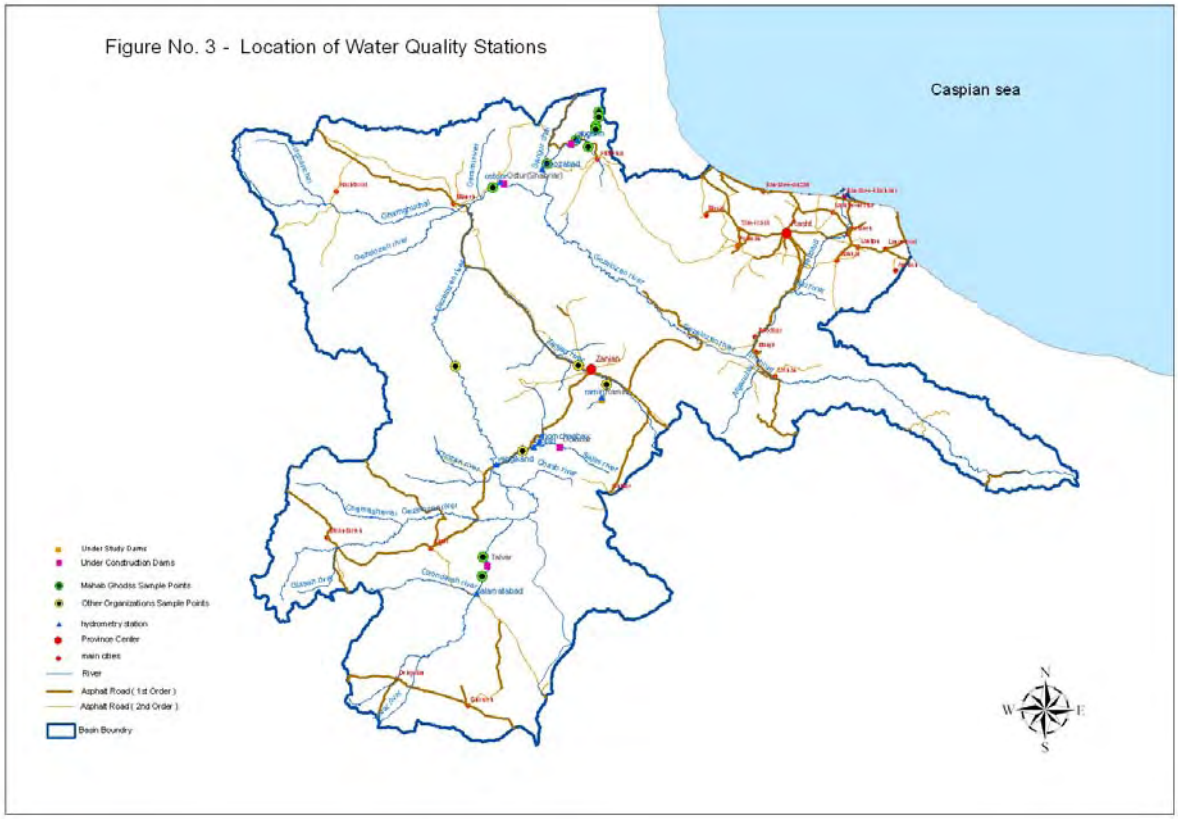
App. Fig. 10 Classification of Ghuzel Ozan River Water Quality for Agricultural Purpose



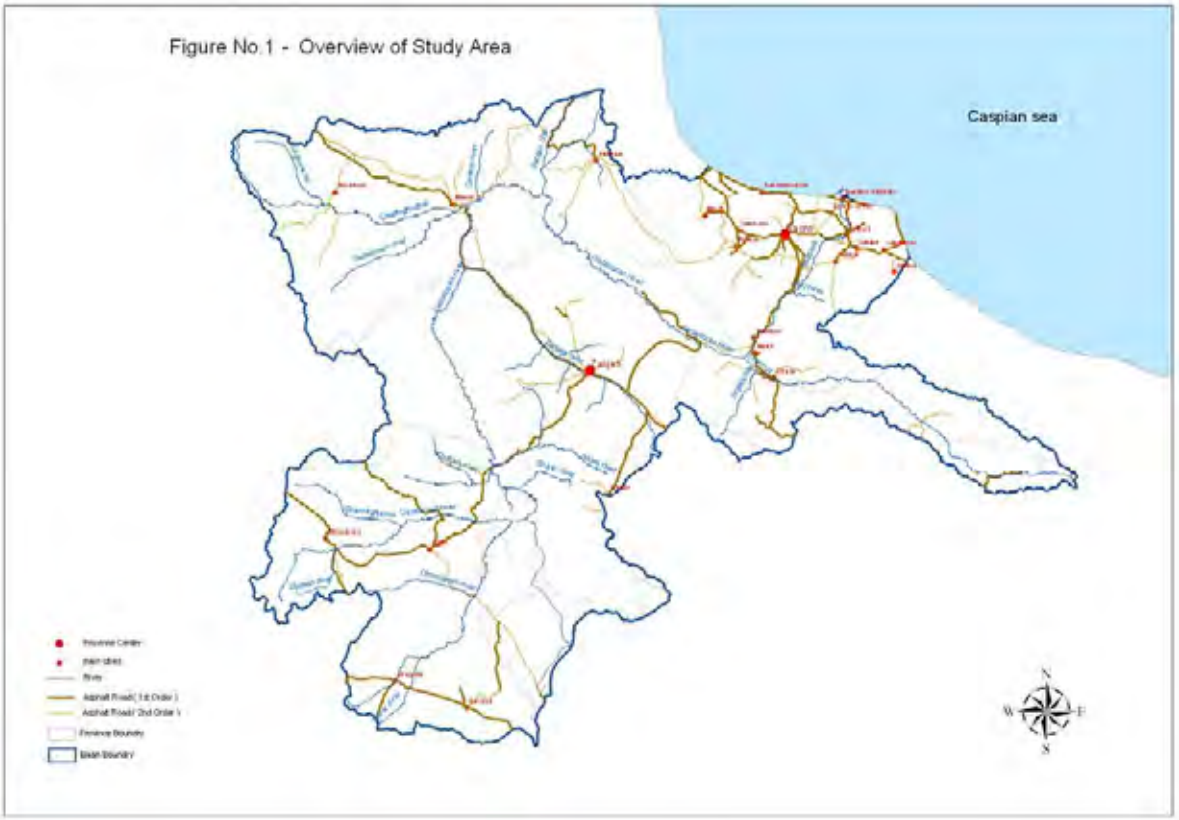
App. Fig. 11 Water Quality of Talvar River in SalamatAbad Station as Drinking Water



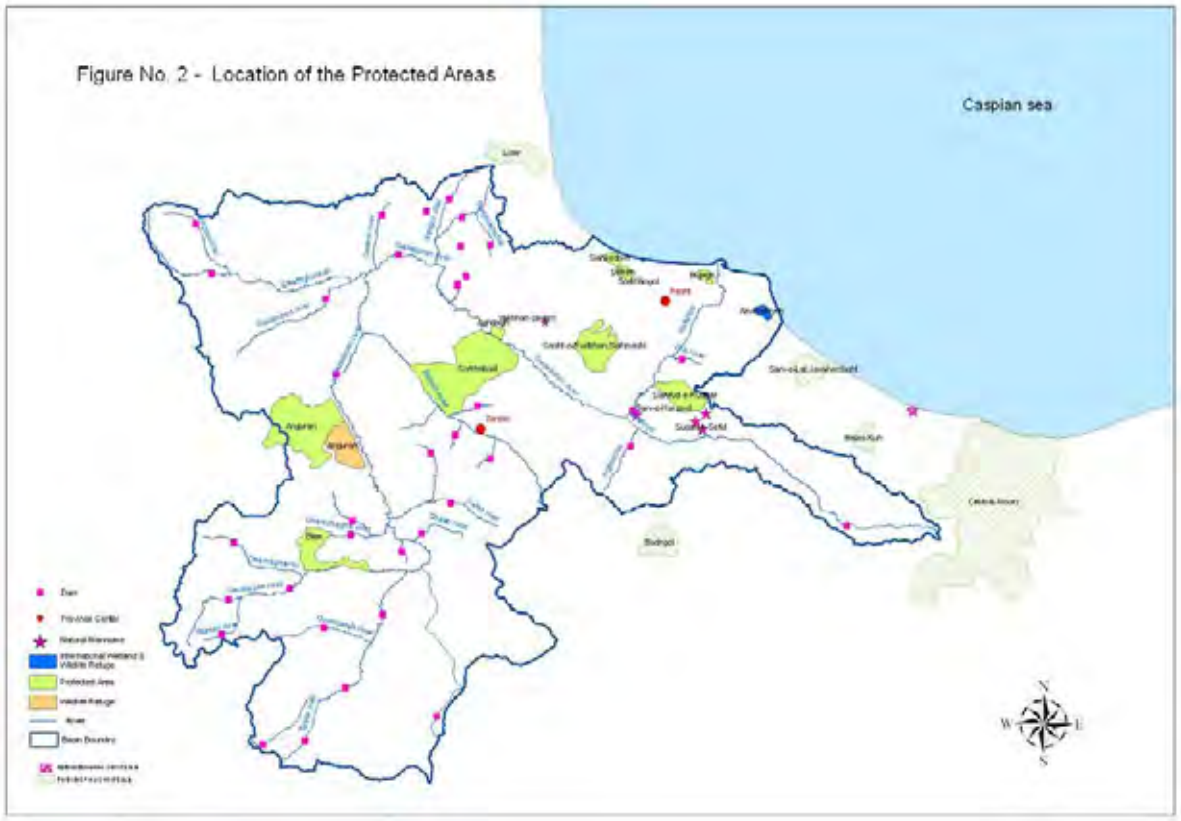
App. Fig. 12 Classification of Talvar River Water Quality for Agricultural Purpose



App. Fig. 13 Classification of Talvar River Water Quality for Agricultural Purpose



App. Fig. 14 Study Area



App. Fig. 15 Location of Protected Areas

Annex
STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)

CTI ENGINEERING INTERNATIONAL CO., LTD.

Strategic Environmental Assessment for the Integrated Water Resource Management Studies of Sefidroud Basin in I.R. IRAN

MAHAB GHODSS
Consulting Engineering

Project Code : 918709	Section Code : 2040	Report Number :
Date Of Issue: November 2008 First Issue Date: November 2008 Change Date : Change Number:		
For Comment ☐	For Validation (Approval) ☐	For Information ☐ For Action ☐

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Tables

C

Introduction

Implementation of project titled Strategic Environmental Assessment for the Integrated Resources Management Studies of Sefidrud River Basin in I.R. Iran has been agreed and signed between CTI engineering international Co. Ltd on the behalf of the Japan International Cooperation Agency and Mahab Ghodss Consulting Engineering Co. under contract No. 918109 on 14th July 2008. The general objective of the project are as follows:

- General description of the area around dams including environmental and social natural environments
- General description of the dams
- Identification of negative impacts on social and natural environments

Study area of the project is consisted of seven dams out of all the dams that have been located in the Sefidrud basin and their environmental impact assessment studies have been conducted. The dams of interests are including Mushampa, Aledare, Ghezel Tappe, Ramin, Songhor, Chesb and Mehtar (Figure 1). Scope of the work consists of the study area that has been defined in each projects as well.

It might be noted that some of the projects of the interests has been accompanied with irrigation and drainage network project in this downstream. In such as case, findings of environmental impacts of dam are considered and reported here.

The dams of the interest have assessed based on different weighting system as majority of them were studied by different Engineering Consulting Companies.

None of the dams of the interested was not studied by Mahab Ghodss Co. except one dam (Ramin). EIA reports of the dams of the interest was investigated by other engineering consulting companies. This is why different approaches were taken to conduct the EIA in general, and weighting system in particular of the dams of the interest. Therefore, It has created some challenges for integration and synthesis of the collected data and information as environmental impacts induced by the project on natural and social environments of dams. To deal with it, environmental impacts have reported as they were appeared in their environmental impact assessment report. It was tried the reasons underlying for each environmental impact to be mentioned based on the related reports as well. it might be mentioned that Mahab Ghodss Co. has not conducted an independent study for the afore-mentioned dams,

however the present study is based on the findings of EIA reports that was conducted by other companies. So that Mahab Ghodss Co. would not accept any responsibility as to accuracy of data and information that was used by the afore-mentioned companies.

1. Methodology

According to Technical Reference of the Contract No. 918709, general description of the study area including geographical situation of the study area, geographical coordination of the dams, topographical features of the study area, geology, soil types, hydrology, climate and wild life), and social environment (including human population, economical activities, hygiene) Would be considered and investigated. Based general description of the dams (including purpose of construction of the dam, location of the dam, supplementary civil constructions) are also investigated. Tables 1-1 to 1-4 have indicated the meta-data for description of human population, economic features, hygien and services, general description of the dams, respectively.

As to environmental impacts of the dams that were listed in the introduction, it might be mentioned that positive and negative impacts, which have been loaded on environmental media including air, water and soil are reported in two separate phase i.e., construction and operational phases. For reporting the environmental impacts of the dams of the interest, tables 1-6 and 1-7 were considered. These tables have been completed based on the data and information that have been included in the relevant project's EIA reports. Scoring the environmental impacts has been carried out based on different procedures namely, checklist and matrix methods so that the former is inspired by Leopold (1970), Canter (1999), ICOLD. According to procedures that were applied by different consulting engineering companies, three features for a given impact are considered. These features are type/kind of impact, characteristics of the impact, and intensity of the impact.

Determining the type of the impact has been carried out in form of negative or positive ones. Intensity of impact has also been quantified (Table 1-7).

It might be mentioned that the above-mentioned procedure was applied to formulate the environmental impact statements of the projects. In present study report, intensity of the impacts and its kind/type (positive/negative) were considered. According to tables 1-6 and 1-7, the required data and information were collected in order to complete the relevant tables.

As to Cehsb and Songhor dam's, assessing environmental impacts of construction and operation of the dams and irrigation networks were carried out for four environments namely, physicochemical, biological, man bait and socio-economic environments. It was done using check-list method considering following items:

- Positive and negative impacts

- Direct and indirect impacts
- Short and long term impacts
- Reversible & irreversible
- Extensive and cumulative

The assessment was carried out qualitatively and no quantification was done for impacts.

As to Qezel Tappe and Mehtar, the assessment takes was carried out using Leopold matrix. The assessment task was done for physico-biological, cultural and socio – economic environments. Weighting the impacts was carried out using Makhdoum (1362) and Canter (1996).

As to Aledareh and Ramin, it might be mentioned that ICOLD procedure has been considered for assessment of the impacts. Features of the impact namely (type of impact +/-, intensity and significance) were considered during the assessment process.

Table 1- 1: General description of human population in the study area

Project	No. of Village	Population	Literacy	
			No. of person	Literacy %
Chesb				
Songhor				
Aledare				
Mehtar				
Ghezel Tape				
Mushampa				
Ramin				

Table 1-2: Description of economic features of the human population

Project	Agricultural	Industry	Construction	Services	Total
Chesb					
Songhor					
Aledare					
Mehtar					
Ghezel Tape					
Mushampa					
Ramin					

Table 1-3: Summary of information as to hygiene and services

Project	Rural Agricultural Center	Bank	Treated drinking water	Untreated drinking water	Electricity	Post office	Telephone	Newspaper – magazine	Public Transport	Radio	T.V	Public Bath	Center of Hygiene	Doctor	Total
Chesb															
Songhor															
Aledare															
Mehtar															
Ghezel Tape															
Mushampa															
Ramin															

Table 1-4: General description of the dams

Project	Objective					Dam feature			
	Surface water control	Flood control	Water supply	Electricity supply	Geographical coordination	Tepee	Height	Reservoir volume	Supplementary Installation
Chesb									
Songhor									
Aledare									
Mehtar									
Ghezel Tape									
Mushampa									
Ramin									

1-4

Table 1-5: Environmental factors that were considered in preparation of environmental impact statements of the projects for Construction phase.

		Environmental Impact					
	Environmental factors	**Chesb& Songhir**	**Mehtar**	**Aledareh**	**Mushampa**	**Qezzel Tappe**	**Ramin**
socio-economic impacts	number of resettlement						
	local economy						
	the poor, indigenous and ethnic people						
	historical and cultural assets						
	regional conflicts						
	water right and common right						
	public hygiene						
	landuse						
	land value						
	social acceptance						
natural environmental impacts	coastal and ocean environment						
	fauna/flora and biological diversity						
	conservative plants and animals						
	downstream fauna and flora						
	aquatics and benthos						
	micro-climate						
physico-chemical impacts	hydrologicla regime						
	water pollution						
	air pollution						
	noise pollution						
	solid waste pollution						

○ Impact was not considered/studies in the report

× Non-impact

✸ Impact was studies but not assessed

Table 1-6: Environmental factors that were considered in preparation of environmental impact statements of the projects for operational phase.

		Environmental Impact					
	Environmental factors	**Chesb& Songhir**	**Mehtar**	**Aledareh**	**Mushampa**	**Qezzel Tappe**	**Ramin**
socio-economic impacts	number of resettlement						
	local economy						
	the poor, indigenous and ethnic people						
	historical and cultural assets						
	regional conflicts						
	water right and common right						
	public hygiene						
	landuse						
	land value						
	social acceptance						
natural environmental impacts	coastal and ocean environment						
	fauna/flora and biological diversity						
	conservative plants and animals						
	downstream fauna and flora						
	aquatics and benthos						
	micro-climate						
physico-chemical impacts	hydrologicla regime						
	water pollution						
	air pollution						
	noise pollution						
	solid waste pollution						

○ Impact was not considered/studies in the report

× Non-impact

✸ Impact was studies but not assessed

Table 1-7: Definition and quantification of environmental impact that were considered in preparation of environmental impact statement of the projects

Score	Definition
−5	Critical Negative Impact
−4	Very Severe Negative Impact
−3	Severe Negative Impact
−2	Moderate Negative Impact
−1	Weak Negative Impact
0	Non-Impact
1	Weak Positive Impact
2	Moderate Positive Impact
3	Severe Positive Impact
4	Very Severe Positive Impact
5	Critical Positive Impact

2. Description of the Dams

Seven dams out of the dams of the under-construction or in-operation dams were selected for present study. These dams includes Qezel Tappe, Mehtar, Moushampa, Aledare, Chesb, Songhor and Ramin. Table 2-1 indicates a summary of specifications and feature of the dams of the interest.

Out of the investigated dams, only Moushampa was constructed for water and energy supply. Others have no objective for energy supply. Songhor dam is highest dam (61 m) and Moushampa is shortest one (22 m), out of the investigated dams. Aledareh dam reserves 19 MCM (as maximum) and lowest water volume that is reserved by Mushampa dam (3 MCM). All the dams have free spillway EIA study reports of the dams were conducted by different engineering consulting companies between 2003-2007, table 2-1 indicated some information about engineering consulting companies, basin.

Table 2-1: General description of the dams

Project	Objective				Geographical coordination		Dam feature			Consulting Engineering Company
	Surface water control	Flood control	Water supply	Electricity supply			Type	Height (m)	Reservoir volume (MCM)	
Chesb	O	O	O	-	512624.79	4003930.76	-	50	9.6	Yekom (2003)
Songhor	O	O	O	-	517514.01	4046206.87	-	61	10.4	Yekom (2003)
Aledare	O	O	O	-	406783.41	3950973.54	-	40.5	19.7	Pars Ray Ab (2005)
Mehtar	O	O	O	-	530414.29	4056254.86	Earth with clay core	45	14.0	Tamavan (2003)
Ghezel Tape	O	O	O	-	51243.92	4061324.88	Earth with clay core	57	6.0	Tamavan (2004)
Mushampa	O	O	25	81	467294.66	4056254.86	Gravel with clay core	100	700.0	Tamavan (2007)
Ramin	O	-	7.12	-	549016.28	4043607.54	Roll concrete	41	9.6	Mahab Ghodss (2004)

3. General description of study area and dams

3.1. Natural environment

3.1.1. Chesb and Songhr Dams

Chesb and Songhor dams are located in the southern part of Khodabandeh and Zanjan counties. Uzundareh and Chesb watershed where the above-mentioned dams have been constructed in it are part of upper Qezel Ozan sub-watershed in Sefidrud basin. Standpoint of topographical features, most of the area is located in elevation lower than 2000 (m). Mean annual discharge is estimated 0.59 and 0.62 m^3/s for Chesb and Songhor rivers, respectively. Annual mean of precipitation is 514 and 431 mm/yr for Songhor and Chesb dams, respectively. The study area has semi-dry cold climate based on Amberge climate classification method. Mean annual wind velocity is 2.64 m/s. Mean annual relative humidity is 52.5%.

As to geological formations, standpoint of historical order includes percambrian, Paleozoic, Jourasic, Eocence, calcic formation, were reported for Songhor dam study area. For Chesb dam study area, this geological formation are alluvial terraces, quaternary terrace, Eocene.

In Chesb dam's study area, soil study revealed that there is heavy-textured soil in surface and very heavy-textured soil in sub-surface soil. In alluvial plains in colluvial surface, soil has medium-heavy texture. Annual mean soil temperature is varied between 8-15 C. Based on soil study, there is no saline and alkaline soil in the study area. Standpoint of soil classification, majority of the soil is categorized as class II and III.

In Songhor dam's study area, texture of surface soil is varied from medium to heavy in plains and collovial plains. It is heavy to very heavy texture in sub-surface soil. In alluvial plains, it is very to very heavy texture in surface and sub-surface soils. Standpoint of thermal regime of the soil and salinity and alkalinity problems, the same situation as Chesb dam's study area was observed in Songhor dam's study area. Majority of the land is classified s class II and III and is low standpoint of erosion rate.

As to vegetation, the study area of the Chesb and Songhor dams is lack of forest vegetation. Vegetation is limited to ranges and orchards. Four range types were recognized so that majority of the area was cavered by annual grass – astragalus.spp. Over-grazing has caused to degrade quality of rangelands due to over-stocking.

There are 30 species of terrestrial mammals that are belong to 28 genus and 13 families. Eight species out of 30 species are listed in Iran EPA's Protected Mammalian species list, 46 bird species were recognized in the study area so that 19 species are migratory species 14 birds species are listed as under protection species. These are 11 fish species were recogrrized in the study area that more than 70% percent are belonged to Cyprinidae family.

- Water Quality

The water quality was not dealt with in the EIA report. Solely mentioned that the Chesb and Songhor has no serious problem as to water quality because of seasonality nature of these rivers and lack of industrial and human communities centers.

Water quality data of the rivers of the interest was collected in a two-years period (1997-98) from 16 hydrometric stations on the basis of T.H.A (Total Hardness, mg/lit $CaCo_3$), SAR (mili equivalent / lit), pH, TDS (mg/lit) and EC (μm/cm) in high flow and low flow months. Considering Wilcox classification, Chesb and Songhor have water of high quality so that is very desirable for agricultural and aquatics. This is while degradation in water quality is observed because of entering nutrients from agricultural dun-offs from upstream to downstream.

3.1.2. Aledareh Dam

The study area of the Aledareh dam is located in Kourdestan province (Divandareh county). The dam was contructed on Chamchaman river. The river originates from Sheikh mountains. There was no hydrometric stations in the study area (within basin). However, for qualitative and quantitative analysis of the river water, five hydrometric stations were applied. Mean annual discharge is estimated 0.44 m^3/s. Based on De Martin climate classification method, the study area's climate is semi-dry climate. Mean annual precipitation is 495 mm/yr and 330 mm/yr for dam site and basin, respectively. Mean annual wind velcocity is estimated between 3.2-5.5 m/s. Dominant wind direction is south and southeast.

Geological structure of the study area includes paleozic stones and Kertacea so that diversity of Kertacea stones is more that paleozoic stones.

Vegetation of the Aledareh dam's reservoir includes a degraded Astragalus Spp in combination with other species such as Spurge,Centaury,Thistle . Both of them are indicators of the degraded ranges. It might be noted that six vegetarian types and 70 plant species were recognized in the study area.

Filed work as to wild life in the study area revealed that 13 species of mammals, which belong to 10 families, were recognized in the study area. As to bird species, 20 species (17 families) were observed. Two species out of 20 species namely *Gyps fulu and Buteo buteo* of national protective values. These two species with *Aquila nipalensis* have of international protective value. In reservoir of the dam, two fish species (Cyprinidae) were recognized. The only recognized fish species in upstream of the reservoir is belong to Cobitidae family.

- Water Quality

Based on the present data in Pouyab Engineering Co. that water quality of the Aledareh river (standpoint of pH, Sulphates, Chloride, TSS, TDS and EC) was investigated, there is no limitation (standpoint of drinking and agricultural uses) for its water because amount of the chloride is less than permissible limit (500 ppm) and that of TDS (1000 ppm). Amount of sulphate and TSS are in minor. Field observation shows that water quality of the river is degraded by rural waste water and animal grazing in low-flow seasons. It is important standpoint of biological and bacteriological aspects. Green color of the water and growth of algae indicates existence of the nutrients in the river water body. Changes in water quality due the implementation of the project construction phase especially cut and fill activities removing vegetation cover would cause to increase, TDS and TSS in the river.

Fixing the equipments and machineries would cause water pollution due to leaking if oils and fuels into water bodies.

In operation phase, it is expected to develop agricultural sector. It, in turn, cause to increase population in the project area and downstream of the dam. Considering increase of population up to 20000 persons, there is likely that generation of waste water would be increased by 370000 m^3/yr. About 110000 m^3/yr out of 370000 m^3/yr would enter into the surface water through absorbtive wells.

Besides, over 5 mcm^3/yr of the runoff would be generated. 4 mcm/yr out of the total run off would enter into surface water. The rest would cause to pollute subsurface

water. Impact of sediment flushing would cause to enter large amount of the sediments into natural surface. Water network (rivers), It would cause to increase TSC, TDS, BOD5 and decrease BO concentrations. The generated waste water from the operating camps would cause to pollute soil and water resources. In case of tourism development, possibility of soil and water pollution would be increased.

- Water pollution sources

- Point source pollution

These kinds of pollution include rural household waste water in the study area. Because of lack of significant industries, these sources would not play significant effect on water quality of the river. As to human waste water, coefficient of waste water generation is estimated 68% in the study area. Human waste water was estimated about 90 mcm/yr. 70% (27 mcm/yr) of the estimated value would enter into the absorptive wells. The others would enter into surface water bodies. Considering the volume of the waste water that enters into the absorptive wells and low water tables, there is no possibility for pollution. Considering 40 gr/person/day of BOD_5 and 50 gr/person/day of TSS, the generated waste water would be able to enter 13.2 ton of TSS, 10.6 ton if BOD_5 into the surface water. There is no rural waste water networks.

- Non – point source pollution

Return coefficient of agricultural run-off is about 35% in the study area. 33% of the agricultural run-off enters into surface waters and rest (2%) enters into subsurface waters i.e. , 1.32 mcm/yr out of 1.4 mcm/yr of the agricultural run-offs would enter into surface and the other (0.8 mcm/yr) would enter into the subsurface waters. Considering the area of the irrigated lands (467 ha), approximate amount of nitrate and phosphate are 2335 and 240 kg/yr, respectively. 94% of these nutrients would enter into surface waters. In this case, approximate concentration for nitrate and phosphate is 0.02 and 0.15 mg/lit in the river.

- Soil pollution sources

- Rural wastes

About 1.2 tons of rural wastes is generated in the rural areas of the study area. It is disposed in the environment of the villages or somewhere in out of the villages. These wastes could leak into surface and subsurface waters. Chemical fertilizers and

pesticides about 50, 50 and 5000 Kg/yr of Nitrate, Phosphate and animal manure are applied in the study area. Annually 23.4 ton of nitrate & phosphate fertilizers are applied for the irrigated land. Besides, about 1000 lit/yr of pesticides is applied as well.

- Investigation of thermal stratification of the reservoir

Based on Froud's index, potential for thermal stratification of the reservoir is possible (Fd=0.001). Since it is less than 0.32, Estimation of phosphate concentration in the river water (as one of indices) shows that it is near euthrotropic to meso – therophic conditions. Concentration of a-chlorophylls is less than oligothrophic condition. Consequently possibility of euthrotropication for the reservoir is bow.

As to environmental discharge, it is estimated 20-30% of the long-term annual mean of discharge.

3.1.3. Mehtar Dam

Mehtar dam was constructed on Mehtar river. The lightest elevation (2518 m) is in the north mount of Bayendar village and the lowest elevation in the watershed is 1640 (m). Basin area is 129.2 Km^2 and its average elevation is 2003 (m). Mean annual discharge is estimated 0.363 m^3/s in the dam site. Annual mean precipitation is 468 mm/yr in the dam site. The study area has a severe dry climate based on Amberage climate classification. Mean annual relative humidity is 56.6% for evaporation, it was estimated 1378 mm/yr as evaporation pan.

Percambrian, infra-cambrian, Cambrian, permin and Jourasic formations were observed in the study area of the Mehtar dam. Two physiographical units (alluvial and colluvial plains) are recognized in the study area. Water erosion is none or very low as well. There is no rich ecosystem or valuable wildlife species in the study area. It might be noted that ir-rational use of natural resources has caused extensive degradation of vegetation. In the study area in elevation less than 1500, bushland and the abundant lands are dominant landscape elements. Bushland – grassland is dominant landscape in elevation between 1500-2100 (m). For elevation higher than 2100, dominate landscape is grassland – bushland.

Sus Scrofa, Canis Aureus, Vulpes vulpes and Lepus carpensis are of important wildlife species in the study area. Bird species are limited to *Columbidae,*

Passeriformes and Accipiteridae. Considering the Mehtar river has not significant flow, there is no significant fish species within most of the seasons.

- Water Quality

Considering location of dam where is nearby hydrometric station, investigation on water quality was carried out using the hydrometric station's data. The water is classified in C2S1-S3S1 based on chemical analysis in the Mehtar station. The water is suitable for drinking.

- Pollution sources

Agricultural activities in upstream of the dam and application of chemical fertilizers and animal manures are accounted as pollution sources Investigation shows that animal manure is ratherly applied more than chemical fertilizers (phosphate 113 ton, nitrate 123 ton). Insecticides, fungicides and herbicides were applied as 117, 845 and 467 Kg/yr respectively. Results of the chemical analysis of the Mehtar river indicated that concentration of heavy metals such as Pb, Zn, Cd, Ni are 9.3, 11, 0.2, 4.39 mg/lit respectively.

To be locate urban waste land fill of Zanjan within the study could be accounted as significant source of pollution. This location is about 1.7 Km from dam location.

As to pollution induced by agricultural activities, it might be noted that dry-land farming might not cause pollution because lack of sufficient water for solving the nutrients and fertilizers and entering them into water bodies in he study area.

- Pollution induced by the project

- TDS induced pollution

This pollution might not be expected considering soil types in the study area. However, there is some possibility for TDS induced pollution during summer and evaporation rate in these seasons. Impact of this phenomena might be low because the area has cold weather.

- TSS – induced pollution

TSS is originated from upstream of the dam. It is deposited it behind the dam. Based on hydrological studies, extend of TSS – induced pollution is not so much that could cause serious problem.

- Araerobic impact and gas dispersion

Considering low height dam and low inflow nutrients, this phenomena could not affect on quality of the water.

- Impact on salinity and soil characteristics

Considering soil studies and quality of the river water, it is forecasted that implementation of project would cause not to affect on soil salinity and nutrient accumulation. Considering river water analysis and lack of limitations for soil salinity, there is no possibility for pollution of the reservoir.

As to thermal stratification, it might be noted that there is no significant possibility for occurrence of thermal stratification since lack of intensive agricultural activities.

Lack of rich and dense vegetation cover in the reservoir, would cause not to affect on occurrence of euthrotrophic condition.

3.1.4. Qezel Tappe Dam

Aryachai is where Qezel Tappe dam was constructed. Aryachai is one of the upstream branch of Zanjan-Roud. The highest elevation is 2518 (m) and difference between the highest and lowest elevation is 930 (m). Basin area is 75 km^2. Mean annual discharge is estimated 0.263 m^3/s in the dam site. Annual mean precipitation is 407 mm/yr. Annual mean of relative humidity is 66% Annual mean of evaporation is estimated 1853 mm/yr as evaporation pan.

Rock formation that were observed in the study area consist of age of Precambrian to recent age they are Precambrian, Infra-Cambrian, Cambrian, Permian and quaternary deposit.

There are eight soil series in the study area. Soil texture is varied from medium to heavy for these soil services and water erosion is low to medium in the study area. In general, there is two specific physiogeraphical units namely; alluvial and colluvial plains. There is no limitation standpoint of salinity and alkalinity for soil resources. Land resources are classified into distinctive classes namely, classes II and III and IV.

Landscape elements of the Mehtar dam's study area might be categorized into the distinctive classes namely; Class I (elevation lower than 1500), Class II (elevation 1500-1200) and class III (elevation 2100-3300). No forest vegetation is observed in

the study area, however riparian forest vegetation that consists of species such as *Populus persica, Cupresus sempervirence and Ulmus glabra* are observed. Rangeland vegetation is to some extend rich in the study area. However, most of the mountainous part of the study area is of non-dense vegetation.

- Water Quality

- Pollution source

Pollution source might be classified as residential industrial and agricultural pollution sources.

- Industrial pollution sources

In the study area, there is no significant industrial zone so that could be cause industrial pollution.

- Residential pollution sources

Four villages are accounted as significant residential pollution source in the study area whose waste waters are disposed through absorptive wells and surface drains. It is finally drained into the river. The disposed animal manures with in the villages are dissolved due to rainfalls so that it is finally drained into the river.

- Agricultural pollution source

Leaking the chemical fertilizers and pesticides and animal manure through rainfall could pollute surface and sub-surface waters. About 182 ton/yr and 117 ton/yr of nitrate and phosphate fertilizers are applied in the study area, respectively. As to pesticides fungicide, about 579.6 kg/yr and 226.5 kg/yr are applied as well.

- Changes in water quality are applied

- Dissolved solid-induced pollution

Considering the soil types of the study area, no significant organic and inorganic loads enter into the river. Around the reservoir, it is expected the nutrients to be increased in hot seasons. However, it is negligible due to entering seasonal floods during high flow seasons. Considering potential agricultural development in downstream of the dam, management plan for chemical fertilizer and pesticides might be formulated and implemented in order to control entering N, P, K through run-offs.

- Suspended solid – induced pollution

Soil erosion and sediment are of the most important factors that would cause suspended solid – induced pollution. However hydrological studies indicated that extend of soil erosion is not so much that could cause serious problem.

- Poison – induced pollution

Origin of such a pollution is application of chemical fertilizers and pesticides in upstream. Nevertheless, lack of intensive agricultural activities in upstream of the dam would not cause such as a pollution.

- Anaerobic impact of the reservoir

Considering low height of the dam, climate conditions, morphology of the reservoir and low nutrient inflow, is no exception for anaerobic condition for the reservoir.

- Impact on salinity and soil features

Soil study, water quality of the river and filed works indicated that implementation of the project would not cause soil salinity and nutrient accumulation. Considering river water analysis and lack of salinity limitation in the reservoirs vicinity, there is no possibility for water pollution of the reservoir.

- Impact on sub-surface water

Results of chemical analysis of the surface water indicates that implementation of the Qezel Tappeh would not cause serious impact on the quality of the sub-surface waters nevertheless, construction of the dam would cause to come up the water tables in downstream, therefore, there is some possibility to establish a water – logged condition. Possibility of thermal stratification of the reservoir considering low height of the dam, climatic features and significant thermal (temperature) differences it is forecasted that thermal stratification is not happened in such an extend so that be able to affect quality of the reservoirs.

- Possibility of euthrophication

Considering the filed works, nutrient inputs into the reservoir with consideration of the upstream land and lack of intensive agricultural activities is minor. It could not cause euthrophication condition in the reservoir. Nutrient input into Aria Chai is because of application of chemical fertilizers, surface soil degradation and release of human waste water from the upstream villages into river would be able to contribute the euthrophication phenomena.

- Environmental water need

No modeling effort was taken. It was mentioned that construction of the dam would have minor effect on the downstream.

3.1.5. Mushampa Dam

Mushampa dam was constructed on Qezel Ozan river. The highest elevation of the basin is 3390 (m). Basin area is about 25000 km^2. Mean elevation of the basin is 1887 (m). Annual mean temperature is 12.9 C. Annual mean of precipitation is 338 mm/yr and that of evaporation is 2219 mm/yr Annual mean of relative humidity is 68% and that of wind velocity is estimated 10 m/s (Zanjan) and 3.5 m/s (Miane). Based on De Martin climate classification the study area climate is varied between dry cold to semi-dry climates.

Geological formation of the study area are belong to periods of Percambrian, Paleozoic and mezozoic.

There are four physiographic types including Fan-shaped alluvial, plains, colluvial plains and river terraces, Based on land classification study. there are six classes. The soil resources of the study area have some limitation standpoint of penetration and salinity. Most of the limitation is related to topographical features.

Flora of the study area is belong to Iranian-Touranian vegetative zone. There are 233 plant (55 families) and 34 wildlife species. Four species out of 34 wildlife species namely *Pantera pardus, Capra aegagrus and Ovis orientalis* and golden hamster are lisited in IUCN red list. Some other distinctive species such as *Capra aegagrus, Ovis orientalis*, *Pantera pardus* and brown bear are observed only in vicinity of Mushampa dam's reservoir.

As to bird species, over 230 species were observed in the study area most of them is belong to *Passeriformes* Moreover, some indicative species such as *Cicomia cicomia* was observed and six species out of 230 bird species have been listed in the IUCN red list. Five fish species were also recognized. One fish species out of five species is belong to *Nemacheilus* genus.

- Water Quality

- Point sources pollution

There are 30 animal husbandary units that their wastes enter into surface waters.

Considering this wastes are rich standpoints of nitrate and phosphate, it cause to pollution of surface waters and decrease of DO concentration, there are also six fish farms, that their waste waters enter into surface waters without any treatments.

Three counties were investigated standpoint of industries for industrial pollutions. There is one industrial zone with 3.5 m^3/day of human waste water, 1.75 kg/day of COD load. There is 30 industrial plants there that are involved in Pb and Cu processing. These would cause to increase heavy metal concentrations in Qezel Ozan river. As to urban and rural waste waters, it might be noted that none of the cities and villages are not equipted with waste water collections and treatment network and facilities. About 18200 m^3/day of water is consumed and 12700 m^3/day waste water is generated.

- Non – point sources

- Agricultural run-off

Many agricultural lands are located in vicinity of the Qezel ozan river in upstream of the dam: It cause to enter agricultural run-off into the river. About 13479 tons of nitrate and 8030 tons of phosphate fertilizers are applied for agricultural lands in the study areas. About 50752, 2777 and 23805 Kg/yr of pesticides, fungicides and herbicides are applied the agricultural lands, respectively in the study area.

- Soil pollution sources

- Industrial wastes

Most of the industrial wastes is generated by Pb and Cu production plants. They are disposed in dried wasteways. They are dissolved due the rainfalls. It cause to pollution seriously.

- Household wastes

On daily bases, 90.75 tons is generated. It generates about 45 m^3/day of the leaked water.

- Changes in quality of the water resources

Due to implementation of the project, development of tourism industry would cause to pollute the water resources. In downstream of the dam, development of the agricultural sectors, the generated run-off could cause to pollute the water resources as well. These run-off contain nutrients, pesticides, fertilizers, TDS.

In construction phase, cut and fill activities would cause to increase TSS concentration in the river. Due to high erosion rate in upstream of the dam, dam

construction would cause to improve water quality in down stream because of sediment deposition. Human re-settlement and immigration would cause water pollution in case of not to be planned for the wastewater.

- Investigation of possibility of euthrotropication

Euthrotropication phenomena was investigated as follows:

a) classification of euthrotropication using nitrogen and phosphor control criteria.

The Nitrogen and phosphor were estimated 4.5 and 0.05 mg/lit respectively. There is possibility of the euthrotropication.

b) Classification of euthrotropication using phosphate control criteria

Concentration of phosphate is estimated as 0.05 mg/lit

c) Classification of euthrotropication using a – chlorophile.

concentration of a – chlorophile was estimated about 24.75. Considering 50 mg/m^3 concentration for phosphate, concentration for a-chlorophile is estimated 24.7 mg/m^3. Consequently, the water is rich standpoint of nutrients. Investigation of possibility of thermal stratification based on Froud's number (Fd = 0.0065) the reservoir of the dam has potential for thermal stratification.

- Investigation of current status of river water quality

As to drinking purpose, the results from sampling (two points) shows that it is drinkable but has not desirable quality (C4S2 class) i.e. it is acceptable for agricultural uses but has limitation for some crops. As to heavy metals, BOD, COD and microbial pollution is higher than environmental standard for drinking water. Water is suitable for agricultural based on Iran EPA standard. As to heavy metals, the results shows that all the factors is less than acceptable standard. There is no problem for heavy metals.

3.1.6. Ramnin Dam

Ramin dam was constructed on Zanjanroud. The highest elevation is 2665 (m) in the south of Soltanieh. Basin area is 67 km^2. Mean elevation of the basin is 2089 (m). Annual mean of discharge is 0.3 m^3/s. Based on Amberage climate classification, the study area is located in a semi-dry cold climate. Annual mean of temperature is estimated 9.1C and that of relative humidity is 54.5%. Annual mean of evaporation is estimated 1544 mm/yr and that of wind velocity is 1.5 (m/s).

Geological formations consists of ecocene series. River bed is covered by quaternary alluvial sediments that has no significant thickness. In upstream of the Ramin dam, surface soil erosion is dominant type of erosions. Standpoint of erosion intensity, land of severe soil erosion has high percentage of land resources in the study area.

There are 11 plant communities in the reservoir area of the Ramin dam. More than 75% of the area is covered by farmlands. Three plant species out of the observed species are list in the IUCN list. Moreover, six plant species are classified as forest reserve groups.

A limited number of carnivores, like wolves and foxes might be mentioned as wildlife. 34 bird species were recognized in the study area. Three species *Accipiter nisus, Buteo buteo and Falco tinnunculus* out of the recognized species have of high significance in conservation. There is no significant fish species in the river because of high level of pollution.

- Water Quality

Investigation of the water quality was carried out using hydrometric stations data and results of the sampling tasks that was done by other organization.

The results of chemical analysis of the water of Ramin dam and hydrometer stations show that the water quality on the subject of agricultural usage is in class C2S1, and the subject of drinking usage is in the range of suitable-good. These results show that the water quality is suitable, in general.

There is no industrial zone as point source pollution in the study area. However, there is two rural population communities so that they might pollute the water resources through release of human waste waters. Considering one of objectives of the Ramin dam is to transmit the water to Zaker Bonab industrial zone, there would be some possibility for pollution of the water resources. It is important because the wells supplying drinking water for Zanjan city and subsurface recharging pools exist in this area. Thermal stratification model was not run for this study.

There is no suitable quality for Zanjan Chai as receiver of Ramin river. Therefore, in case of water up taking from Ramin river, it would degrade quality of Zanjan Chai because of decreasing volume of Ramin river entering the Zanjan.

Table 3-1 : Water Quality Parameters of Ramin River at Ramin Station

Parameter	T.H.	TDS (mg/l)	EC (µS/cm)	pH	Anions (meq/l)				Cations (meq/l)					SAR
					HCO_3^-	Cl^-	SO_4^{2}	Total	Ca^{2+}	Mg^{2}	Na^+	K^+	Total	
Average	221	354	550	7.6	4.6	0.5	0.7	5.8	2.8	1.6	1.2	0.1	5.7	0.8
Max.	355	522	828	8.3	6.7	0.9	2.2	8.3	4.6	3.6	3.2	6.6	8.2	2.4
Min.	113	139	279	6.9	2.4	0.2	0.1	2.9	1.2	0.4	0.04	0.01	3	0.03

Reference: Revised repor of hydrological studies of Ramin Project (2003)

Table 3-2 : Chemical Test Results of Ramin River

Parameter	Amount (ppm)	
	Sample A	Sample B
Ammonia	Nil	Nil
Nitrate	7	Nil
Nitrite	Nil	0.05
Sulfide	Nil	0.013
Suspended Solid	Nil	Nil
pH	7.3	7.4
Electrical Conductivity	6.5×10^2	4.3×10^2
Sulfate	197	137
Cl-	19	12
Residual Evaporation	487.5	301
CO2	Nil	Nil
Total Hardness	300	185
Carbonate Hardness	370	275
Calcium	96	48
Magnesium	14	16
Sodium	50	46.5
Potassium	2.5	1.5
Total Alkalinity	69	64

Reference: Borrow sources and construction materials, first phase studies of Ramin Project (1995)

Table 3-3 : Range of Water Quality Parameters of Zanjan-rud River in Consecutive Years

Row	Chemical Parameter	Average	Max.	Min.
1	EC (µS/cm)	1084	2148	257
2	TH (mg/l)	319.7	655	115
3	TDS (mg/l)	586	1353	162
4	pH	7.7	8.2	7.16
5	SAR	2.3	10.85	0.4
6	HCO_3^- (meq/l)	3.8	4.7	2
7	Cl^- (meq/l)	2.4	4.6	0.15
8	SO_4^{2-} (meq/l)	3.2	5.56	0.28
9	Na^+ (meq/l)	3.2	9.56	0.43
10	Mg^{2+} (meq/l)	2.1	5.2	0.5
11	Ca^{2+} (meq/l)	4.3	9.5	1.8
12	K^{2+} (meq/l)	0.07	0.01	0.179

Reference: Limnological assessment of Zanjan-rud, 1997, Zanjan Department of Environment

Table 3-4 : Result of Physical and Chemical Water Analysis at Zanjanrud Sampling Station (2/13/1996)

Station No.	DO	BOD	COD	pH	EC	TDS	T_{water}	T_{air}
1	14.3	3.5	9	7.7	750	485	6.5	5.5
2	8.4	15	40.8	7.05	860	615	5.3	8.2

Reference: Limnological assessment of Zanjan-rud, 1997, Zanjan Department of Environment

Table 3-5 : Result of Physical and Chemical Water Analysis at Zanjanrud Sampling Station (5/13/1997)

Station No.	DO	BOD	COD	pH	EC	TDS	T_{water}	T_{air}
1	10.4	8.6	14	7.3	694	415	9.8	19.3
2	5.6	28	67	6.5	902	476.1	10.1	21.8

Reference: Limnological assessment of Zanjan-rud, 1997, Zanjan Department of Environment

- Synthesis of ecological features

Investigation of the climate parameters which govern on study area of the dams of the interest indicates that those factors are of considerable variations. For example, standpoint of rainfall, it was 514 mm/yr for Songhor dam as maximum and 330 mm/yr for Aledareh dam as minimum. Annual mean of temperature is 12.9^{C} for Musshampa dam as maximum and minimum annual mean of temperature ($7.6\ ^{C}$) was recorded in Songhor dam. Maximum and minimum annual mean of evaporation were reported 2218 and 1261 mm/yr in Mushampa and Aledareh dams, respectively. Maximum and minimum number of freeze days were observed in study area of Aledareh dam (147 days/hr) and that of Mushampa dam (94 days/yr) table 3-6 indicates climatic features for study area of dams of the interest.

Four dams out of seven dams of the interest whose EIA studies have reported number of wildlife species (mammals, birds and fish) specifically. One study (Mushampa EIA study) out of four EIA studies had 34 terrestrial mammal species and 240 bird species. It indicates that the study area of the Mushampa has of high species diversity in comparison with the other study areas. It might be related to less environmental degradation in the study area of the interest comparatively. Out of the reported wildlife species namely, *Aegypius monachus and Buteo buteo* are listed in Iran EPA's list of under protection species it is necessary to be mentioned that four species such as Capra *aegagrus, Ovis orientalis, Panthera pardus* and golden hamster with six species of birds have been listed in IUCN Red List. Table 3-7 indicates information as to wildlife in the study area.

Table 3-6 : Climate features in the study areas

Dam/Project name	Precipitation (mm/yr)	Temperature (c)	Evaporation (mm/yr)	Dominant wind direction	Wind velocity (m/s)	No. Freeze day	Mean relative humidity %	Climate
Chesb Songhor	431 514	8.90 7.62	-	East	2.64	-	52.5	S.D.C
Aledareh	330	-	1436 (dam site) 1261 (basin scale)	-	3.2-5.5	147	53.2	S.D
Mehtar	468	10.9	1378	Southeast	-	120	56.6	Se.S.D
Qezel Tappeh	407	9.1	1267	-	-	118	66	-
Mushampa	337	12.9	2218	-	3.5	94	68	D.C-S.D.
Ramin	406	9.1	1544	Southeast	1.5	134	55	S.D.C

S.D.C.= Semi Dry Cold

S.D.= Semi – Dry

Se.S.D.= Serve Semi Dry

D.C.= Dry Cold

Table 3-7 : Natural environmental features of the study areas

Dam/Project name	Terrestrial mammal species no.	Terrestrial bird species	Fish species No.	Remarks
Chesb Songhor	30	46	11	8 species out of the reported terrestrial mammal species are listed in Iran EPA protected species list. 19 birds species out of the reported species are migratory ones and 14 species are among the protected species. These are *Ammoperdix griseogularis, Bubo bubo, Aquila heliaca, Acrocephalus menalopogon, Sylvia communis, Milvus migrans, Accipiter gentiles, Accipiter bervipes, Accipiter nisus, Buteo buteo, Aquila nipalensis, Falco subbuteo, Gyps fulvus, Falco tinnunculus*
Aledareh	13	17	7	Three species including *Gyps fulvus* and *Buteo buteo* (at international scale) and *Aquila nipalensis* (at national scale) have of conservative significance.
Mehtar	No Report	No Report	-	*Sus scrofa, Canis aureus, Vulpes vulpes, Lepus capensis, mice, Hedge,* are of important mammal species in the study area. Important bird species include *Galliformes, Columbidae, Passeriformes, Accipiteridae* Considering no significant flow during most of the seasons, no significant fish species are expected.
Qezel Tappeh	-	-	-	Standpoint of wildlife and fish species is similar to the Mehtar dam.
Mushampa	34	230	5	Four wildlife species *Capra aegagrus, ovis orientalis and golden hamster* have been listed in IUCN red list Six bird species have been listed in IUCN red list
Ramin	-	34	-	Three bird species *Accipiter nisus, Buteo buteo* and *Falco tinnunculus* have of high conservative significant No significant fish species even *Sus scrofa, Canis aureus, Vulpes vulpes* because of high pollution load

Table 3-8 : Geological periods and formation in the study area

	Dam or project name	Songhor	Chesb	Aledareh	Mehtar	Qeael Tappe	Mushampa	Ramin
Geological Periods	Percombrien	+	-	-	+	-	-	-
	Paleozoic	+	-	+	-	-	-	-
	Jouraic	+	-	-	+	-	-	-
	Certace	+	+	+	-	-	-	-
	Eocene	+	+	-	-	-	-	+
	Oligomioun	+	+	-	-	-	-	-
	Permin	-	-	-	+	+	-	-
	Tersier	-	-	-	-	-	-	-
	Camberian	-	-	-	+	+	+	-
	Mesozoic	-	-	-	-	-	+	-
	Cenozoic	-	-	-	-	-	-	-
Geological formation	Calcic	+	-	-	-	-	-	-
	Conglomerate	+	-	-	-	-	-	-
	Alluvial fan	-	+	-	-	-	-	-
	Quternary deposists	-	-	-	+	+	-	+
	Pelio Pelioson	-	-	-	-	+	-	-

Table 3-9 : Vegetation features in the study area

Dam/Project name	Forest	Rangs	Orchards	Remarks
Chesb & Songhor	-	+4	+	Orchards are in limited areas. Most of the area is covered by annual grass – astragalus type.
Aledareh	N.R	+6	N.R	Existence of *Cirsium arvense, Centaurea virgata and Euphorbia* that indicate extensive degradation of the rangelands.
Mehtar	N.R	+N.R	N.R	For the area lower than 1500 m, bush land and the abondaned land. Tor the area between 2100 -3100 m, grassland-bush land were reported. For the area over 3100 m bush land – grassland was reported.
Qezel Tappeh	-	+N.R	N.R	Forest cover is not reported. Forest stands *(Populus alba, Platanus orientalis, Populus persica, Cupresus sempervinense, Fraxinus orientalis and Ulmus glabra)* as riparian vegetation is reported. For most of the mountainous area of the study area, no vegetation is reported.
Mushampa	-	-N.R	-	Vegetation of the area is belong to Irano-touranian vegetative unit.
Ramin	-	N.R (11 plant communities)	+	Three species *(Colchicum autumnale, Astragalus and Amygdalus orientalis)* are listed in the IUCN red list. More than 75% of the area is covered by agricultural land use.

N.R. Not reported

Ramin river was assessed that has no significant fish species because of high pollution loads. There is no such a claim for other rivers of the interest. This is while Chesb and Songhor dam's study area have high species diversity since 11 fish species were reported.

Geological studies that were conducted in framework of EIA studies indicate that Songhor dam's study area has some geological formations that are all related to six geological periods. After Songhor dam; Mehtar, Qezel Tappe and Moushampa were decreasingly ranked. All the afore-mentioned dams have some geological formation that are related to four geological periods. For Songhor and Ramin dams, study areas are the most diversified and less- diversified ones standpoints of geological periods, respectively Table 3-8 indicate geological periods and formations in the study area.

As to vegetation it might be mentioned that significant forest cover is not reported in the study areas of the interests. Dominant type of vegetation cover is rangelands whose plant type or plant communities is varied from four for Chesb and Songhor to 11 plant communities for Ramin dam's study area. Table 3-9 indicates vegetations features of the study areas.

3.2. Social Environments

3.2.1. Chesb and Songhor

The study area is located in Ijard and central district of Zanjan county and in Sejas Roud district in Khodabande county. Vanity of the study to Zanjan and Khodabande counties has caused to affect on quality of life of people in the study area. Information and data that was presented in the EIA's report is not at level of villages. Besides, information and data related to the dam and the irrigation network was not presented separately. Based on national population consus (1396), population of the villages within Chesb dam and irrigation & drainage networks is 1950 person (353 household) and 4005 person (749 household) for Songhor dam's study area.

Stand point of Infra-structure and facilities, villages within Chseb's study area has better situation than those within Songhor's area. Three villages out of five villages within Songhor's area has no treated water and one village has no electricity. This is while all the villages with in Chesb's study area has treated water and electricity. Hygiene condition is poor for both areas. Transport and telecommunication has better condition in comparison with Infra-structure and hygiene in songhor's study area. Occurrence of 15 water-born diseases is expended in the study area. This is while 6 diseases have more long history than others in the area.

3.2.2. Aledareh

There is no specific definition of the study area and no map or figure that depict it. However, there are four villages in the study where are belong to central district of Divan Darreh county. Based on the recent data and information (2004), population is 2415 persons (400 households). Based on the estimation (2004), about 39.8 % of the population is at 0-14 year olds, 56.3% (15-64 years old) 60.8% of the population is literated. Literary (%) for man (over 6 years old) is 75% and that for women is 41.6%. For over 10 years old, only 39.9% is being employed. This rate for man is 65.3% and for women is 8.5% General rate unemployment is 8.2%.

Most of the population is envolved in agricultural sector because lack of other economic sectors. Women are active in agricultural and handcraft industries.

Standpoint of facilities, it might be mentioned that all the villages have primary and junior high schools. However, for education at higher levels such as high schools, students must go to the cities. There are 3 clinics, treated water and electricity, rural

agricultural services center. There is only one rural cooperative company in the study area.

3.2.3. Mehtar

There is three villages in the study area. They are belong to central district of Zanjan county. Based on statistics (2002), it has 854 persons (191 household).

Population growth rate is 0.3% (in period of 1966-2002). It means a low value implying occurrence of immigration from villages to cities.

Based on statistics (2002), 36.6% (262 persons) out of 716 persons have been employed, for men, it is 67.3%; and for women, it is 6.09%. 206 persons out of 262 persons work in agricultural sector, 22 persons in rural industry, 21 persons in construction sector and 13 persons in service sector.

Literacy (%) is 78.6% (607 persons) in the study area for men, it is 84.9%; and for women, it is 71.9%. Only one village has the treated water, others have no access treated water. All the villages have electricity and telephone and have access to T.V. and Radio networks. Lack of access water for agricultural activities, low income, lack of hygiene facilities and unemployment have all caused to establish low quality standards for life in the study area. All the above – mentioned reasons have cause to increase emigration rate in the study area.

3.2.4. Qezel Tappe

There is no specific definition for study area in the EIA report. It was mentioned that there are 2 villages in the study area that are belong to Zanjan county Based on statistics (2002), its population is 905 persons (187 household). Family size has decreased in 2002 in comparison with statistics 1997. It could be referred to immigration of family member to cities. Based on statistics (2002) 536 persons out of 795 persons ware literated. For men, it is 74.4% and for women, it is 59.8% about 675 persons out of 675 persons have been employed. For men it is 62.6% ; and for woman it is 6.8%. Standpoint of facilities and infra-structure, it might be mentioned that there is no limitation for access road. As the two villages are very near to each other. Many facilities are common for them. There is no hygiene center but there is one telephone center as common. Both the villages have not treated water and rural agricultural services center. There is no pharmacy, medical doctor and public bath in both the villages

3.2.5. Mushampa Dam

There are seven villages in the study area that would be degraded due to construction and operation of the dam. Based on the present statistics population is 5032 persons (1228 household). Increasing the population is due to development of Mahneshan city as capital (center) of Mahneshan county since 2000. There is some evidence about immigration from villages to the city. Since 1996, the main reason for immigration is lack of access employment opportunities, sufficient water for agricultural activities and lack of sufficient land.

Based on statistics 2005, about 29.69% of the population is classified as 0-14 years old, 65.06% (15-64 years old) and 5.27% (over 65 years old). Literacy (%) of the population is 70.9% (2005). It is 64.2% and 77.8% for women and men, respectively It might be mentioned that the communities of the interest are being experiencing considerable growth in period 1986-2005. There is only primary schools in the villages. Other educational levels such junior high schools and high schools are found in Mahneshan city. Employment rate has important growth during 1996-2005. It has grown from 39.9% to 45.14%. For men, it has grown from 4.6% to 7.79.

All the villages, except one, has rural Islamic council only one village has treated water and telephone. Electrification has been carried out for only two villages. Only two villages has hygienic center. One village has medical doctor. Agricultural is main economic source of the study area.

3.2.6. Ramin

The reservoir area is located in central district of Zanjan county. Based on present information, if dam is construction, 10 village would be inandunated. Besides, three villages are located in around the reservoir so that some part of their lands, ranges and access roads would be influence by the reservoir. Mean unemployment rate for zanjan county where Ramin dam reservoir is located in there, is 5.56%.

In total, difference between literacy (%) in rural areas and urban areas is reducing. Literacy (%) for 6-14 years old persons is 96.25%. There is no significant difference between boys and girls or rural and urban areas.

All the urban areas have electricity and treated water. About 69.56% of households in Zanjan county has gas. 41.31% of the households has telephone. All the data that was presented in the EIA report is at country-scale.

3.3. Synthesis of Socio – economic features

There are 31 village with a population over 29673 in the study area. Literacy (%) is varied from 28% (Chesb) to 77(%) in Ramin. Table 3-10 indicated population, number of village and literacy (%) in the study area of the interest.

Investigation of householders in the study area shows that three project out of seven projects have presented the related statistics. The statistics indicated that most of the householders are involved in agricultural activities. At the second rank, services sector has allocated most of labor works.

Table 3-11 summarized information as to labor work per different economic sectors.

In total, there is only one rural agricultural services center in the study area. Only five villages out of 37 villages have access the treated water. Four villages out of 37 villages have mailbox. Two villages out of 37 villages have access to newspaper. As to public hygiene, 6 villages out of 37 villages have medical doctor.

Table 3-12 indicated services and hygienic facilities in the study area.

Table 3-10 : General description of human population in the study area

Dam/Project name	No. of village	Population	Literacy(%)	Remarks
Chesb	5	3627	28	The villages are located in three types of the study areas namely, immediate, direct and indirect study areas
Songhor	6	4005	48	The villages are located in three types of the study areas namely, immediate, direct and indirect study areas
Aledareh	7	2415	53	Although no definition for study area was presented, it was mentioned that all the villages were located in the study area. It seems that the study area might be overlaid by the direct study area. All the mentioned villages are located in the study areas
Mehtar	3	854	71	Although no definition for study area was presented, it was mentioned that all the villages were located in the study area. It seems that the study area might be overlaid by the direct study area. All the mentioned villages are located in the study areas
Qezel Tappeh	3	905	59	Although no definition for study area was presented, it was mentioned that all the villages were located in the study area. It seems that the study area might be overlaid by the direct study area. All the mentioned villages are located in the downstream of the dam.
Mushampa	4	5032	65	The EIA report has not presented a map or figure that shows boundaries of the study area. It was emphasized that that the study area includes the immediate study area, direct study area and indirect study areas. However there is no evidence as to in choice one of the study area the villages are.
Ramin	9	12835	77	One village out of nine villages is located in the immediate study area. Others are located in and indirect study areas.

Table 3-11 : Description of economic features of the human population

Dam/Project name	Agricultural	Industry	Construction	Services	Total
Chesb	-	-	-	-	In the EIA report, data about structure of employment if different sectors was not present.
Songhor	-	-	-	-	In the EIA report, data about structure of employment if different sectors was not present.
Aledareh	81%	6.7%	-	12.3%	-
Mehtar	206 (79%)	22 (8%)	21 (8%)	13 (5%)	-
Qezel Tappeh	-	-	-	-	Stand point of the employment structure, considering the study area has an agricultural economic. Most of the employed person has been working in agricultural sector. Based on the analysis of the questionnaire, number of employed person in different.
Mushampa	-	-	-	-	In the EIA report, data about structure of employment if different sectors was not present.
Ramin	-	-	-	-	-

Table 3-12 : Summary of information as to hygiene and services

Project name	Rural agricultural center	Bank	Treated drinking water	Untreated drinking water	Electricity	Post office	Telephone	Newspaper-magazine	Public transport	Radio	T.V	Public bath	Center of hygiene	Doctor	total
Chesb	-	-	-	5	5	-	-	-	3	5	3	-	-	1	5
Songhor	-	-	-	2	4	-	3	-	3	5	5	-	3	-	5
Aledareh	-	-	-	4	4	-	4	-	-	-	-	-	4	3	4
Mehtar	-	-	-	3	1	-	3	-	2	3	3	2	-	-	3
Qezel Tappeh	-	-	-	2	2	-	2	2	2	2	2	1	2	-	2
Mushampa	1	-	5	17	22	4	-	-	17	23	23	1	12	2	23
Ramin	-	-	-	6	9	-	1	-	-	-	-	-	3	-	9

(Unit number of villages)

4. Environmental Impact of the Dams

Investigation of the EIA study reports of the dams of the interest indicates that consulting engineering companies were applied ICOLD procedure for assessing the environmental impacts of the dams. However, different approaches were used by them standpoint weighting systems. For example Tamavan consulting engineering company has tried to use Spatially Explicit Approach in other to relate the environmental impact of the dams with space. That is why it would be difficult to present synthesized conclusion as to environmental impacts. Therefore environmental impacts of the dams are reported here as to separated sections namely construction and operation phases (Table 4-1 to 4-13).

Table 4-1-Environmental Impact Assessment of Chesb & Songhor Dams during the Construction Phase

		Score	Remarks
Socio-economic & cultural impacts	Human population displacement	-	Lands falling within upstream of Sarab village located in the southeastern parts of the study area and Ghojalo village at north of the irrigation system far to the riparian of Ghezel-ozan River, close to Gonbad village are directly impacted by Chesb dam and irrigation system. Also lands located upstream of Gooche-ghoba village at northeastern parts of the study area up to Saeed-abad village in the central parts of the study area receive direct impact from construction of Songhor Dam and Irrigation system. It was not directly implied how many households have to move during the construction phase.
	Local economy	+	Employment and income generation are the foremost positive impacts of the project.
	Poor people and ethnic groups	+	Increase in income rate consequently increases living conditions.
	Regional conflicts	O	This item was not considered during the impact assessments.
	Water rights	O	This item was not considered during the impact assessments.
	Public Hygiene	O	This item was not considered during the impact assessments.
	Land use	O	This item was not considered during the impact assessments. The amount of area of different land uses affected during the construction phase is not identified.
	Land value	O	This item was not considered during the impact assessments.
	Social acceptance	O	This item was not considered during the impact assessments.
Natural environmental impacts	Marine & coastal environments	O	This item was not considered during the impact assessments.
	Animal/plants & biological diversity	O	This item was not considered during the impact assessments.
	Conservative plants & animal species	O	This item was not considered during the impact assessments.
	Downstream flora and fauna	-	If this item is regarded as equal to the wildlife of the region, implementation of the project will have negative impacts on the wildlife.
	Aquatics & benthoses	-	Remove of borrow materials from river sites, soil cut & fills results in sedimentation into the river, worsen water turbidity, and consequently decreased level of dissolved oxygen which creates dreadful living conditions for aquatics as well as benthoses.
	Micro-climate	X	Since the construction works are limited, no significant changes are imposed to the hydrological cycle components; thus there will be no impact on micro-climate.
Physico-chemical environmental impacts	Hydrological regime	O	This item was not considered during the impact assessments.
	Water pollution	+	Increase of surface water withdrawals as a result of construction and implementation of Songhor & Chesb irrigation system, increases the vegetation coverage of the area, avoiding soil erosion and consequently preventing water pollution; which is a positive impact on water quality.
	Air pollution	-	During the construction period, remove of borrow materials from river sites, movement of machineries and etc. cause dust and particles for which together with fuel consumption contribute to air pollution.
	Noise pollution	+	Noise from construction works will cause increases in sound pollution during the implementation phase of the project.
	Solid waste	O	This item was not considered during the impact assessments.

O: Not considered for impact assessments
+ : Positive impacts
- : Negative impacts
X : No impact

Table 4-4-Environmental Impact Assessment of Mooshampa Dam during the Operation Phase

		Mooshampa	Remarks
Socio-economic & cultural impacts	Human population displacement	+3DHP, +1NMP	This item is reviewed in the terms of immigration. By implementation of the project and creation of agricultural opportunities and alteration of rain fed lands to irrigated lands, trends of residing in the region enhances, thus the population grows larger.
	Local economy	+3DCP	By of implementation of the project, new agricultural and animal husbandry (indirect) jobs are created which are considered as local employment and income generation impacts. Development of tourism, recreation and aqua sports in the region improves the local economy and income rates.
	Poor people and ethnic groups		This item was not considered during the impact assessments.
	Regional conflicts	-2NMP	Since water is regulated and supplied for all the seasons during the implementation phase, there will be no more water shortage concerns. As a result many tensions in the region are reduced. Immigration of non-locals toward the region can bring new cultures to the region. Besides, operation of the cooperative societies is not accomplished by the development of the system.
	Water rights		This item was not considered during the impact assessments.
	Public Hygiene	-1NMP, -1DMP	During the implementation phase, since Ghezel-ozan River is rather highly polluted, and some animal husbandry centers exist at the upstream of the river, particularly during summer the reservoir is prepared to up bring different aquatic insects which will consequently result in spread of disease in the region. Fertilizer and toxin consumptions in the irrigation system can cause irritation through breathing and adsorption.
	Land use	-2NCP	This item has been graded in the matrix, but not referenced in the text.
	Land value	+3NHP, +2DHP	This item has been disregarded during the construction phase.
	Social acceptance	O	This item was not considered during the impact assessments.
Natural environmental impacts	Marine & coastal environments	X	The execution area of the project is not associated to marine and coastal environments.
	Animal/plants & biological diversity	-3NCP, -2DMP, -3NCP, -2DMP	By implementation of the project, a vast area of high-quality flora habitats between Mooshampa and Mah-neshan villages will sink. Reservoir impounding will destroy some parts of high-quality wildlife habitats of the region and will consequently affect living conditions of creepers and fishes.
	Conservative plants & animal species	-1NMP, -2NMP	Reservoir impounding at the upstream of Mooshampa village will destroy some vulnerable Astragalus and Thymus species habitats and will also ruin parts of Testudo graeca habitats. Poor water quality can impose environmental threats to Delije-koochak and Oghab-shahi.
	Downstream flora and fauna	+2NCP, -3NCP	During the implementation phase only plants at the downstream of the irrigation system are affected, it has been implied that development of cultivated lands result in enhancement of flora accumulation and decrease of river flow at downstream will decreases birds accumulation at the riparian of the river.
	Aquatics & benthoses	-2NMP, -2DMP	Reservoir impounding and as a result changes of water characteristics at downstream, imposes threat to sensible fishes, for instance Nemachelhis gender. Reservoir impounding also destroys habitats of Balitoridae spp., including Nemachelhis and Sabanejewia genders. These genders on average live in the tributaries and parts of the river holding lower depth. The power plant kills fishes as well.
	Micro-climate	+3NHP	During the implementation phase, formation of the lake being 20 km long greatly affects the relative wetness and fresh air around the lake. Development of lands and as a result soil evaporation increases relative wetness in the irrigation system area.
Physico-chemical environmental impacts	Hydrological regime	-4OCP, +3DCP	Operation of the dam is estimated to have positive impacts on surface water resources since water of Gezel-ozan River is regulated by implementation of the project. It also has a positive impact on ground water resources since discharge and withdrawal from the aquifer will decrease by implementing the project.
	Water pollution	-2NMP, +2NHP	By Reservoir impounding, qualitative analyses might reveal eutrophication in the reservoir which is estimated to have negative impacts to water pollution, but on the other hand reservoir impounding has positive impacts on ground water resources, while withdrawal from these sources will decrease.
	Air pollution	+1NHP, +1DHP	Reservoir impounding will improve the air quality. Operation of the power plant avoids consumption of fossil fuels for electricity generation, which improves the air quality as well. Operation of the irrigation system and the growing trend of toxin consumptions can distribute pollutants to some extent; But due to expansion of landscapes they have positive impacts on air quality as air purifications.
	Sound pollution	-2NMP	Operation of the power plant is considered as sound polluter during the implementation phase. In the irrigation system area operation of machineries will produce sound and noise, since trees are sound absorbers this impact is positive in this area but on the other hand this impact will receive negative grade in the matrix.
	Solid waste	-2NLP	This item is considered as soil quality impacts, and is considered to have small effects to the project since operation works are limited during the implementation phase.

C: Certain
M: Medium probability
T: Temporary
N: Immediate study area
I: Indirect study area
O: Not considered for impact assessments

H: High probability
L: Poor probability
P: Permanent
D: Direct study area
X: No impact

Table 4-5-Environmental Impact Assessment of Ale-darre Dam during the Construction Phase

		Ale-darre	Remarks
Socio-economic & cultural impacts	Human population displacement	-2IPM	Some people will leave the region as they receive money of land possessions.
	Local economy	+2ITM +3IPC -3PIC -1IPM	On account of construction works, creation of new jobs, withdrawal of vegetation coverage and increase in local employment & income generation, agricultural and animal husbandry efficiency decreases. The implementation of the project has small effects on tourism and recreation in the region.
	Poor people and ethnic groups	*	The possibility of unemployment of locals in the project increases the gap between poor and employed people.
	Regional conflicts	-3ITC	As a result of the gap between the incomes of poor and employed people trends of social resistance and job competitions are growing in the region.
	Water rights	O	This item was not considered during the impact assessments.
	Public Hygiene	O	This item was not considered during the impact assessments.
	Land use	*	Land use alterations in the reservoir area and related construction works.
	Land value	-1IPM	Increase of land value as execution works begin, which causes sort of harm to local residents.
	Social acceptance	-3ITC	Employment of non-locals resulting in point competitions.
Natural environmental impacts	Marine & coastal environments	X	The execution area of the project is not associated to marine and coastal environments.
	Animal/plants & biological diversity	-2IPC -2ITC	Soil cut and remove of borrow materials from river sites: destruction of mammal habitats, particularly Arvicola terrestris sp. / Entry of water runoffs, petroleum and gasoline into the river: increase of water turbidity and other pollutions, impacts on loss of vegetation coverage of the region and therefore decrease of food supply to Arvicola terrestris sp. / Cleaning the reservoir: losing parts of Arvicola terrestris sp. food chain/ Geotechnical operation: the produced noise stresses out Martes foina sp. so the animal leaves the area/ Construction works at the dam site: destruction and loss of Buteo sp. food and habitat/ Clear cut cut: loss of some parts of vegetation coverage resulting in sedimentation of the river that will impact the vegetation coverage of the river riparian/ Remove of borrow materials: destruction of vegetation coverage at borrow sites/ clear cut the dam reservoir and withdrawal of vegetation coverage/ Entry of polluted runoffs resulted from machinery repairs: alteration in substances adsorption conditions by ﷺ species and other macro-floras and changes in food chain.
	Conservative plants & animal species	-3IPC	Clear cutting of the reservoir: destruction of flora communities (Astragalus species)
	Downstream flora and fauna	O	This item was not considered during the impact assessments.
	Aquatics & benthoses	-1ITC -2IPC -3LPC	Construction works (particularly soil cut): muddying the river, impact on aquatic living conditions and possible immigration/ Remove of borrow materials: destruction of aquatic habitats/ Entry of petroleum and oil matter runoffs resulted form machinery repairs into the river: multi-effect on micro-flora and micro-fauna and production of mud and sludge under forceful circumstances/ Labor transportation: fishing by dynamite, poisoning substances or traps/ tunnel construction
	Micro-climate	X	No impact is estimated on micro-climate during the construction phase.
Physico-chemical environmental impacts	Hydrological regime	-2IPM -2ITC	Remove of borrow materials from river sites changes the river path. Surface water construction works that are carried out by construction of the reservoir body and related water supply structures; decrease the amount of surface waters, particularly during dry seasons.
	Water pollution	-2ITC	Soil cut & fills, Remove of borrow materials from river sites enhance water turbidity, TDS, TSS and potential of erosion. Entry of oil matter runoffs into the river (Surface and groundwater pollution).
	Air pollution	-1ITM	Factory equipment.
	Sound pollution	-1ITM	Factory equipment.
	Solid waste	-1ITM	Factory equipment causes waste pilling.

C: Critical I: Immediate impact
P: Permanent impact M: Certain impact
T: Temporary impact X: No impact
O: Not considered for impact assessments

Table 4-6-Environmental Impact Assessment of Ale-darre Dam during the Operation Phase

		Ale-darre	Remarks
Socio-economic & cultural impacts	Human population displacement	+3LPC	The present review (page 125) reveals that Ale-darre residents have a tendency to live in suburbs, thus resettlement is unnecessary.
	Local economy	+3LPC	Employment and income generation are the foremost positive impacts of the project.
	Poor people and ethnic groups	-	Increase in income rate consequently enhances living conditions.
	Regional conflicts	O	This item was not considered during the impact assessments.
	Water rights	O	This item was not considered during the impact assessments.
	Public Hygiene	O	This item was not considered during the impact assessments.
	Land use	O	This item was not considered during the impact assessments. The amount of area of different land uses affected during the construction phase is unidentified.
	Land value	+1LPM	This item was not considered during the impact assessments.
	Social acceptance	*	Implementation of the project will cause increase in price of lands.
Natural environmental impacts	Marine & coastal environments	O	The execution area of the project is not associated to marine and coastal environments.
	Animal/plants & biological diversity	+3LPC +2LPM	Water intake form the dam reservoir will cause in good climate which will consequently increase the growing period of herbal plants and will provide protected vegetation coverage in the area. Diversity of vegetation coverage will increase; as a result mice grow in the area and therefore food is supplied for Buteo and Aquila spp.
	Conservative plants & animal species	+3LPC	A cover up habitat for Zarivar and Orumiye Wetlands is created by development of the lake, which is considered as a new habitat for valuable protective species as Antidae and Tringa spp.
	Downstream flora and fauna	+4LPC +2LPM	The flora and fauna survie at downstream as the water is regulated by the dam and abandoned, in view of the environmental flow. Offload of sediments result in destruction of ecosystems at downstream.
	Aquatics & benthoses	+2LPC	Aquatic productivity enhances by the construction of the dam, since Lentic ecosystem sp. Growth is increased in the dam reservoir. 2 out of 3 Lentic ecosystem species develop in the dam reservoir.
	Micro-climate	+2LPC	Formation of the lake greatly effects cause of relative wetness and fresh air around the lake and reduces of aridity.
Physico-chemical environmental impacts	Hydrological regime	-1IPC +2IPC	The quantity of water at downstream decreases since the dam blocks the River path since the dam regulates the abandoned water; no water shortage at downstream particularly during summer.
	Water pollution	-2LPC -3ITM	According to high agricultural potentials of the area and the population growth the amount of human wastes off-loaded to surface water resources increases. Water quality drops as a result of sediment abandonment. Water pollution as a result of tourism and recreation and campsites.
	Air pollution	-1ITM	Agricultural developments and operations of machineries produce air pollution.
	Sound pollution	-1ITM	Operations of machineries produce sound and noise.
	Solid waste	-1LPC	The ever growing population and tourism and recreation, as a result increases waste pilling which therefore might cause soil pollution.

C: Critical
I: Immediate impact
P: Permanent impact
M: Certain impact
T: Temporary impact
O: Not considered for impact assessments
*: Not Assessed

Table 4-7-Environmental Impact Assessment of Qezel Tappe Dam during the construction Phase

		Ale-darre	Remarks
Socio-economic & cultural impacts	Human population displacement	0	Construction works have no effect on population displacement (resettlement).
	Local economy	2.03 2.43	This item is studied in terms of cost & income (2.03) employment/unemployment (2.43). The construction works increases local employment and incomes which will also decrease the unemployment.
	Poor people and ethnic groups	0.33	This parameter has been assessed in the matrix as race and tribe.
	Regional conflicts	O	This item was not considered during the impact assessments.
	Water rights	-1.55	This item is studied in terms of water consumption in the matrix. Infrastructural and road operations, together with diversion system works and dam constructions have negative impacts on this item.
	Public Hygiene	-1.5 1.62	This item is studied in terms of hygienic index (-1.5) and hygienic facilities and services (1.62). Construction activities cause of air and sound pollution have negative impacts on hygienic indices especially tunnel explosions, but operation of bridges; road and buildings have positive impacts on this item.
	Land use	-1.67	Construction activities including diversion tunnel digging, tunnel explosions, operation of roads and bridges, soil cut & filling, clear cutting in order to construct bridges, solid waste storing and operation of cement diversion dams have negative impacts on land use (stabilizing slops and remove of workshops are the only positive impacts)
	Land value	0.38	Solid wastes storing, implementation of the diversion system and almost all of the implementation works have negative impact on price and calue of lands, but operation of roads and buildings have positive impact on this item.
	Social acceptance	1.25	Locales agree to implementation of the project, they also have tendency to take part in the project as labors and give financial supports to the project.
Natural environmental impacts	Marine & coastal environments	X	Due to the geographical conditions of the region no impacts are imposed to marine & coastal environments.
	Animal/plants & biological diversity	X	Development of two immense water areas in the region increases living conditions for aquatics and creates a proper seasonal and permanent habitat for birds which as a result causes in immigration of birds toward the area. Besides, watershed managements and erosion control have positive impacts on this item.
	Conservative plants & animal species	X	According to the studies carried out in the region, no valuable fauna and flora species exist within the region; thus this item is not graded in the matrix.
	Downstream flora and fauna	*	Fauna and flora of the region are not clearly assessed in the matrix, thus they are left un-separated.
	Aquatics & benthoses	-1.7	This item is considered in terms of Aquatic ecosystems (-1.7) in the matrix assessment.
	Micro-climate	X	Construction activities don't have any impacts on the microclimate.
Physico-chemical environmental impacts	Hydrological regime	-1.06 -1.11	This item is considered in terms of A) low flow (-1.06) and flood regime (-1.11).
	Water pollution	-1.66 -1.30	This item is considered in terms of Surface water quality (-1.66) and Ground water quality (-1.3). Tunnel digging and the water diversion tunnel, tunnel explosion, soil cut and operation of roads, infrastructure transportations, have negative impacts on water quality. The groundwater quality is affected by the same activities with sewages.
	Air pollution	-1.77	The structural activities which have negative effect on air pollution are; digging and explosions, soil cut & filling, channel and water diversion digging, infrastructural transportation, road constructions,…
	Sound pollution	-1.16	Digging and explosions, channel and water diversion digging, soil cut and filling of dam roadway, road and bridge construction has maximum effect on the air pollution..
	Solid waste	-1.79	There isn't significant explanations in main report about this item.

O: Not considered for impact assessments
X: No impact
*: Not Assessed

Table 4-8-Environmental Impact Assessment of Qezel-tappeh Dam during the Operation Phase

		Quezel-tappeh	
Socio-economic & cultural impacts	Human population displacement	2.5	Creation of jobs and reservoir impounding has a positive impact on resettlement.
	Local economy	2.28 2.63	This parameter has been assessed in the matrix as Cost and income (2.28) Employment (2.63).
	Poor people and ethnic groups	2.44	This parameter has been assessed in the matrix as race and tribe. Reservoir impounding, operation of access roads, watershed managements, erosion controls, study of races and etc. are estimated to have positive impacts on poor people & ethnic groups.
	Regional conflicts	O	This item was not considered during the impact assessments.
	Water rights	2.37	This parameter has been assessed in the matrix as water consumption. Reservoir impounding, control of Arpachay River, water regulation for different uses, control of amount of sediment are estimated to have positive impacts on water rights.
	Public Hygiene	0.5 1	This parameter has been assessed in the matrix as hygienic indices (0.5) hygienic facilities & services (1).
	Land use	1.5	Flood control, water regulation for different uses, watershed managements, collection and management of wastes and erosion control have positive impacts on land use.
	Land value	3	All operation activities (including reservoir impounding, flood control, water regulation for different uses etc.) have positive impact on increase of land value. As the local residents show interest on agricultural activities, land value highly increases.
	Social acceptance	2.5	This item is considered in terms of public cooperation. Operation of roads and bridges, flood control, water regulation for different uses, watershed managements, creation of job and erosion controls have positive impacts on public cooperation.
Natural environmental impacts	Marine & coastal environments	X	Due to the geographical conditions of the region no impacts are imposed to marine & coastal environments.
	Animal/plants & biological diversity	-0.16	Development of agricultural activities by operation phase may decrease biodiversity.
	Conservative plants & animal species	X	Since there are no valuable fauna and flora species in the region, this item is not graded in the matrix.
	Downstream flora and fauna	*	There are not any valuable flora and fauna species at downstream of the (Pg. 101-102 of report) , on the other hand vegetation and fauna are scored in the matrix but the location of them (upstream and downstream) are not identified.
	Aquatics & benthoses	0.14	By construction of the lake, living conditions of aquatics improves.
	Micro-climate	3	By development of two immense water areas in the region, small changes will be made to relative wetness which might consequently change the climate.
Physico-chemical environmental impacts	Hydrological regime	-0.5 3.28	This item is considered as two parameters low flow regime (-0.5) flood regime (3.28) in the matrix. Construction of the dams has no big negative impacts on this item, given that Arpachay is a seasonal river. Flood control and physical flood halter have positive impacts on this item.
	Water pollution	0.14 0.33	This item is considered in terms of surface water quality (0.14) and ground water quality (0.33). Reservoir impounding, operation of roads and bridges and removal of sedimentation from the river have negative impacts on this item. On the other hand, river flow control, flood control, watershed management, and erosion control have positive impacts on surface water quality. All of the operation works have positive impacts on ground water quality.
	Air pollution	0.8	There isn't significant explanation in main report about this item.
	Sound pollution	-1.33	There isn't significant explanation in main report about this item.
	Solid waste	-1.14	There isn't significant explanation in main report about this item.

O: Not considered for impact assessments
X: No impact
*: Not Assessed

Table 4-9-Environmental Impact Assessment of Mehtar Dam during the operation Phase

		Mehtar	Remarks
Socio-economic & cultural impacts	Human population displacement	-1	By implementation of the project, parts of Mehtar village with a population of 350 will sink.
	Local economy	4.3 (Income)	As the project implementation creates new job opportunities, local economical and Social condition will improve. The lake will create tourism and recreation, alteration of rain fed lands to irrigated lands and increase in man-need power in the region, improves social living condition and incomes, as well as husbandry of the region.
	Poor people and ethnic groups	O	The item was not considered during the impact assessment
	Regional conflicts	O	The item was not considered during the impact assessment
	Water rights	-0.55	Because of downstream flow
	Public Hygiene	1.5	The level of public hygiene will improve after implementation of the project.
	Land use	2	Because of impounding, some impacts would be incurred on the land use
	Land value	3.8	Because of impounding, some lands would be purchased
	Social acceptance	-	Because of the lack of irrigation water shortages and high unemployment rates, the villagers at downstream agree to implementation of the project. People at downstream are more cooperated to the project, compared to Mehtar villagers at upstream of the region.
Natural environmental impacts	Marine & coastal environments	-0.88	There are no wetlands and valuable habitats for fauna and flora in the study area, thus no negative impacts are estimated to this item.
	Animal/plants & biological diversity	-0.33	There are neither rich flora ecosystems nor any valuable species in the study area. The Dam's lake will improve living conditions of fauna species and particularly aquatics and birds. As a result vital species and the positive balance increases.
	Conservative plants & animal species	O	The item was not considered during the impact assessment
	Downstream flora and fauna	+	The Dam's lake will improve living conditions of different fauna species and particularly aquatics and birds.
	Aquatics & benthoses	-1.6	Since Mehtar river is a seasonal river and there are no valuable riparian species along the river, thus water will be no problem at upstream and downstream of the area. The foundation of the lake creates a suitable habitat for fauna and flora species.
	Micro-climate	0.66	By operation of the dam and consequently variation of the river discharge, the relative wetness and fresh air around the lake varies. Thus the vegetation coverage and living conditions of fauna and flora species improves.
Physico-chemical environmental impacts	Hydrological regime	0.55	Implementation of Mehtar Dam causes a number of changes to the hydrological regime of the river: - Decrease of water discharge at downstream during high-flow seasons. - Decrease of suspended solids at downstream and sedimentation in the upstream. - Riverbed enhancement at upstream Since Mehtar river is a seasonal river and is dried during most months of the year, thus construction of the dam makes no serious impacts the hydrological regime of the river.
	Water pollution	-0. 53	By implementation of the project, as a result of recreation and agricultural activities the concentration of dissolved solids might increase in the river. But the implementation of the projects has no direct affect on the concentration of dissolved inorganic and organic substances in the river. Penetration of agricultural runoffs drops the surface and groundwater quality. Since there are no considerable agricultural lands within upstream of the dam site, surface and ground water and soil resources might become polluted at downstream, as a result eutrophication is likely at downstream. The groundwater table increases and results in high-flow streams at upstream of the dam site. Groundwater table might increase at downstream of the dam site and in the irrigation system, thus the water might flow from the coastal toward the riverbed which might cause collapse parts of the upper layers and erosion of the reservoir. Toxin and fertilizers consumption might contaminate the surface and groundwater resources. The groundwater in the irrigation system can result in water resting in cultivated lands.
	Air pollution	0.66	Waste burial sites of Zanjan city and conservative Zinc factory are addressed in the report. Due to the dominate wind directions in the region, contamination of the river is less possible whereas agricultural lands will probably get contaminated. The affect of the implementation of the project in air pollution was not reviewed in the report.
	Sound pollution	O	The item was not considered during the impact assessment
	Solid waste	1	According to the shape of Mehtar water basin and its topography situation, pollutant will enter to the dam's lake.

O: Not considered for impact assessments

Table 4-10-Environmental Impact Assessment of Mehtar Dam during the construction Phase

		Mehtar	Remarks
Socio-economic & cultural impacts	Human population displacement	-	By implementation of the project, parts of Mehtar village with a population of 350 will sink. Generally the region faces with the problem of immigration because of irrigation water shortage, the low income, lack of public health facility and employment
	Local economy	1.3	New employment opportunities for natives will be created during construction
	Poor people and ethnic groups	O	The item was not considered during the impact assessment
	Regional conflicts	O	The item was not considered during the impact assessment
	Water rights	O	The item was not considered during the impact assessment
	Public Hygiene	-0.36	Lack of public health facilities (specifically safe domestic water) has caused immigration to outer areas
	Land use	0.62	Agriculture is the major local activities, but water passage leads to limit the irrigated farming. Lack of farmers' technical, scientific and skill awareness has caused scattered and small agricultural lands. About 35% of farming land is irrigated and 65%is non- irrigated. (In the previous years irrigated farming was more common.)
	Land value	1.16	Value of the land would be increased because they would be purchased by project's financial resources
	Social acceptance	-	Local villager especially downstream village support the project with respect to existing status. The support of farmers and exploiters in the region is the main advantage of the project.
Natural environmental impacts	Marine & coastal environments	-1.6	The region does not have any important habitat of faun and flora.
	Animal/plants & biological diversity	-2.18	The study region with regard to its small area lacks of rich ecosystem or valuable species.
	Conservative plants & animal species	O	The item was not considered during the impact assessment
	Downstream flora and fauna	O	The item was not considered during the impact assessment
	Aquatics & benthoses	-	Aquatic ecosystem is weak because the Mehtar river is seasonal.
	Micro-climate	-1.3	Air quality and microclimate has been scored as the same items.
Physico-chemical environmental impacts	Hydrological regime	-2.1	No description is available
	Water pollution	-1.13	Severe Water pollution is caused by various excavation activities such as digging from dam foundation, the sides of dam axis and river bed. However, due to seasonality of the Mehtar river, no problem is considered in this issue. During the construction due to increase in population settlement, the probability of water pollution and the relevant disease will be increased.
	Air pollution	-1.3	Air quality and microclimate has been scored as the same items.
	Noise pollution	-3.75	Project construction will cause noise pollution due to bore hole construction and excavation and soil fill and cut, explosion and tunnel excavations. This section is scored in the operation section.
	Solid waste	-	During construction and exploitation of borrow, some parts of the region will be demolished. The side effect due to seasonal flow pattern of the river is minimum. Local and side erosion is caused at the beginning of the construction during cut and fill activities which gradually decline during the operation phase.

O: Not considered for impact assessments

Table 4-11- The reason(s) for the assessed environmental impacts in construction phase (Ramin)

		Ramin	Remark
socio-economic and cultural impacts	Human population displacement	X	Due to lack of human population over dam site and supplementary facilities area, there is no impact that to be incurred.
	Local economy	3	With creating new jobs, the income of the local people will be increased due to construction phase of the project..(employment about 300 person)
	Poor people and ethnic groups	O	The item was not considered during the impact assessment
	Regional conflicts	O	The item was not considered during the impact assessment
	Water rights	O	The item was not considered during the impact assessment
	Public Hygiene	O	The item was not considered during the impact assessment
	Land use	-1	Due to limitation of project area, change in land use is minor.
	Land value	O	The item was not considered during the impact assessment
	Social acceptance	-1	Although there are few people who opposed the project, they will accept the project provided the complementation is conducted.
Natural environmental impacts	Marine and coastal environments	O	The item was not considered during the impact assessment
	Animal/ plant and biological diversity	*	Because of lack of sufficient data quantitative assessment was not carried out
	Conservative plant and animal species	*	Because of lack of sufficient data quantitative assessment was not carried out
	Downstream flora and fauna	O	The item was not considered during the impact assessment
	Aquatics and benthoses	X	Environmental impact analysts assessed no considerable impact incurs on aquatics and benthoses.
	Micro-climate	O	The item was not considered during the impact assessment
Physico-chemical environmental impacts	Hydrological regime	-2	Construction phase of the dam would increase bed load erosion. It would, in turn, increase suspended loads and downstream sedimentation. Increasing sediment loads and downstream sedimentation would affect hydrological regime of the river.
	Water pollution	-1	During the construction phase of the dam, although cut and fill operation in place of construction of the dam, diversion tunnel, access road around the reservoir of the dam would increase the soil erosion, the stream system would be able to absorb it through self-purification of the system.
	Air pollution	-1	During the construction phase of the dam, minor air pollution is generated because of emission from machineries equipments.
	Noise pollution	-2	Transportation and use of heavy vehicles would also incur noise pollution so that it might be considered as a stressing factors for abandon the study area.
	Solid waste	O	The item was not considered during the impact assessment

O: Not considered for impact assessments
X: No impact
*: Not Assessed

Table 4-12- The reason(s) for the assessed environmental impacts in operation phase (Ramin)

		Ramin	Remark
socio-economic and cultural impacts	Human population displacement	-3	Because of human population displacement, the environmental impact analysts assessed it as negative impact.(Population displacement about 1083 person)
	Local economy	3	Because of creation of new job opportunities, the environmental impact analysts assessed it as positive impact. (employment about 500 person)
	Poor people and ethnic groups	O	This item was not considered during the impact assessments.
	Regional conflicts	O	This item was not considered during the impact assessments.
	Water rights	O	This item was not considered during the impact assessments.
	Public Hygiene	2	Because of increasing incomes of the local people through employment at the operation phase of the project, selling goods and services and take advantage of the hygenic facilities that are provided for engineers and workers at dam site, public hygiene would be enhanced.
	Land use	X	Because a few percentage of land uses would be incurred
	Land value	2	Because of demand for purchasing the land and properties for construction and operation of the dam, their economic values would be increased.
	Social acceptance	*	Because of lack of sufficient data quantitative assessment was not carried out
Natural environmental impacts	Marine and coastal environments	*	Because of lack of sufficient data quantitative assessment was not carried out
	Animal/ plant and biological diversity	*	Because of lack of sufficient data quantitative assessment was not carried out
	Conservative plant and animal species	O	This item was not considered during the impact assessments.
	Downstream flora and fauna	O	This item was not considered during the impact assessments.
	Aquatics and benthoses	*	Because of lack of sufficient data quantitative assessment was not carried out (Ramin)
	Micro-climate	O	This item was not considered during the impact assessments.
Physico-chemical environmental impacts	Hydrological regime	O	This item was not considered during the impact assessments.
	Water pollution	1	Operation phase of the project would enhance water quality of the stream. Since suspended solid would be deposited in the reservoir. It would, in turn, improve quality of the stream water physically in general and enhance quality of the water for aquatic lives in particular. That is why the environmental impact analysts assessed it as positive impact.
	Air pollution	O	This item was not considered during the impact assessments.
	Noise pollution	O	This item was not considered during the impact assessments.
	Solid waste	O	This item was not considered during the impact assessments.

O: Not considered for impact assessments
X: No impact
*: Not Assessed

4-13

Reference

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SUPPORTING REPORT

PAPER 5

ORGANIZATION, INSTITUTION AND LEGAL SYSTEM

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

SUPPORTING REPORT

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1.1 GENERAL

Administrative setup in Iran is shown in the following Figure.

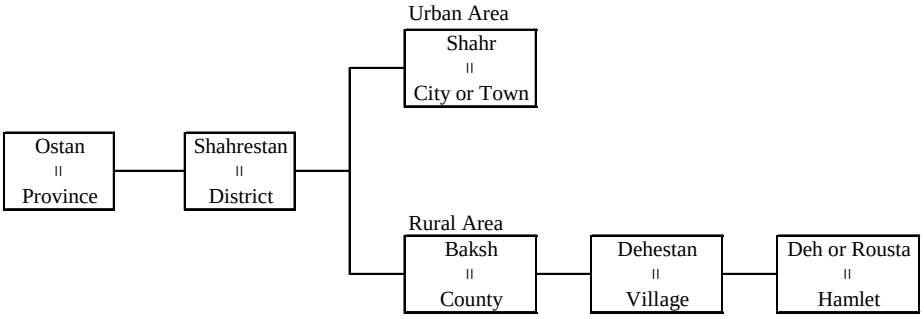


Figure 1.1.1 Administrative Setup in Iran

In the above Figure , the term of "Shahrestan" locally called is also translated as "township." However, according to administrative customs in almost of all the European countries, the township is usually set under the county after province. Accordingly, the term of "the shahrestan" has been translated into English as "District". The term of "shahr" means "town" or "city". Village is locally called as "dehestan". However, above the dehestan, there is "baksh" which has been translated as "county", but this term is used for rural community only. The most subordinate administrative unit is locally called as "deh" or "rousta" that has been translated into English as "hamlet" in this report.

The whole territory of the nation consists of 30 Provinces. Under the provinces, there are 336 Districts. Sub units of Districts are 1,015 Cities/Towns and 889 Counties. Following table shows its details.

Table 1.1.1 List of Provinces with Areas and Number of Administrative Units in Target Provinces

Province	Capital of Province	Area (km^2)	Number of District	Number of County	Number of Cities	Number of Village
East Azarbaijan	Tabriz	45,650	19	42	57	141
Ardebil	Ardebil	17,800	9	25	21	66
Tehran	Tehran	18,814	13	35	53	79
Zanjan	Zanjan	21,773	7	16	16	46
Qazvin	Qazvin	15,549	5	19	24	46
Kordestan	Sanandaj	29,137	9	26	23	83
Gilan	Rasht	14,042	16	43	49	109
Hamedan	Hamedan	19,368	8	23	27	72
Total of the Targeted Province		182,133	86	229	270	642
Total in Whole Iran		1,628,554	336	889	1,015	2,400

Source: Iran Statistical Year Book 1384, Statistical Center of Iran, Management and Planning Organization, Iran.

People living in Cities/Towns are classified as "urban population", and all the people living in Counties are classified as "rural population." Under the Counties, there are 2,400 villages. The lowest administrative unit is Hamlet, and unfortunately the number of Hamlets and population by hamlet are not reported in the statistics.

CHAPTER 2. RELATED LAWS AND REGULATIONS, AND STRATEGY

2.1 RELATED LAWS AND REGULATIONS

Major laws concerning water resources management are shown below.

Table 2.1.1 Major laws concerning water resources management

No.	Law	Issued year
1	Fair Water Distribution Act	1983
2	Water Allocation Law	1983
3	Act of the Establishment of Water and Wastewater Companies	1983
4	Maintenance and Fixing of Boundary River Beds	1983
5	The Law of Promotion of investment in Water Projects in Iran and Enforcing Bylaw	2002
6	Preservation and Maintenance of Groundwater Resources	1966
7	Iran Water Law and the Manner of Water Nationalization	1968
8	Environmental Protection and Enhancement Act	1974
9	Prevention of Water Pollution Regulation	1994
10	Qanat and Well Excavation Regulation	1984
11	Long-term Development Strategies of Water Resources	2003
12	The Articles of Association of Iran Water Resources Management Specialized for Mother Company	2003
13	Farming Water Fee Law	1980

In above laws, Fair water Distribution Act ,Water Allocation Law, The Articles of Association of Iran Water Resources Management Specialized for Mother Company and Long-term Development Strategies of Water Resources are especially quite significant to manage water resources fairly.

Fair Water Distribution Act

Water and its Nationalization Law was issued in 1968. After the Islamic revolution, the law was amended in 1983. The law consists of 52 Articles and 27 Notes. This law is the most basic law for water resources management with nullifying the regulations which disagree with this law.

Chapter 1. National and Public Water Ownership

Article 1.

As per principle 45 of Constitution of Islamic Republic of Iran, water flowing in sea, rivers, natural creeks, valleys and any natural routes including surface or groundwater, flood water, waste water, drained water, lakes, marshes, natural ponds and springs and mineral water and underground water resources are the property of government of Islamic regime and they are utilized for public interest. Government is responsible for protection, permission of and supervision over the utilization of these resources.

Article 2. Note 2

Right of way of water reservoir and installations and public water supply and irrigation canals either surface or underground shall be fixed by Ministry of Energy and shall be final upon approval by the Cabinet.

Article 2. Note 3

Constructing any superstructure and drilling and trespassing beds of rivers, natural creeks, public creeks, waterways and natural ponds and on the right of way of seaboards and lakes including natural or reservoir ones is forbidden unless otherwise permitted by Ministry of Energy.

Chapter 2. Groundwater

Chapter 3. Surface Water (Water right and Reasonable Use Permission)

Article 19

Ministry of Energy is obliged to allocate reasonable water consumption quantity for agricultural, industrial and urban affairs from state water sources for real or legal entities who have had right of water and converting the same to reasonable consumption authorization by three-member committees.

Chapter 4. Duties and Powers (Issuing Reasonable Water Use Permission)

Article 21

Ministry of Energy exclusively permits utilization of public water resources for drinking, agricultural, industrial and other purposes.

Article 22

Ministry of Energy or affiliated organizations and companies shall at the request of applicant and conducting necessary investigations take action to issue reasonable water consumption license observing the priority as per the proposal of by-laws by Ministry of Energy and Ministry of Agriculture and approval of the Cabinet.

Article 25

Holders of consumption licenses are obliged to avoid unreasonable consumption of water and construct and maintain their own canals in such a way to meet this purpose. If due to any reason it is proved that consumption is not reasonable and economic, then as per case, Ministry of Energy or Ministry of Agriculture shall notify the consumer stating reasons and give technical instructions.

Article 26

Ministry of Energy is obliged to fix water consumption amount with regard to type of product and area of lands with the use of information that Ministry of Agriculture provides for Ministry of Energy concerning amount of water consumption for any of the agricultural products in any region, and then take action to issue utilization license.

Article 28

Nobody is entitled to utilize the water for purposes other than indicated in the license, and to transfer the license to others without permission of Ministry of Energy, unless consequently for the land and for the same consumption upon notification to Ministry of Energy.

Article 29

Ministry of Energy is obliged to act as follows to supply water the required country:

J- To control floods and save river waters in surface or ground reservoirs.

L-To study all water resources of the country.

P-To control and supervise consumption of water and rationing when necessary.

Q-To establish regional water companies and organizations and other necessary institutions, councils and committees.

Article 32

Ministry of Energy may directly or in cooperation with other governmental organizations or companies established with government's capital establish regional water companies and organizations in the form of commercial companies.

Article 32 Note

Ministry of Energy shall fix scope of activity of regional water organizations and companies.

Article 42

For utilization of surface water, any dispute resulting from priority and method of extraction and distribution and consumption of water and disputes arising from delayed water supply, shall be settled in the first instance by the local water in-charge officials in cooperation with local councils, if any, otherwise the dispute shall be referred to competent court of law.

Chapter 5. Collection of Water Fee and Dues

Chapter 6. Protection and Maintenance of the Joint Irrigation Facilities

Chapter 7. Compensation-Violations and Different Regulations

Chapter 8. Violations and Fines

Chapter 9. Miscellaneous regulations

Water Allocation Law

This Water Allocation Law was issued based on Articles 21 and 29 of the Fair Water Distribution Act and article 1 of Energy Ministry establishment law in line with the implementation of the Fourth National Development Plan in 1983. The law consists of 21 Articles and 5 Notes.

Chapter 1. Definitions and Concepts

Article 2 Objectives

Organizing the process of water allocation in order to implement the Fair Water Distribution Act create a balance between water supply and demands, achieve an integrated water resources management plan by adopting proper approaches, improving decision-making process, and establishing a national water accountancy system.

Article 4 Definitions

4-2 Water Allocation

The amount of water determined by the Ministry of Energy to be allocated to different consumptions. The Ministry of Energy determines the amount of water allocation in each study area, watershed basins, and rivers flowing to the country with the consideration of water resources potential and the users' water rights.

The Ministry of Energy also authorizes the companies to issue usage permits for users to use the allocated water.

4-3 Allocator

Ministry of Energy which will take measures through the Water Resources Management Organization.(=WRMC)

Chapter 2. Water Allocation Structure and Responsibilities

Article 8-1 Responsibilities (by water allocation commission in WRMC)

- Determination of the amount of water that should be allocated from surface and groundwater resources for different consumptions in watersheds and study areas through the country, considering priorities and quality and transfer limitations.

- Making decisions about regulated water resources at dams and water resources development projects and determining the amount of water that should be allocated to different consumptions.

- Making decisions on revising allocations in droughts and water rationing seasons based on Article 29 of the Fair Water Distribution Act

Chapter 3. Structure and Operation of Water Allocation

The Articles of Association of Iran Water Resources Management Specialized for Mother Company

The objective of establishing the company is to arrange the activities under the charge of the Water Affairs of the Ministry of Energy, including the organization, direction and technical, engineering, legal, financial and administrative supports of the subsidiary companies to recognize, study, develop, conserve and operate water resources and installations efficiently, and exploit hydropower energy and operate the related systems. The law was issued in 2003 and consist of 21 Articles and 5 Notes.

Chapter 1. Generalities and Capital

Chapter 2. Operation and Duties

Chapter 3. The Pillars of the Company

Chapter 4. Financial Statements

Chapter 5. Other Regulations

Farming Water Fee Law

This is water fee law for agriculture and was issued in 1980. Water fee is different depending on condition of irrigation system. The law consists of 3 articles and 2 Notes.

Modern network: 3% of planted crop

Semi-modern canal: 2% of planted crop

Traditional canal: 1% of planted crop

Water fee is renewed every year due to variation of planted crop by the year. MOJA decides the average planted crop of previous year; MOE decides the water fee of next year based on the planted crop price.

The Law of Promotion of Investment in Water Projects in Iran and Enforcing Bylaw

This law was issued in 2003, in order to promote cooperative and private sectors (real and legal entities) to invest in the projects for water supply and construction of drainage and irrigation networks and water and soil. Privatization is the policy of the Government and people can participate widely and implement water projects. The law consists of Single Article, 29 Articles and 12 Notes.

Private sector cannot decide the water price by them under present law. The entire water price is decided by the Government. Participant to projects by the private sector is still slow due to difficulty of profiting.

2.2 DEVELOPMENT STRATEGY OF WATER RESOURCES

The document of "Long-Term Development Strategies for Iran's Water Resources" says that the Government raises a rate of utilization of surface water for Agriculture, 46% as of 2002, to 55% within the coming 20 years. It also says that the Government controls share of water demand for agriculture from 92% as of 2002 to 87% within the same term and make shift to cash crops in agriculture sector to activate the regional economy.

Table 2.2.1 Summary of Long-Term Development Strategies for Iran's Water Resources

No.	Title	Content
1	Macro management	National water management must be based on supply and demand management, water cycle, sustainable development, land use planning and joint basin, and to realize water resources integrated management, economic, social, infrastructural and service sectors must be coordinated with the water sector.
2	Water Resources Management	The utilization of Iran's water resources in each basin must be planned in such a way that the volume of the utilized underground water does not exceed the present utilized volume. Utilized share of surface water shall be increased from 46% to 55% within the coming 20 years.
3	Consumption Management	The water consumption must be improved so that agriculture water demand shall be reduced from 92% to 87% within the coming 20 years. Efficient consumption of water shall be required and economical valuable crops shall be allocated. Priority will be drinking and hygiene, industry and service, and gardening and agriculture respectively.
4	Economic Value	Water management must determine and express the economic value of water, including its natural and climatic conditions having access to water, the value of investment in supplying, transferring, distributing and recycling water to be consumed in various sectors.
5	Quality Control	All water consumers shall control water pollution and water quality. Water consumers have to observe the national standards of water resources quality conservation and sewage disposal system.
6	Water Supply Costs	The price of water for various consumptions must be fixed to meet people's essential needs for drinking and hygiene.
7	Water Exchange	Exchanging water with neighboring countries shall be considered, considering the role of water in national development and its economic value in the region's market.
8	Land use Planning	Development projects and land use planning must take into consideration cost and inherent value of water.
9	Inter-basin Water Transfer	The projects of transferring water from the view point of sustainable development while observing interested parties' right and their technical, economic, social feasibilities and explanation and national interests.
10	Management and Structure	Structure of water management of decentralization shall be considered increasing people's and local organizations' participation.
11	Watershed/Basin Consumption	In provincial development plans, basins must be considered as effective territories in the economic and social development of the province.
12	Risk Management	Plans for drought and flood management must be prepared and executed with the cooperation of all related and organizations.
13	Urban Water Distribution	Various methods preventing water losses in water transfer lines and urban and rural water distribution networks must be adopted as the first priority.
14	Public Training	Public awareness programs for conserving water quantity and quality as well as optimized consumption of water must be compiled and executed.
15	Shared Waters	All the waters flowing out and joint waters must be harnessed and consumed. And frontier river rivers must be systematized observing economic and environmental standards.
16	Informal Management	Equipping and completing water quality and quantity gauging networks and information and communication systems must be considered.
17	Preservation of Historic Structure	The sustainable preservation, revival and operation of the historic hydraulic structures must be considered in providing and compiling water planning of the country.
18	Interdepartmental Management	High Water Council will coordinate the policies in water supply, distribution and consumption.

Source: Long-Term Development Strategies for Iran's Water Resources

CHAPTER 3. RELATED ORGANIZATIONS AND INSTITUTIONS

3.1 GENERAL

Iran water law and water nationalization law was issued in 1968, in which it is mentioned clearly that all the water resources belong to the Islamic Government. This law was amended as Fair Water Distribution Act and Water allocation Law. All the powers and responsibility concerning on water resources management belong to MOE.

3.2 RELATED ORGANIZATIONS

3.2.1 Overall Structure of Related Organizations

Major organizations for water resources management and utilization are as follows:

Water policy organization

(i) Parliament, Supreme water Council (chairman is President of Iran)

Related organization of MOE

(ii) WRMC (Water Resources Management Company)

(iii) RWC (Regional Water Company)

(iv) WWC (Water and Wastewater Company)

- UWWC (Urban Water and Wastewater Company)
- RWWC (Rural water and Wastewater Company)

Other ministry organization

(v) MOJA (Ministry of Jihad Agriculture)

(vi) MOI (Ministry of Industry)

(vii) DOE (Department of Environment)

3.3 MOE

Main task of MOE is water resource management, power supply, other energy supply and training of human resources. Eight of organizations were established as legal independent entities. WRMC and WWC are one of those organizations.

RWC is established as regional organization of the WRMC in every province. RWC conducts water resources management for each province.

UWWC and RWWC are regional organizations of the WWC located in every province. UWWC controls urban areas as towns and cities, and WWC controls rural areas. It was separated after "Water and Wastewater Companies Establishment Law" were issued in 1981. Then "Rural Water and Wastewater Companies Establishment Law" were issued in 1995. Water supply and wastewater for rural area was transferred from MOJA to RWWC.

3.3.1 Water Section

(i) Reservation and supply of water and conveyance for domestic usage as drinking water, agricultural and public usage for commercial and industry water.

(ii) Protection, control and utilization of surface and groundwater resources (rivers, river banks, springs, currents, water canals, qanats, wells and etc.)

(iii) Formulation of draft of laws on water resources and proposing the bills to the government and parliament.

(iv) Participation to commission and conference related to water to improve their technology and know-how.

(v) Policy making and planning of the suitable approaches for implementation of water projects in the framework of laws and plans of the government.

(vi) Planning and research of water resource projects and employment of specialists.

(vii) Coordination, supervision and evaluation of the activities of sub-companies or public corporation for water resources.

(viii) Promotion of national and foreign investments and fostering the suitable environment for private sector to participate in water projects in the country.

3.3.2 Water and Wastewater Section

(i) Policy making, planning and implementation of water supply and treatment of urban & rural water.

(ii) Policy making, planning, implementation and development of rural water collection and conveyance.

(iii) Preparation & formulation of drafts of laws on water tariffs and proposing the bills to the parliament and government annually.

(iv) Researches for the activities of the water and wastewater companies and coordination of the staff's training.

(v) Attendance in domestic and international conferences for exchanging, learning for water & wastewater projects and developing new projects.

(vi) Preparation of standards and executive procedures in order to improve water & wastewater services, and to optimize the facilities and qualitative control of domestic sewage.

(vii) Coordination, supervision and evaluation of the activities of sub-companies or public corporation for water & wastewater.

3.3.3 Power Section

(i) Policy making, planning, implementation and development of power generation, transfer and distribution throughout the country.

(ii) Study and preparation of policy, code, law and program for power consumption price and power subscription, which will be presented to the government and parliament.

(iii) Research and coordination to improve the scientific level of the power industry staff.

(iv) Promotion of national and foreign investment, and fostering the suitable environment for private sector to participate in electricity projects.

(v) Attendance in domestic and international conferences to exchange their learning and to improve the power industry.

(vi) World trend research of power consumption and subsidies to improve the consumption in Iran.

(vii) Coordination, supervision and evaluation of the activities of sub-companies or public corporation for electricity.

3.3.4 Renewable Energy Section

(i) Determination of the major energy policies.

(ii) Planning and implementation of renewable energy considering the characteristics of each region.

(iii) Study and research of potentiality and feasibility of renewable energy.

(iv) Study and research to optimize renewable energy.

3.3.5 Technology and General Control Section

(i) Study and research to improve national potential in manufacturing the equipment of water and power projects in Iran.

(ii) Management of production and manufacturing of spare parts of water and power projects.

(iii) Engineering for water projects in foreign country.

3.3.6 Planning and Human Resource Section

(i) Policy making and management of human resources to optimize the control and improve the quality of work.

(ii) Study and research to apply technology to water and power industry.

(iii) Training of engineers and planning of training for electricity and water.

(iv) Formulation of long-term water and power strategy based on short-term and middle-term strategy, and submitting the budget bill to MOE.

(v) Explanation of laws and bills of MOE to Islamic Council Majlis (Islamic Parliament).

3.3.7 Organization Chart

MOE's organization is under the renewal process which has been started since 2007. Organization chart shown as below is just before renewal.

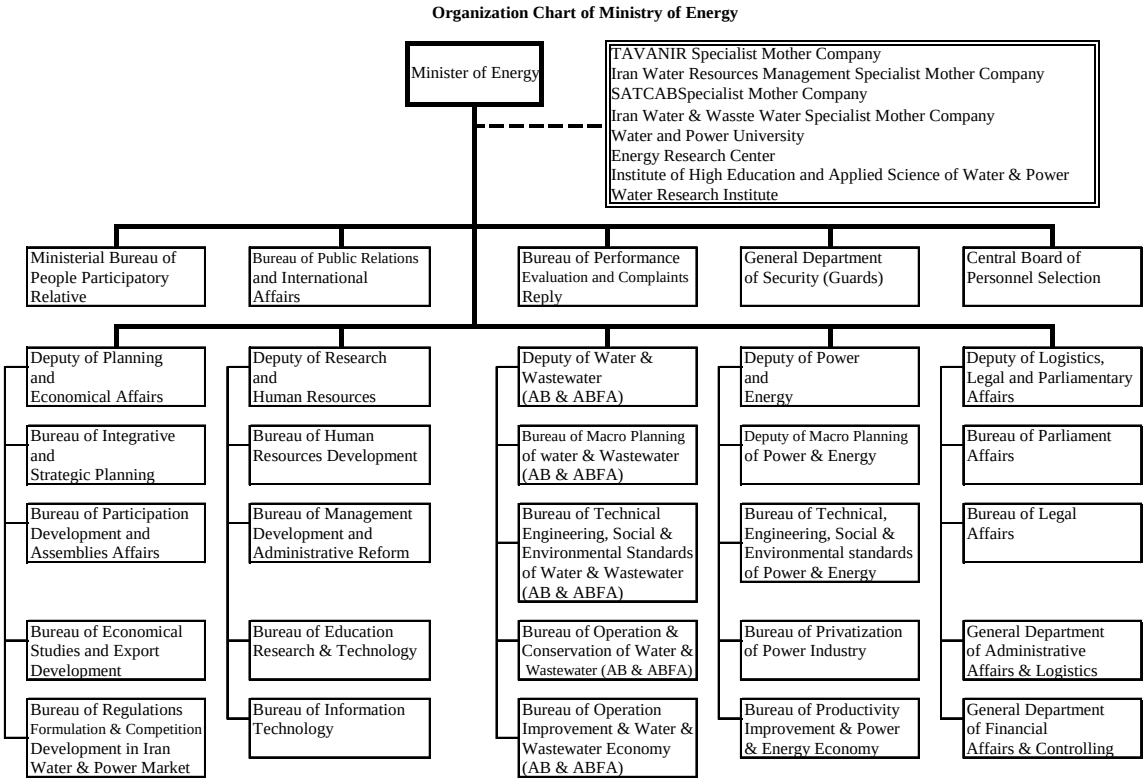


Figure 3.3.1 Organization Chart of MOE

3.3.8 Flow for Application of Proposal and Permission

There are several water-related projects like drinking water, irrigation and industrial water, which are categorized from nation wide to provincial level. Flow for application of proposal from water users to MOE and permission is shown as below. The flow is categorized into four levels from the viewpoint of project scale, budget scale and importance.

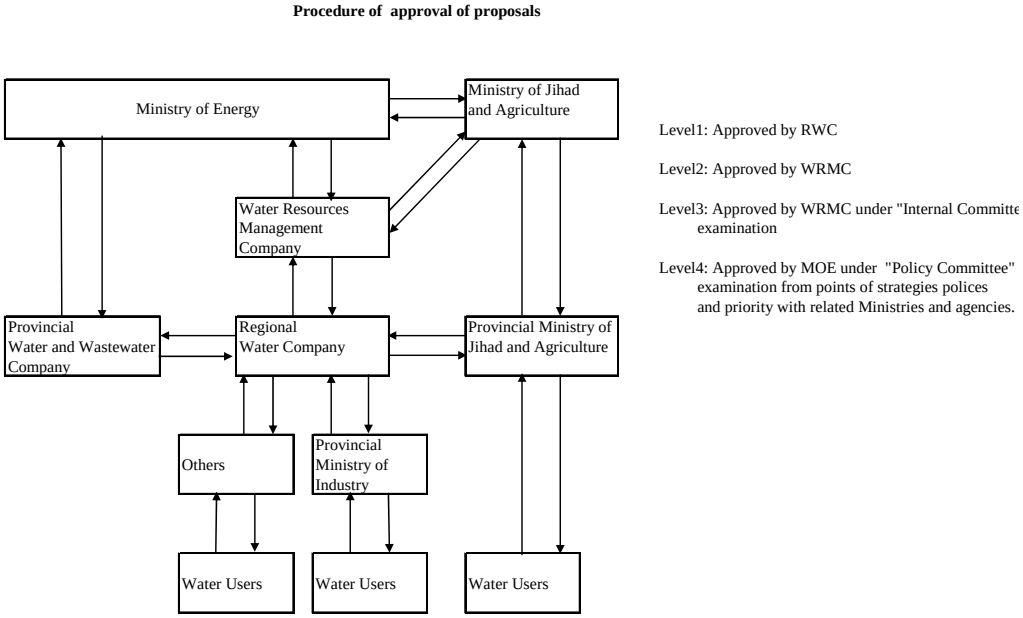


Figure 3.3.2 Flow for Application of Proposal and Permission

3.4 WRMC

WRMC was established as a legal and independent entity in 2003 according to The Articles of Association of Iran Water Resources Management Specialized for Mother Company.

Is main task is, as an agency of the Ministry of Energy, to enforce the law of Fair Water Distribution and other rules and regulations related to water, including the planning and development, management and control of water resources, basic researches of water resources and hydropower energy.

The company's capital amounts to ten million Rials (IRR 10,000,000) divided into 100 name stocks and each stock amounts to 100,000 Rials. All the stocks belong to the government. Company's structure is same as corporation, but management is not for profit and the company acts as an agency of MOE. Operation and duties of the company is mentioned in Chapter 2 of the Articles of association of Iran Water Resources Management Specialized for Mother Company as follows.

(i) To enforce the Law of Fair Distribution of Water and other regulations related to water as an agency of Ministry of Energy.

(ii) Management and control of water resources, quality and quantity.

(iii) To examine strategy of long and medium term policies, which are to be submitted to Ministry of Energy.

(iv) To enforce the plans approved by Ministry of Energy.

(v) Measurement of flow rate and water quality and related basic study.

(vi) Planning, implementation and control of following projects: water supply, irrigation and drainage networks, operation of dam, river and embankment, flood control, hydropower generation.

Note: Hydropower generation is undertaken by the subsidiaries observing operation instructions

and supervised by National Dispatching Protection Center of National Power Grid.

(vii) Planning of ordinance for appropriate use of water and submit to Ministry of Energy.

(viii) Control and optimization of water consumption and punishment against wasting water as a representative of Ministry of Energy.

(ix) To provide technical instructions, codes, criteria and standards required for the construction, maintenance and operation of water installations and structures and to submit them to Ministry of Energy for approval.

(x) Transfer of information on water and hydropower, technology transfer, development of research and financial support.

(xi) Improvement of human resources and control of hydropower facilities.

(xii) Support of education for water sector and training of water engineers.

(xiii) Participation in domestic and international associations within the framework of the related laws and regulations.

(xiv) Cooperation with domestic and foreign organizations and exchange the scientific information.

(xv) To suggest water tariffs to the subsidiaries of the Ministry of Energy and coordinate to determine the water tariffs.

(xvi) To conclude the contracts for wholesale transactions of water and hydropower via subsidiaries.

(xvii) Management of financial resources, investment in supplying and transferring water and hydropower energy, efficient consumption of these resources through facilities and financial resources circulation among the company and subsidiary.

(xviii) Establishment of financial and executive management strategies for implementation of the projects.

(xix) To arrange and collect loans and mortgages from domestic and foreign resources, issue bonds and assure the revenue for budget

(xx) Planning and implementation to assure revenue by involvement of citizen and private sector to water-related project, financial support and management of related facilities.

(xxi) Assistance for private sector participation in the researches, construction, operation and maintenance of water and hydropower projects.

(xxii) Coordination of technical, financial and administrative relations among participant companies.

(xxiii) Appraisal of annual operation of participant companies regarding technical, financial and administrative management and human resources.

(xxiv) Establishment of new relevant companies and partnership based on the related regulations.

(xxv) To perform any operation related to the company's objectives.

3.4.1 Organization Chart

WRMC organization is under the renewal process in accordance with MOE. Organization chart shown below is before renewal.

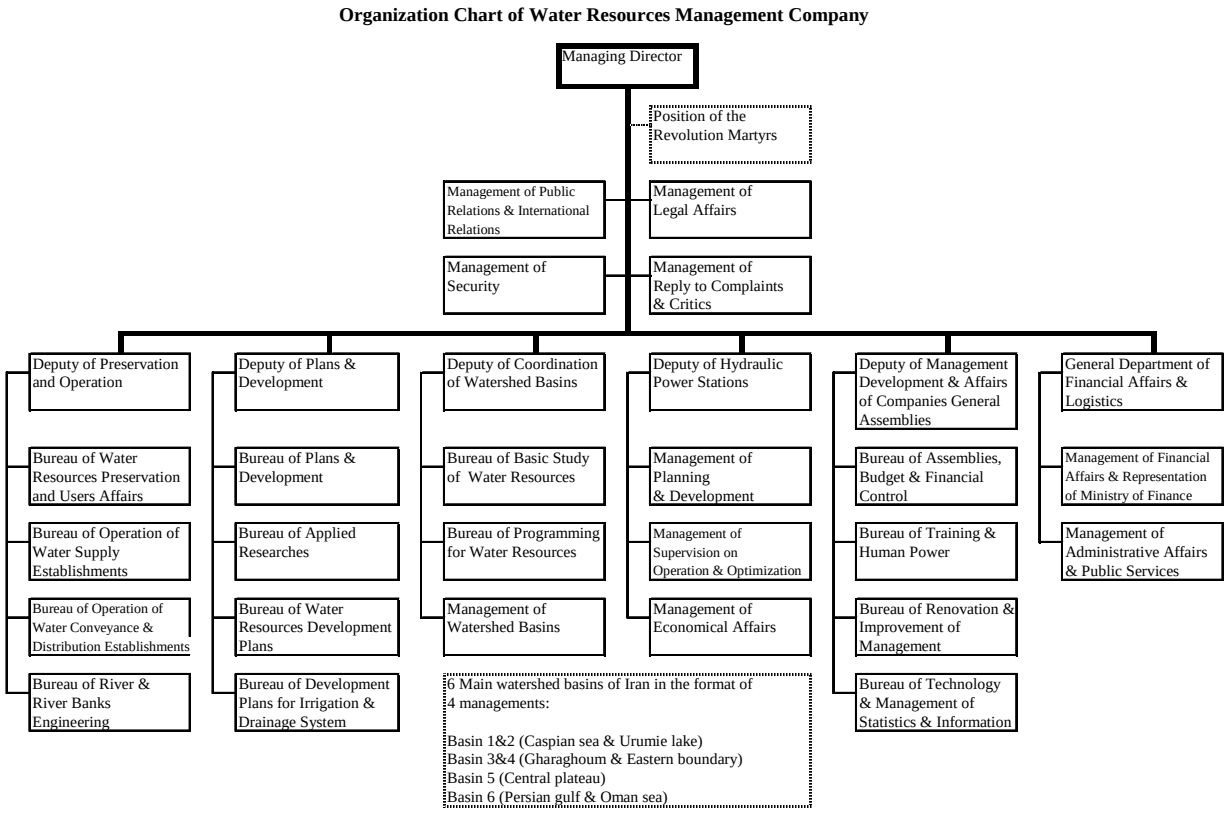


Figure 3.4.1 Organization Chart of WRMC

3.4.2 Budget and personnel

Number of normal personnel is 300 and that of temporary personnel is 50.

Revenue and expenditure of the last five years of WRMC are shown below.

Table 3.4.1 Revenue and expenditure of the last five years of WRMC

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2003	41,651	44,519
2004	55,826	58,694
2005	66,916	69,640
2006	74,459	77,183
2007	89,845	92,845

Source：WRMC

3.4.3 Deputy of Coordination of Watershed Basins Management of Watershed Basins

Watershed basin through the country is managed by Deputy of Coordination of Watershed Basins Management of Watershed Basins. There are six main watershed basins in Iran and classified into four management divisions. Basin name and divisions are shown as below.

Basin 1&2: Caspian sea, Urumie lake

Basin 3&4: Gharaghoum & Eastern boundary

Basin 5: Central plateau

Basin 6: Persian gulf & Oman sea

There are about 30 large and small rivers in the six watershed basins and Sefidrud river basin is one of them. Sefidrud river basin belongs to Basin 1&2: Caspian sea, Urumie lake. Management of Caspian sea and Urumie lake compose two Groups, Programming Group and Coordination, Evaluation and Supervision Group. Total personnel are 7.

TOR for Management of Watershed Basin composes of 19 articles. All of them are useful and effective. Some of them are very useful for solving conflict and are shown below.

- To determine duties and methods of common surface and ground water resources management between RWC in River Basin
- To reform and improve water management methods in River Basin by the results of technical and social study particularly through nonstructural techniques
- To combine and integrate the results of province units' activities in River Basin
- To provide programs for research development and performance of research plans in integrated management and comprehensive water resources in River Basin in order to coordinate and perform total supervision
- In order to prevent from local development, formulate rules for water use rights of upstream and downstream of water project as integrated water resources management in River Basin
- To provide total aspect of water supply and demand in River Basin by conduct reports and regarding potential of regional water and specify critical regions and priority of some regions
- To recommend and persist in ratify laws and new guidelines and reform law and current criterion in the framework of integrated water resources management
- To settle confrontations between local managers about water allocation in River Basin
- To formulate integrated management concepts in River Basin

3.5 RWC

RWC was established as a regional organization of the WRMC in every Provincial capital, changing from RWA (Regional Water Authority) for water management in each Province in 2006. In some Provinces, one RWA had managed plural Provinces before then.

RWC is also under renewal and organization is not fixed yet. The structure of RWC in each province is almost the same except some parts. Numbers of staff and sizes of budget are different for the Province.

Its main task is to conduct planning and development of water resources (surface water and groundwater), conservation, utilization, operation and maintenance for water facilities, planning of water distribution, permission for water use, permission for construction of wells, river protection and maintenance. Other major tasks are as follows:

(i) Planning of water allocation for irrigation, drinking water and industry water

(ii) Study for water resource development plan for province

(iii) Planning and implementation of water facilities

(iv) Operation and maintenance for major water facilities

(v) Maintenance and preservation of river

(vi) Preparation of application document for water users

(vii) Coordination of trouble regarding water use

(viii) Observation for hydro-meteorology

(ix) Preparation of database on data, statistics and information

RWC may permit the proposal of small scale projects which is affordable within RWC'S budget. In case that the project is important and budget is insufficient, the proposal is consulted with WRMC. In case that the project is important much further and the budget of WRMC is insufficient, the proposal is consulted with MOE. The entire proposal is consulted from technical, economical, social, environmental and political viewpoints. Procedure of water use permission is made by RWC and the final permission is issued by MOE.

Appropriate water allocation is discussed among MOJA, UWWC, RWWC and RWC and executed. Management is conducted basically within the provincial border. Sefidrud river extends to eight provinces and each province secure and utilize its water resources respectively.

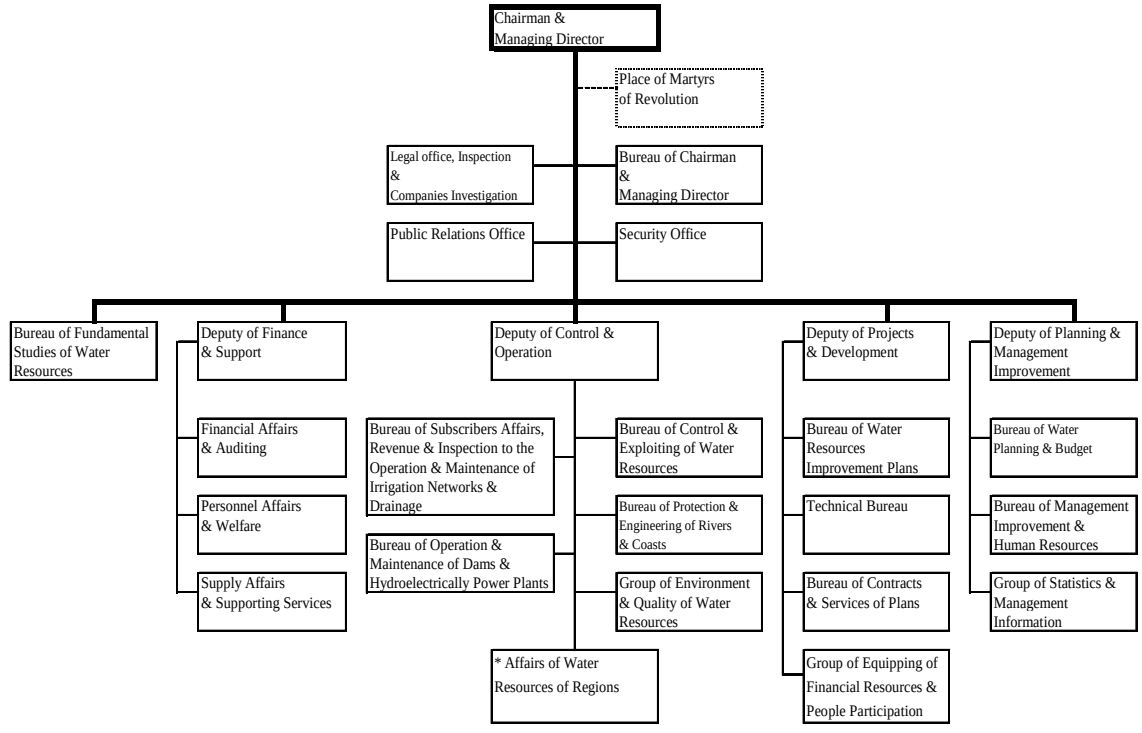
Management of whole river basin is quite difficult under the present structure of organizations, which is one of the reasons to cause conflicts among related provinces. Although WRMC's task is to coordinate interests among provinces to seek the benefit throughout the basin and the country as an agency of MOE, it is difficult in fact.

Water resources management committee is established in RWC. The committee consists of managing director, deputy of each bureau and experts. The committee is held regularly to discuss water resources management.. Other committees were established such as Council for dam and technique, project development committee, planning committee, organization improvement committee, ISO steering committee, IT work group and so on. Number of committees and kinds are different for each Province.

3.5.1 Gilan Province

1) Organization Chart

Organization Chart of Regional Water Company in Gilan Province



* Water resources affairs for regions are consisted of : Foumanat affairs, Central, West & East of Gilan Province (Totally four WRA.)

Figure 3.5.1 Organization Chart of Gilan Province RWC

2) Budget and Personnel

Number of normal personnel is 145 and the one of temporary personnel is 80.

172 personnel are placed for field work.

Revenue and expenditure of current five years is shown as below.

Table 3.5.1 Revenue and expenditure of current five years of Gilan RWC

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2003	152,904	149,013
2004	161,069	152,684
2005	170,429	160,226
2006	164,408	174,538
2007	200,284	-

Source：Gilan RWC

3.5.2 East Azarbaijan Province

1) Organization Chart

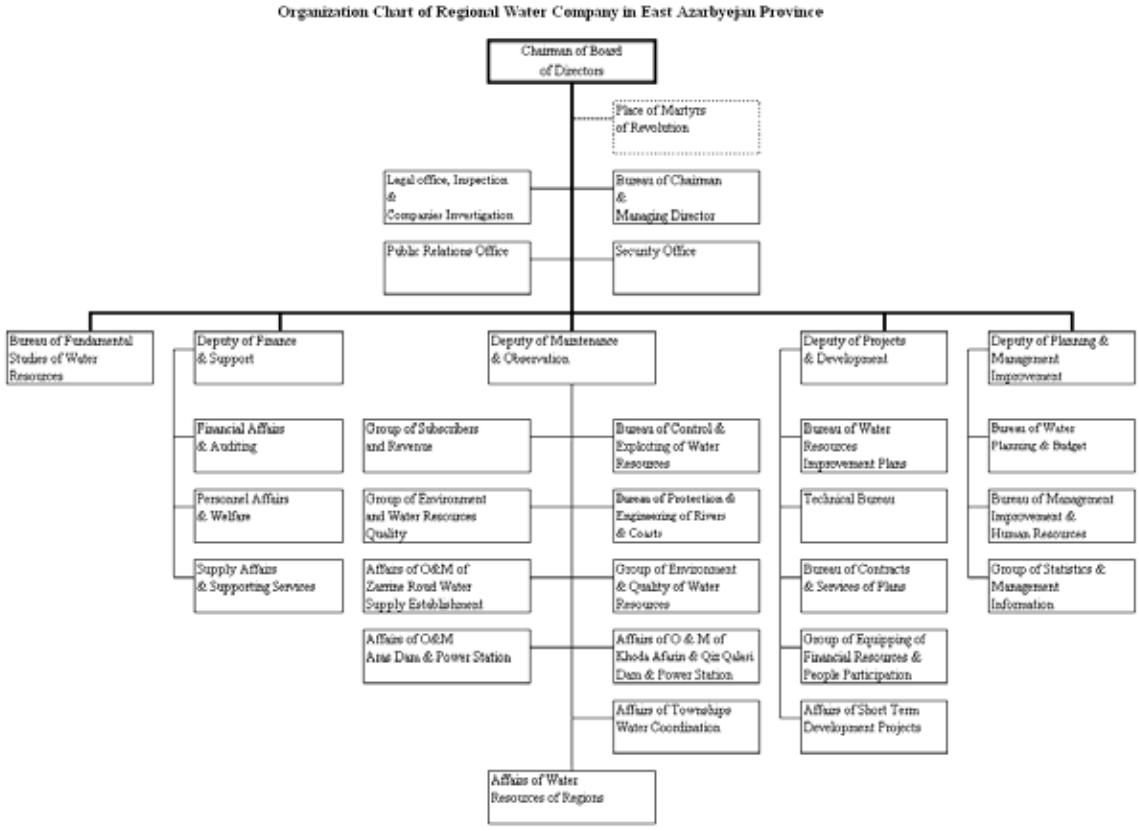


Figure 3.5.2 Organization Chart of East Azarbaijan RWC

2) Budget and Personnel

Number of regular personnel is 592. Revenue and expenditure of current five years is shown as below.

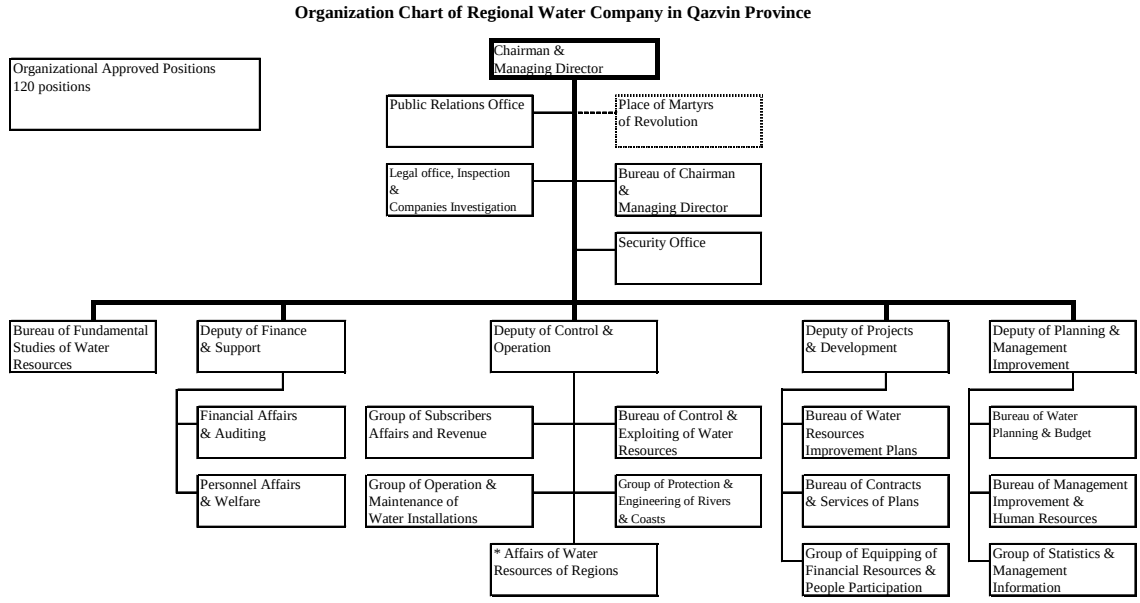
Table 3.5.2 Revenue and expenditure of current five years of East Azarbaijan

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2003	170,030	242,892
2004	197,683	264,342
2005	189,178	285,003
2006	153,466	238,182
2007	167,911	265,995

Source：East Azarbaijan RWC

3.5.3 Qazvin Province

1) Organization Chart



* Water resources affairs for regions are consisted of : Qazvin affairs, Water Resources Departments of Takestan,Abbik.
Boeenzahra & Alborz are totally 1 affairs and 4 Water Resources Departments.

Figure 3.5.3 Organization Chart of Qazvin RWC

2) Budget and Personnel

Number of total personnel is 100-150. Revenue and expenditure of current two years is shown as below.

Table 3.5.3 Revenue and expenditure of current two years of Qazvin

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2006	2,776	11,845
2007	12,425	45362

Source：WRMC

3.5.4 Ardebil Province

1) Budget and Personnel

Number of regular personnel is 160. Revenue and expenditure of current two years is shown as below.

Table 3.5.4 Revenue and expenditure of current two years of Ardebil

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2006	153,466	238,182
2007	167,911	265,995

Source：WRMC

3.5.5 Zanjan Province

1) Budget and Personnel

Number of regular personnel is 170, temporary personnel is 40. Revenue and expenditure of current three years is shown as below.

Table 3.5.8 Revenue and expenditure of current three years of Zanjan

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2005	6,434	16,148
2006	6,793	19,640
2007	8,213	21,821

Source：WRMC

3.5.6 Kordestan Province

1) Budget and Personnel

Number of regular personnel is 300. Revenue and expenditure of current two years is shown as below.

Table 3.5.5 Revenue and expenditure of current two years of Kordestan

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2006	11,342	25,137
2007	10,445	32,484

Source：WRMC

3.5.7 Tehran Province

1) Budget and Personnel

Number of regular personnel is 400. Revenue and expenditure of current five years is shown as below.

Table 3.5.6 Revenue and expenditure of current five years of Tehran

Year	Revenue (Million Rials)	Expenditure (Million Rials)
2003	183,866	183,866
2004	212,614	212,614
2005	437,808	437,808
2006	456,132	456,132
2007	356,599	356,599

Source：Tehran RWC

3.6 UWWC AND RWWC

UWWC and RWWC were established through the country and counting 64 in total. Each Province has one UWWC and one RWWC except Esfahan, Khoseztan, Khorsan and Fars province. These provinces are so wide that they have three in one Province. UWWC manages water distribution for urban areas and RWWC for rural areas.

National Water and Wastewater Engineering Company (Head Quarter of UWWC and RWWC) was established in 1988, and UWWC and RWWC were established later in each province.

Water consumption plan is made by UWWC and RWWC every year and the water is requested to RWC in each province. Water amount requested in the plan tends to increase every year. UWWC and RWWC buy water from RWC. Water fee is collected in accordance with tariff. The tariff is decided by the Council of Economy. Water fee is different in each province and between urban and rural areas. Water fee in rural areas is usually set lower than that of urban area by 70%.

3.7 OMC (OPERATION AND MANAGEMENT COMPANY)

OMCs are established in some provinces. Organizational structure varies by Province. For example, some OMC's stocks are held with 49% by WRMC and 51% by private companies (Qazbin, Gilan). Another OMC's stocks are held with 100% by private companies (East Azarbaijan). OMC conducts operation and maintenance work for irrigation under the contract with RWC.

3.7.1 Gilan Province

WRMC holds 49% of the company's stocks and the remaining are held by private companies. Its main task is operation of water distribution for irrigation water and maintenance for irrigation facilities under the contract with RWC. Number of staff is 15. Among them 11 is approved by MOE and 4 is approved by Managing Director in central organization. There are five regional offices under Vice Director of Operation. Besides, there is a Sub-region Office under each Regional Office.

1) Organization Chart

Organization Chart of Operation and Management Company in Gilan Province

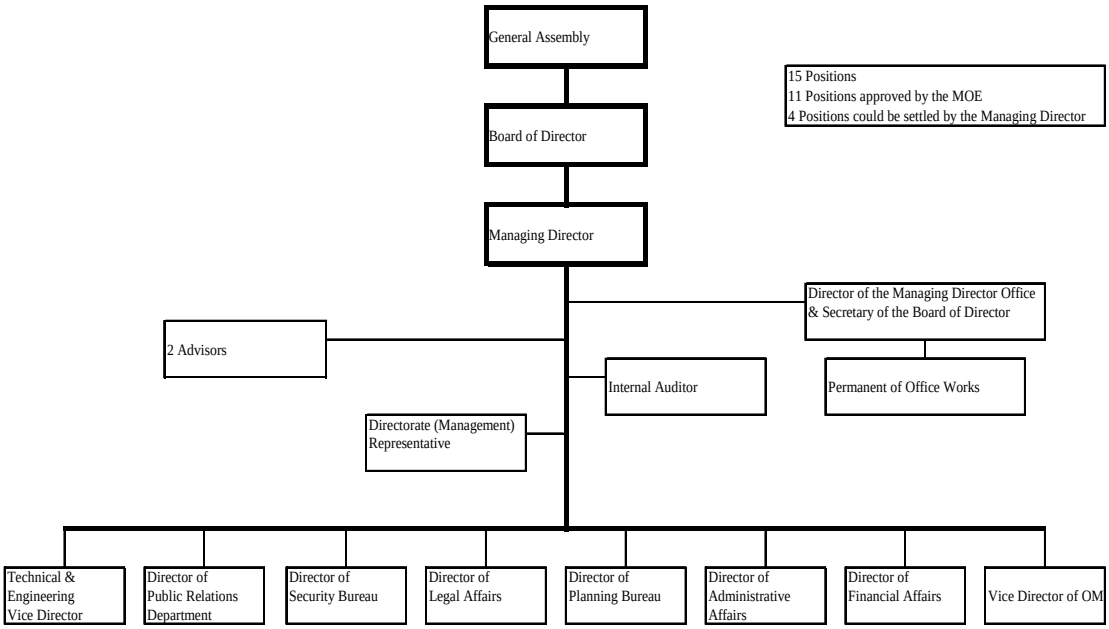


Figure 3.7.1 Organization Chart of Gilan Province OMC

2) Personnel

Number of regular personnel is 191, temporary personnel 40 and seasonal personnel 260 (Four months from May to August).

3.7.2 East Azarbaijan Province

Previously, WRMC had held 49% of the stocks and the remaining had been held by private companies. WRMC sold all its stocks to private companies in 2007, and now OMC is completely a private company.

By its privatization, OMC can join ranking system determined by Government.

1) Personnel

Number of regular personnel is 300.

3.7.3 Qazvin Province

WRMC holds 49% of the company's stocks and the remaining are held by private companies.

1) Organization Chart

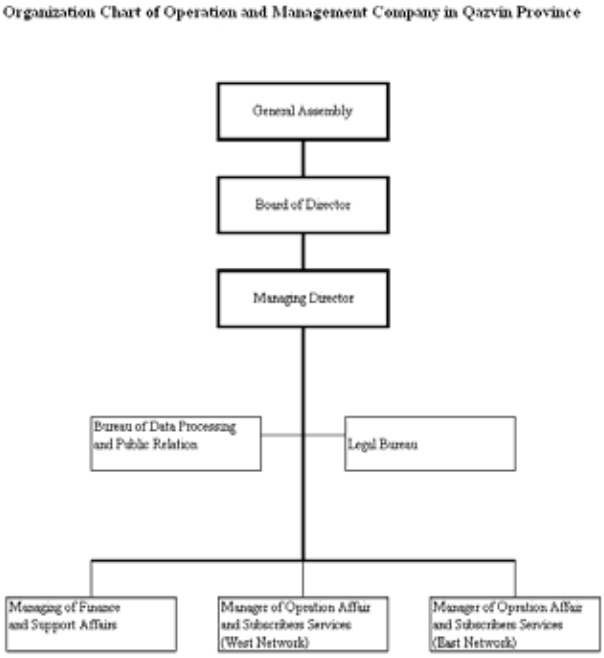


Figure 3.7.2 Organization Chart of Qazvin Province OMC

3.7.4 Tehran Province

The company was established in 1993 as private company and managing director is from RWC.

1) Organization Chart

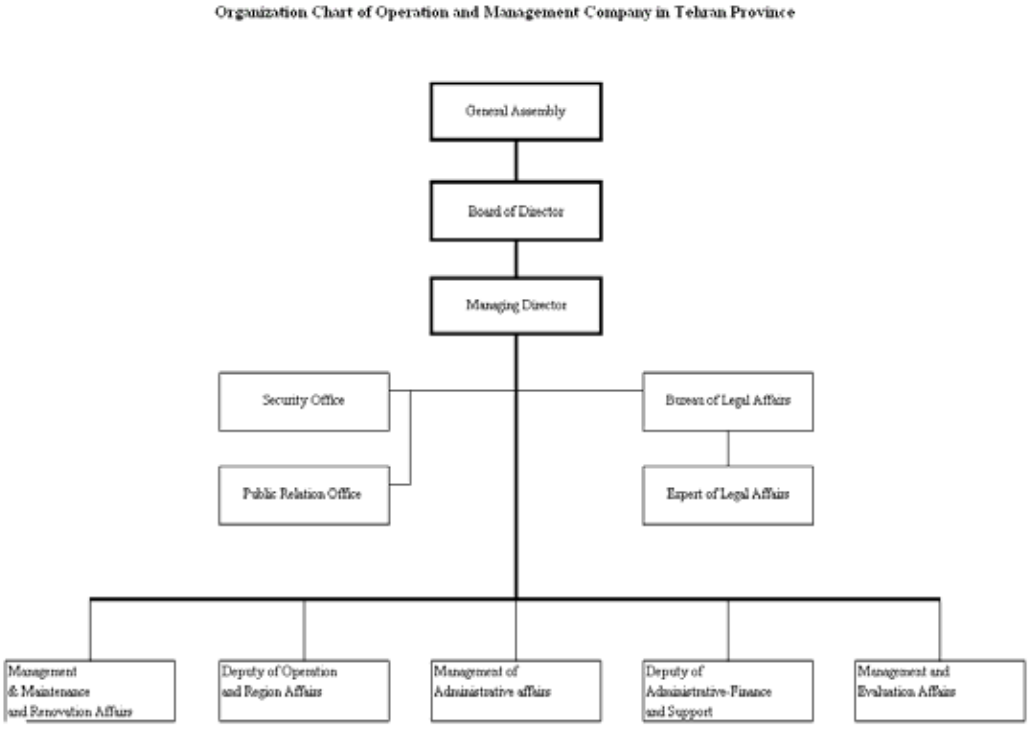


Figure 3.7.3 Organization Chart of Tehran Province OMC

2) Personnel

Number of regular personnel is 150, work is conducted by two shift system.

3.8 WATER USER ASSOCIATION IN THE STUDY AREA

WUA (Water Users Association) is established under instruction of MOJA and MOC. After establishment of WUA, RWC instructs to WUA members operation and management. Traditional WUAs have been organized from a long time ago, but only a few modern WUAs are established so far.

Its main task is water distribution and farming supports. Since each province has multi ethnicity, religion, language, tradition, culture, climates, custom and so on inside, it takes time to establish a modern WUA.

3.8.1 Qazvin

WUAs were established from 2002 to 2005. Number of WUA is 158 and beneficiary is 30,000. These were the first case in Iran. Number of staff in one WUA ranges 30-40 at leas and 3000-4000 at most. Duty of the WUA is water distribution to tertiary canal, rotation control of water, dredge work, clearing and minor repair of canal in addition to exchange of cropping information.

1) Organization Chart

Management center is established at main canal and eight offices are established at secondary canals. One General Manager, one district Manager, one Finance Manager, one Public Manager and two Site Managers are placed in the center. One Sales Administrative Officer and one or two Water Masters are placed in the secondary canal office.

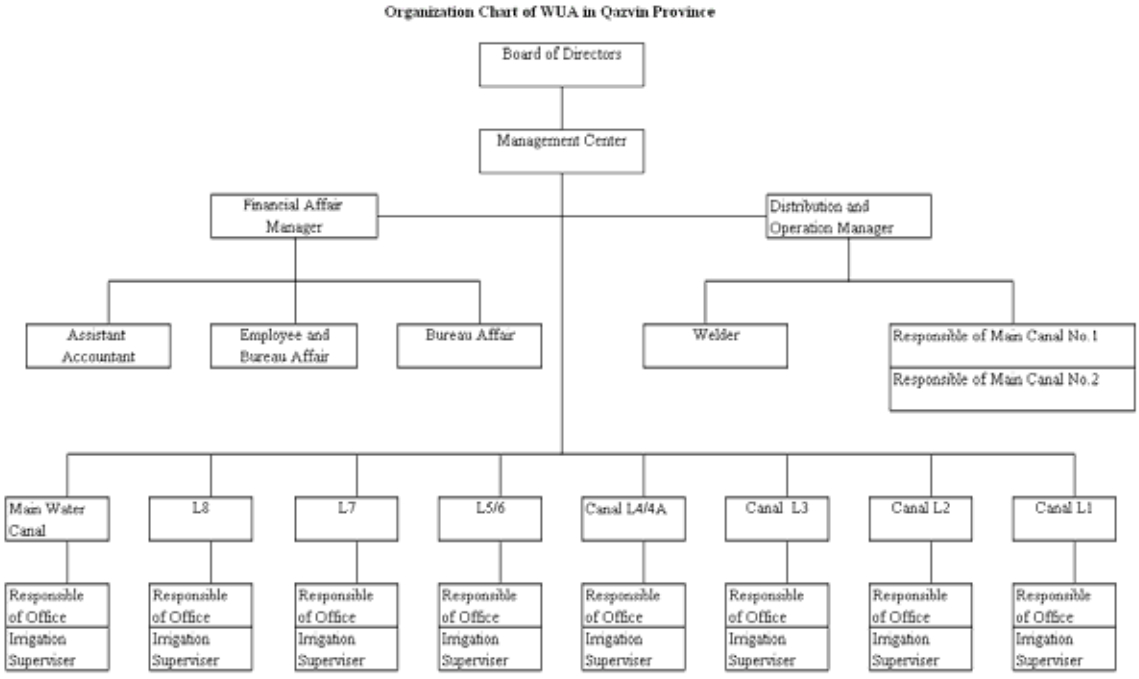


Figure 3.8.1 Organization Chart of Qazvin WUA

2) Water Fee

Water fee varies every year. Water fee is decided by MOE and new water fee is informed to each WUA by RWC at the beginning of year for irrigation.

Water fee is collected before water distribution. Collection ratio is 100%. Representative of the each WUA informs WUA members of the water fee. Collected water fee were paid to RWC bank account, and registered to computer system. Situations of water selling is confirmed at 11 A.M. every day.

Water fee for 2007-2008 is 67 Rials/m^3. This is 3% of production in 1 ha in the previous year. Production data is informed by MOJA. 7% of water fee is paid from RWC bank account to the Management center as operation fee of WUA.

3.8.2 East Azarbaijan

1) Organization

There are 39 projects and 21,000 of beneficiaries. 108 of WUAs and one Association is registered in present. Number of beneficiary for one WUA ranges 200-700. Main tasks of WUA are water management and soil improvement, exchanging cropping pattern information, and living standard improvement for income (employment young people, job placement, etc.)

2) Water Fee

Water fee varies every year. Water fee is decided by MOE and new water fee is informed to each WUA by RWC at the beginning of year for irrigation. Water fee varies with conditions of irrigation facilities as follows:

- Modern irrigation facilities: 3% of previous crop,
- Semi modern irrigation facilities: 2% of previous crop,
- Traditional irrigation facilities: 1% of previous crop.

If WUA exists, water fee is collected and paid to RWC bank account by WUA. If WUA does not exist, water fee is collected and paid RWC bank account by a private company or farmer themselves. Collection ratio is 97%.

3.9 OPERATION & MAINTENANCE SYSTEM FOR IRRIGATION

Irrigation facilities consist of dams, main canals, secondary, tertiary and quaternary canals and related structures. Basic and major facilities such as dams, main canals, water transfer systems for drinking and industry water, water purification plants are constructed by RWC. Secondary and tertiary canals are constructed by RWC or MOJA. Quaternary canals are constructed by MOJA. Wells are constructed by owner after permission by RWC. Newly constructed qanat is not found at present.

Operation and Maintenance for dams, main canals, water transfer systems for drinking and industry water, water purification plants are conducted by RWC. Some time small dams are maintained by MOJA. Secondary canals are normally maintained by RWC, sometimes by MOJA. Tertiary and quaternary canals are maintained by MOJA. Water distribution networks are maintained by UWWC and RWWC and sometime purification plants are included. Qanat is maintained by MOJA, and wells by owners.

Contractors are selected through bidding and consultants supervise construction work. Operation and maintenance is conducted by responsible organization directory or through OMC.

Table 3.9.1 Responsible Organization for Construction and Operation & Maintenance

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC/ MOJA（Small）	RWC, MOJA（Small）
Main canal Secondary canal Tertiary canal Quaternary canal	RWC RWC, MOJA* MOJA, RWC MOJA	RWC RWC, MOJA MOJA MOJA
Urban water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network)
Rural water & wastewater facility	RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	New construction is not Found/MOJA/Owner	MOJA
Well	Owner with a permission of RWC	Owner

3.9.1 Gilan Province

Responsible Organizations for Construction and Operation & Maintenance in Gilan Province are shown as below. Tertiary canals are constructed by RWC. No Qanat exists in Gilan. Main and secondary canals are maintained by OMC on contract basis.

Table 3.9.2 Responsible Organizations for Construction and Operation & Maintenance in Gilan Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC	RWC
Main canal Secondary canal Tertiary canal Quaternary canal	RWC RWC RWC MOJA	RWC(Contract with OMC) RWC(Contract with OMC) MOJA MOJA
Urban water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network)
Rural water & wastewater facility	RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	No Qanat	No Qanat
Well	Owner with a permission of RWC	Owner

3.9.2 East Azarbaijan Province

Responsible Organizations for Construction and Operation & Maintenance in Azarbaijan Province are shown as below. Secondary canals are constructed by MOJA and maintained by MOJA. Main canals are maintained by OMC on contract basis.

Table 3.9.3 Responsible Organizations for Construction and Operation & Maintenance in Azarbaijan Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC	RWC
Main canal	RWC	RWC(Contract with OMC)
Secondary canal	MOJA	MOJA
Tertiary canal	MOJA	MOJA
Quaternary canal	MOJA	MOJA
Urban water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network)
Rural water & wastewater facility	RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	Owner	Owner
Well	Owner with a permission of RWC	Owner

3.9.3 Qazvin Province

Responsible Organizations for Construction and Operation & Maintenance in Qazvin Province are shown as below. Qanat is basically constructed by MOJA, but no new qanat is constructed in present. Main and secondary canal are maintained by OMC on contract basis.

Table 3.9.4 Responsible Organizations for Construction and Operation & Maintenance in Qazvin Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC	RWC
Main canal	RWC	RWC(Contract with OMC)
Secondary canal	RWC	RWC(Contract with OMC)
Tertiary canal	MOJA	MOJA
Quaternary canal	MOJA	MOJA
Urban water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network)
Rural water & wastewater facility	RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	MOJA	MOJA
Well	Owner with a permission of RWC	Owner

3.9.4 Ardebil Province

Responsible Organizations for Construction and Operation & Maintenance in Ardebil Province are shown as below. Small dams are constructed by MOJA and maintained by MOJA. Main, secondary and tertiary canals are maintained by OMC on contract basis.

Table 3.9.5 Responsible Organizations for Construction and Operation & Maintenance in Ardebil Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC, MOJA（Small）	RWC, MOJA（Small）
Main canal Secondary canal Tertiary canal Quaternary canal	RWC RWC MOJA MOJA	RWC(Contract with OMC) RWC(Contract with OMC) MOJA(Contract with OMC) MOJA
Urban water & wastewater facility Rural water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network) RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network) RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	New construction is not found	MOJA
Well	Owner with a permission of RWC	Owner

3.9.5 Zanjan Province

Responsible Organizations for Construction and Operation & Maintenance in Zanjan Province are shown as below. Qanat is maintained by Owner.

Table 3.9.6 Responsible Organizations for Construction and Operation & Maintenance in Zanjan Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC	RWC
Main canal Secondary canal Tertiary canal Quaternary canal	RWC RWC MOJA MOJA	RWC RWC MOJA MOJA
Urban water & wastewater facility Rural water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network) RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network) RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	New construction is not found	Owner
Well	Owner with a permission of RWC	Owner

3.9.6 Kordestan Province

Responsible Organizations for Construction and Operation & Maintenance in Kordestan Province are shown as below.

Table 3.9.7 Responsible Organizations for Construction and Operation & Maintenance in Kordestan Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC	RWC
Main canal Secondary canal Tertiary canal Quaternary canal	RWC RWC MOJA MOJA	RWC RWC MOJA MOJA
Urban water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network)
Rural water & wastewater facility	RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	New construction is not found	MOJA
Well	Owner with a permission of RWC	Owner

3.9.7 Tehran Province

Responsible Organizations for Construction and Operation & Maintenance in Tehran Province are shown as below. Main canals and secondary canals are maintained by OMC on contract basis.

Table 3.9.8 Responsible Organizations for Construction and Operation & Maintenance in Tehran Province

Facilities	Responsible organization	
	Construction	Operation & Maintenance
Dam	RWC	RWC
Main canal Secondary canal Tertiary canal Quaternary canal	RWC RWC MOJA MOJA	RWC(Contract with OMC) RWC(Contract with OMC) MOJA MOJA
Urban water & wastewater facility	RWC (Water transfer, Purification) UWWC (Water distribution network)	RWC (Water transfer, Purification) UWWC (Water distribution network)
Rural water & wastewater facility	RWC (Water transfer, Purification) RWWC (Water distribution network)	RWC (Water transfer, Purification) RWWC (Water distribution network)
Industry water facility	RWC (Water transfer, Purification)	RWC (Water transfer, Purification)
Qanat	New construction is not found	MOJA
Well	Owner with a permission of RWC	Owner

3.10 MANAGEMENT SYSTEM OF HYDRO-METEOROLOGICAL OBSERVATION

RWC controls hydro-meteorological observations. Observed data are kept and exchanged with WRMC and other provinces. Observation is conducted by manual, automatic log and telemeters. Telemeter system is installed in water transfer project from Zarrineroud River to Tabriz. The telemeters are connected from intake point of water transfer to RWC office in East Azarbaijan. 24 hours observation is possible by this system. Adoption for telemeter system is proposed in many places. Discharge observation is conducted twice a month and flooding time. Water quality is checked at the same time.

Laboratory is provided and experts are placed. Every data is submitted to WRMC. When abnormality is found, information is to be reported to Ministry of Environment. Number of staff for observation varies by provincial conditions. Number of staff ranges from a few to more than 20. Budget for observation rages 1500 million to 2500 million Rials.

3.11 WATER RIGHTS IN THE STUDY AREA

Water right is applied to RWC and permitted by MOE finally.

Although there is no law that allows people in upstream to take water from the river by priority, but the water is taken from upstream traditionally. If water right is permitted, taking water from river is possible within allowable range. Rotation distribution management is applied in the area where modern facilities are provided.

Water fee for drinking, industry and agriculture is varied every year and contract with RWC is renewed.

3.12 ENVIRONMENTAL LAWS AND INSTITUTIONAL FRAMEWORK

Iran has established a comprehensive legislative foundation for environmental policy. The Article 50 of the constitution of Iran declares that protection of the environment is a public obligation and therefore "economic and any other activity, which results in pollution or irremediable destruction of the environment is prohibited". The legal framework for environmental protection and management of Iran comprises the constitution of Iran, domestic laws, regulations and by-laws, and as well as international environmental conventions, treaties and agreements.

The competent body for Environmental Assessment as defined in Decree 138 of 12/04/1994 is the Department of Environment. In addition to Environmental Assessment, there a wide range of regulations regarding environmental protection including the Environmental Protection Act 1974 and its executive by-law dated 1975, the Clean Water Act 1982 that was amended in 1994, the executive by-law on the Prevention of Water Pollution 1994, the Air Pollution abatement the Game and Fish law 1957 amended 1975 and 1996.

A number of governmental organizations have responsibilities for managing and monitoring environmental impacts.

3.12.1 Environmental High Council (EHC)

Headed by the President of Iran, EHC decides environmental policies and strategies and approves environmental standards.

The Environmental High Council is composed of the Minister of Jihad-e-Agriculture, the Minister of Health, the Director of the Plan and Budget Organization, the Director of Department of Environment and four other qualified persons recommended by the Chairman of the EHC and appointed for a term of three years by the chairman. The Chairman of the Environmental High Council is the President of Iran. The followings are the members of the council.

- Ministry of Jihad-e-Agriculture
- Ministry of Industry

- Ministry of Interior
- Ministry of Housing and Urban Development
- Ministry of Health and medial Education
- The Director of Planning and Budget Organization
- The Director of the DOE and
- Four qualified persons recommended by the Chairman of the EHC appointed for a term of Three (3) years.
- EHC has a specific committee called the Sustainable Development Committee (SDC).

The SDC prepares the reports for discussion on issues regarding environmental protection and management.

3.12.2 Department of Environment（DOE）

The Environmental Protection and Enhancement Act (1974) established the Department of Environment (DOE) under the EHC as an authority for controlling activities harmful to the environment of Iran. DOE is a corporate body with financial independence functioning under the supervision of EHC and the Vice-President of Iran is the Chairman of the DOE.

Along with its provincial environmental offices, the DOE is the principal environmental protection agency with mandate to monitor implementation of environmental policies and enforce relevant laws and regulations.

The DOE is responsible for the protection and enhancement of the environment, prevention and control of pollution and degradation, overseeing protected areas, and setting and monitoring standards.

The DOE is the competent authority for approving EIA reports as defined in Note 2 of Decree 138 under the authority of Environmental High Council (EHC). The DOE processes the EIA reports and gives its recommendations to the government directorate responsible for a project. In case a project execution is found to be inconsistent with the recommendations of the DOE, it shall notify a relevant ministry and any controversy shall be resolved by the decision of the President of Iran.

The responsibilities of the DOE with respect to water issues include:

- Conducting economic and scientific researches and studies concerning environmental protection and enhancement.
- Preparing plans for the elimination or reduction of pollution in any area or Province.
- Monitoring and enforcing the regulations.
- Controling pollution and preventing any disturbance in the environmental balance.

3.12.3 Ministry of Energy

The ministry oversees a major part of the country's development and resource exploitation activities and is responsible for generation and distribution of energy for light and heavy industries consumption, supply and improvement of energy consumption, supply and distribution of water to all sectors of society, urban sewage system control, quantitative and qualitative protection of water resources, and implementing river and coastal development plans.

3.12.4 Ministry of Agriculture Jihad

The Ministry of Jihad and the Ministry of Agriculture were merged together in 2001 to focus on protecting the environment and sustainable development. The ministry attempted to reduce the

consumption of chemical fertilizer and pesticides and proposed plans to replace the old methods of pest control with new techniques. For example,

- No hazardous high-risk pesticide can be imported,
- The subsidy for buying agricultural chemicals is to be gradually eliminated,
- Further use of agricultural chemicals will be gradually adjusted to the need of the land and the specific product efficiency
- According to the general laws of the country, responsibilities concerning protection and proper utilization of water and aquatic resources, forests and pastures
- Conducting comprehensive research studies on the water resources of the country and presenting plans for proper exploitation of the land.
- Developing policies and taking the required measures to preserve, renovate, develop, expand, and put into proper use all the water and aquatic resources.
- Policy-making, planning, constructing, developing, and maintaining the systems of potable water (provision, treatment, transmission, and distribution) in villages as well as the proper disposal of the wastewater.

3.12.5 Ministry of Health and Medical Education

The articles and the comments of the Regulations concerning environmental health ratified by the Cabinets in 1992 define the responsibility of the ministry for supervision of the quality of potable water.

According to article 4 of executive by-law, a committee for the protection of potable water resources has been formed in each province and is headed by the Province Governor and the membership of provincial managers and director generals of the Ministry of health & Medical Education, Department of Environment, Regional Water Organization of the Province, Organization of Agriculture-e-Jihad, Management & Planning Organization and Water & Sewage Company.

The committee is to examine possible causes of water pollution and ways for treatment and protection of water resources.

3.12.6 Institute of Standard and Industrial Research

Affiliated with the Ministry of Industries and Mines, this institute is responsible for setting and publishing national standards.

3.12.7 Cultural Heritage Organization

This organization has the following responsibilities.

- Prepare and regulate the ancient relics research programs in the country.
- Study and recognize precincts, hills, buildings and historical collections and prepare a list of maps
- Purse legal claims against violators related to cultural heritage
- Take necessary action to recognize and reclaim Iranian cultural properties.
- Prepare and perform necessary plans to secure and safeguard, repair and revive masterpieces.
- Encourage people to participate in all activities related to promoting, saving, and restore cultural heritage.