SUPPORTING REPORT 3

WATER BALANCE BETWEEN DEMAND AND SUPPLY

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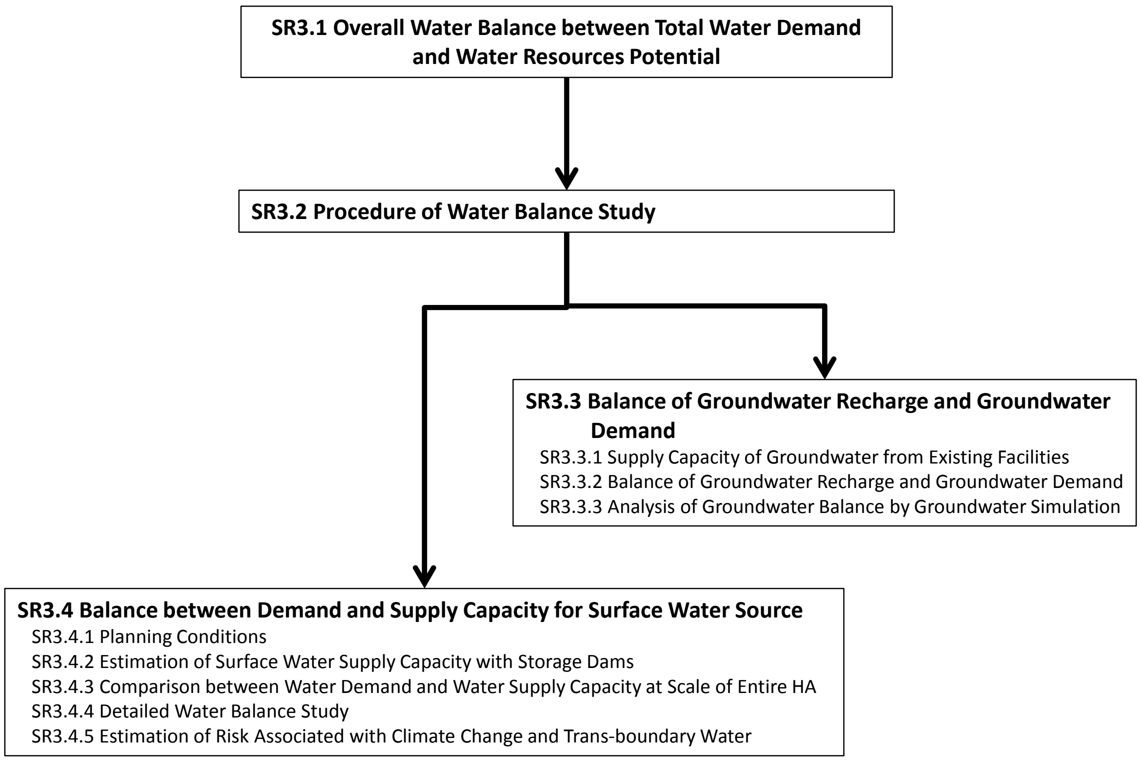


Contents

SR3 WATER BALANCE BETWEEN DEMAND AND SUPPLY

SR3.1 Overall Water Balance between Total Water Demand and Water Resources Potential

Table SR3-1 shows the total water demand and water resources potential by HA.

Table SR3-1 Overall Water Balance between Total Water Demand and Water Resources Potential

			HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Total
Total Water Resources Potential											
Including inflow from outside Nigeria	(BCM /year)	(1)	37.4	40.9	60.2	47.9	50.7	43.7	84.0	10.3	375.1
Only Internal Generation	(BCM /year)	(2)	10.7	40.3	37.9	32.8	50.7	43.6	60.3	10.3	286.6
Groundwater Resources Potential	(BCM /year)	(3)	5.0	20.5	19.3	18.6	31.9	23.4	32.8	4.3	155.8
Total Water Demand											
Existing (2010)	(BCM /year)	(4)	**0.79**	**0.59**	**0.35**	**0.25**	**0.50**	**1.54**	**0.46**	**1.46**	**5.93**
	(%)	(4)/(1)	2.1	1.5	0.6	0.5	1.0	3.5	0.5	14.2	1.6
	(%)	(4)/(2)	7.4	1.5	0.9	0.8	1.0	3.5	0.8	14.2	2.1
Future (2030)	(BCM /year)	(5)	**1.63**	**1.87**	**2.27**	**1.15**	**1.66**	**3.54**	**1.36**	**3.11**	**16.58**
	(%)	(5)/(1)	4.3	4.6	3.8	2.4	3.3	8.1	1.6	30.2	4.4
	(%)	(5)/(2)	15.2	4.6	6.0	3.5	3.3	8.1	2.3	30.2	5.8

Remarks:
1) Water Resources Potential in HA-5, 6 include the runoff in the delta area.
2) Water Resources Potential in HA-8 shows the total runoff generation without the loss in the large wet land area.
Source: JICA Project Team

The existing total water demand is estimated at 5.93BCM/year. It is expected to increase to 16.58BCM/year.

The water use rate is here defined as the ratio between the total water demand and the surface water resources potential. The water use rate in 2010 is just 1.6%. In 2030, the ratio will become 4.4%, however.

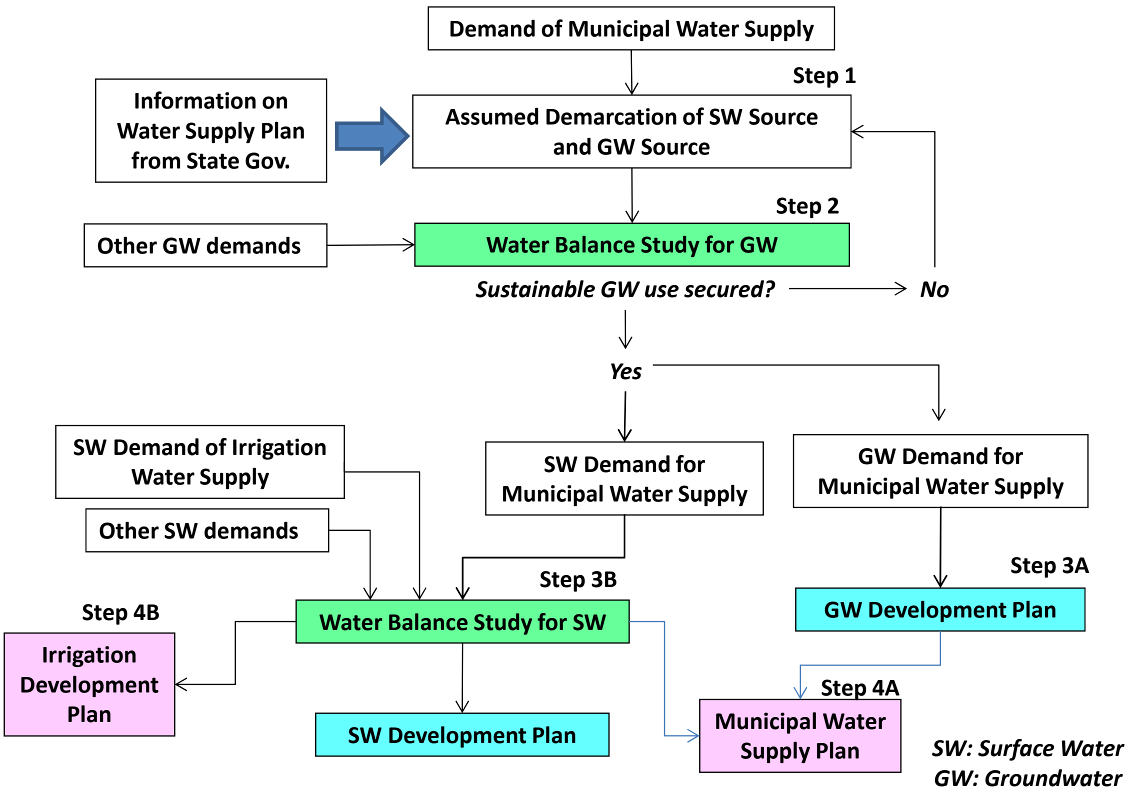
The water use rate varies from HA to HA. The rate in HA-8 in 2010 is 14%, which is much higher than the other HAs. In 2030, the water use rate in HA-8 may reach to about 30%, whereas the ratio in other HAs may be less than 10%.

The total water demand in 2030 is still much less than the total water resources potential. However, it should be noted that the currently usable water with stable supply for the demand is also much smaller than the surface water resources potential. Furthermore, because the water demand and water resources are unevenly distributed, the necessity of water resources development should be examined through the water balance between supply and demand at local level.

SR3.2 Procedure of Water Balance Study

Water usage in terms of source can be categorized into two types; groundwater and surface water uses. The water resources development plan should consider the water balance for both usages so as to secure sustainable use of water resources.

The current demarcation of water source in Nigeria is estimated that 40% for groundwater and 60% for surface water. The ratio of groundwater in municipal water supply is high. This nature would be kept even in 2030, although the usage of surface water would increase in urban areas. Considering this situation, the sustainability of groundwater use would be firstly examined. Then, the water balance for both groundwater and surface water would be studied. Figure SR3-1 shows the procedure for the water balance study.



Step 1: The demarcation between usage of groundwater and surface water for municipal water supply is set, on the basis of existing plans by state government.
Step 2: The water balance for groundwater usage which include not only municipal water but also other purposes is checked, in order to secure sustainable usage of groundwater. If it is judged that the groundwater usage is sustainable, the next steps would be examined. If not, the demarcation between groundwater and surface water uses would be adjusted, and the groundwater balance would be checked again.
Step 3A: The necessary development of groundwater is determined based on the results of Step2. The groundwater development plan is formulated.
Step 3B: The surface water demand for municipal water supply is fixed based on the results of Step2. The water balance study for surface water is examined and the surface water development plan is formulated, considering the municipal water, irrigation water and other demands.
Step 4A: The municipal water supply plan is formulated utilizing the results of step 3.
Step 4B: The irrigation development plan is formulated utilizing the results of step 3B.

Source: JICA Project Team

Figure SR3-1 Procedure of Water Balance Study

SR3.3 Balance of Groundwater Recharge and Groundwater Demand

SR3.3.1 Supply Capacity of Groundwater from Existing Facilities

Groundwater is extracted from boreholes. Borehole is water extraction facilities but not water storage facilities. In case of groundwater, aquifer can be compared to reservoir facilities created by nature. Groundwater flows slowly and is stored in aquifer for several year to several tens of thousands years. Groundwater potential should be the same as renewable groundwater in view point of sustainable groundwater development. Therefore, groundwater potential (mm/year) is defined as groundwater recharge (mm/year), which can be called as potential supply capacity of groundwater. This is discussed in SR2 and SR4.

In practical view point of water supply, groundwater supply capacity can be regarded as available yield from boreholes. Available yield from boreholes will be decided based on aquifer capacity. Then, capacity of pumps to be installed will be decided. Discussion above can be summarized below:

- Potential supply capacity of groundwater depends on capacity of aquifer. Potential supply capacity of groundwater is equal to groundwater recharge in view point of sustainable water supply.
- Groundwater will be pumped up from aquifer through boreholes. Therefore, supply capacity of groundwater means available yield from the existing boreholes.

(1) Existing Groundwater Supply Facilities

As information on groundwater supply facilities nationwide, there is “Baseline Survey for Water Supply and Sanitation Facilities” (FMWR, 2006). The result of this survey is explained in Chapter 4 of this Report. However, 5 years have already passed since above survey, so that borehole inventory survey was implemented in this Project, to know amount of groundwater extraction for water supply. Number of boreholes and available yield were surveyed by LGA based on borehole data of State Agencies. This survey does not include private boreholes and wells. The result of survey is shown in Table SR3-2.

- Borehole with motorized pump : 19,758
- Boreholes with hand pump : 44,736
- Shallow hand-dug wells : 13,108

According to survey results, total number of boreholes is 57,759. The number of boreholes has increased around 2.1 times as many as that in period of M/P1995. Amount of groundwater extraction is estimated about 6,340 thousand m^3/day.

(2) Potential Supply Capacity

Supply capacity of existing boreholes can be given two definitions below, though current available yield of boreholes are 6,340 m^3/day as mentioned above:

<u>Case where borehole operation rate increases</u>

Average operation rate of borehole is as low as 63% nationwide. Therefore, water coverage rate will be significantly increased by increasing borehole operation rate.

- Current extraction rate : 6,340,000m^3/day
- Extraction rate in case of 100% borehole operation : 10,063,000 m^3/day

There are three reasons for failure of borehole operation

- Breakdown of pump
- Breakdown or clogging of screen
- Drying up of borehole

Table SR3-2 Numbers of Boreholes

No	State	Geology	Type of borehole			Operation rate (%)
			Motorized pump (No.)	Hand pump (No.)	Hand dug shallow well 1) (No.)	
1	Abia	Sedimentary	610	243	3	70
2	Adamawa	B/T/S	302	1,190	3	85
3	Akwa Ibom	B/S	683	0	0	45
4	Anambra	Sedimentary	496	126	0	69
5	Bauchi	B/T/S	410	721	0	54
6	Bayelsa	Sedimentary	150	0	0	40
7	Benue	Sedimentary/T	318	1,318	4	53
8	Borno	Sedimentary/B	911	821	106	80
9	Cross Rivers	Sedimentary	1,140	0	0	11
10	Delta	Sedimentary	189	447	0	40
11	Ebonyi	Sedimentary	134	779	0	77
12	Edo	Sedimentary/B	0	295	0	31
13	Ekiti	Basement	95	245	5	50
14	Enugu	Sedimentary	219	147	12	60
15	Gombe	Sedimentary/B	773	1,586	3,186	45
16	Imo	Sedimentary	934	337	22	70
17	Jigawa	B/T/S	1,333	15,422	3,982	89
18	Kaduna	Basement	802	2,089	0	51
19	Kano	Basement	1,147	2,952	0	70
20	Katsina	Basement/T	864	2,083	100	66
21	Kebbi	B/T/S	544	1,388	0	46
22	Kogi	B/S	291	438	7	50
23	Kwara	Basement	229	917	0	54
24	Lagos	Sedimentary	1,106	880	0	62
25	Nassarawa	B/T/S	598	607	156	44
26	Niger	B/T/S	104	1919	0	61
27	Ogun	B/S	322	84	93	50
28	Ondo	B/T	866	681	34	50
29	Osun	Basement	367	819	98	35
30	Oyo	Basement	623	1,274	180	60
31	Plateau	Basement	88	360	4	50
32	Rivers	Sedimentary	295	864	0	63
33	Sokoto	Sedimentary	959	891	102	37
34	Taraba	B/T/S	219	417	18	80
35	Yobe	Sedimentary	1,189	879	2,199	52
36	Zamfara	B/T/S	134	903	3,039	69
37	FCT Abuja	B/T	146	516	4	45
	Total		**19,758**	**44,736**	**13,108**	**63**

Note) Number of shallow hand-dug well is those that were constructed by State Agencies. It does not include private wells.
B: Basement rock, T: Tertiary rock. S: Sedimentary rock/layer
Source: JICA Project Team

Of above three reasons, pump breakdown is the main reason. Then, screen breakdown and screen clogging will follow. Borehole drying up will be only few cases. It is possible to recover pump breakdown by repair with spare parts. Screen clogging can be recovered, though screen breakdown cannot be recovered. Borehole drying up usually cannot be recovered at all. As a result, most of the non-operational borehole can be recovered. 70% of boreholes are installed with hand-pump, and 30% of boreholes are installed with motorized pumps. Usually breakdown of hand pump require only simple skill for repair. However, it is serious problem that even such simple breakdown cannot be repaired to finally leave boreholes broken without any use.

Case where pump was replaced

Hand-pumps are installed into most of the existing boreholes for rural water supply. Pumping capacity of hand pump is around 7m3/day, though borehole itself have higher capacity than 7m3/day in many cases. Most of the boreholes for rural water supply have 6 inch diameter, which can be installed with motorized pump. It means that groundwater extraction capacity of boreholes will be increased by replacing hand pumps with motorized pumps.

Conclusion

Based on discussion above, there are four (4) types of definition as available yield of boreholes

a) Groundwater supply capacity of aquifer.
b) Current available yield of existing boreholes.
c) Available yields of existing boreholes in case where borehole operation rate is improved to 100%.
d) Available yield of existing boreholes in case where hand-pumps are replaced with motorized pumps.

Case-c) and d) above seem non-realistic. Thus “b) Current available yield of existing boreholes” above will be regarded as supply capacity of exiting boreholes. And the future demand will be satisfied with “a) Groundwater supply capacity of aquifer” above by drilling new boreholes. Therefore, the future water demand will be compared with aquifer capacity to analyses balance between demand and supply. Optimum methods for groundwater development by boreholes are explained in Chapter 7 of this Report.

SR3.3.2 Balance of Groundwater Recharge and Groundwater Demand

Balance between groundwater recharge and demands are shown in Table SR3-3 and Figure SR3-2. Ratio of water groundwater demand/recharge is 6% in national average.

However it is 1-72% state by state showing large difference among states. This is because of difference in groundwater recharge state by state. Ratio of groundwater demand/recharge is higher in the northern part of Nigeria, where there is sedimentary rocks distributed, and groundwater recharge is smaller. However aquifer expands in wide area crossing state boundary, where groundwater can be extracted from boreholes collecting groundwater from large surrounding area to meet groundwater demand.

Table SR3-3 Groundwater Recharge and Groundwater Demand (2030)

No	State	Groundwater recharge (MCM/year)	Groundwater demand (2030) (MCM/year)					
			Water supply	Private irrigation	Live stock	aquaculture	total	Groundwater demand/ recharge
1	Abia	2,810	165	9	1	7	182	6%
2	Adamawa	3,707	96	26	17	4	142	4%
3	Akwa Ibom	5,759	221	12	1	8	242	4%
4	Anambra	1,728	125	8	2	5	140	8%
5	Bauchi	3,970	205	69	13	3	290	7%
6	Bayelsa	11,010	100	4	1	2	107	1%
7	Benue	10,655	152	50	1	3	206	2%
8	Borno	570	197	47	26	2	272	48%
9	Cross River	14,620	84	24	0	52	160	1%
10	Delta	13,056	260	19	3	344	626	5%
11	Ebonyi	2,174	43	12	3	0	58	3%
12	Edo	6,867	187	38	1	2	228	3%
13	Ekiti	863	59	11	0	11	82	9%
14	Enugu	2,504	171	15	1	1	188	8%
15	Gombe	943	83	20	13	1	117	12%
16	Imo	3,135	195	9	1	9	214	7%
17	Jigawa	349	207	70	14	9	301	86%
18	Kaduna	8,446	157	53	7	8	225	3%
19	Kano	1,028	354	66	23	102	545	53%
20	Katsina	670	231	74	14	4	324	48%
21	Kebbi	1,626	126	40	7	8	180	11%
22	Kogi	4,142	148	46	3	5	202	5%
23	Kwara	2,521	87	26	1	12	126	5%
24	Lagos	736	425	5	1	10	441	60%
25	Nasarawa	4,657	67	29	2	11	109	2%
26	Niger	8,402	156	57	7	4	224	3%
27	Ogun	1,928	106	38	1	14	159	8%
28	Ondo	3,973	145	27	0	5	178	4%
29	Osun	888	100	18	1	68	187	21%
30	Oyo	1,329	154	46	6	81	287	22%
31	Plateau	3,917	113	31	10	27	181	5%
32	Rivers	9,957	370	8	2	41	421	4%
33	Sokoto	315	131	42	27	2	202	64%
34	Taraba	13,147	81	41	4	0	127	1%
35	Yobe	421	118	51	13	1	183	44%
36	Zamfara	1,539	126	51	12	5	195	13%
37	FCT Abuja	1,374	216	7	1	2	226	16%
	Total	155,736	5,964	1,199	241	875	8,276	5%

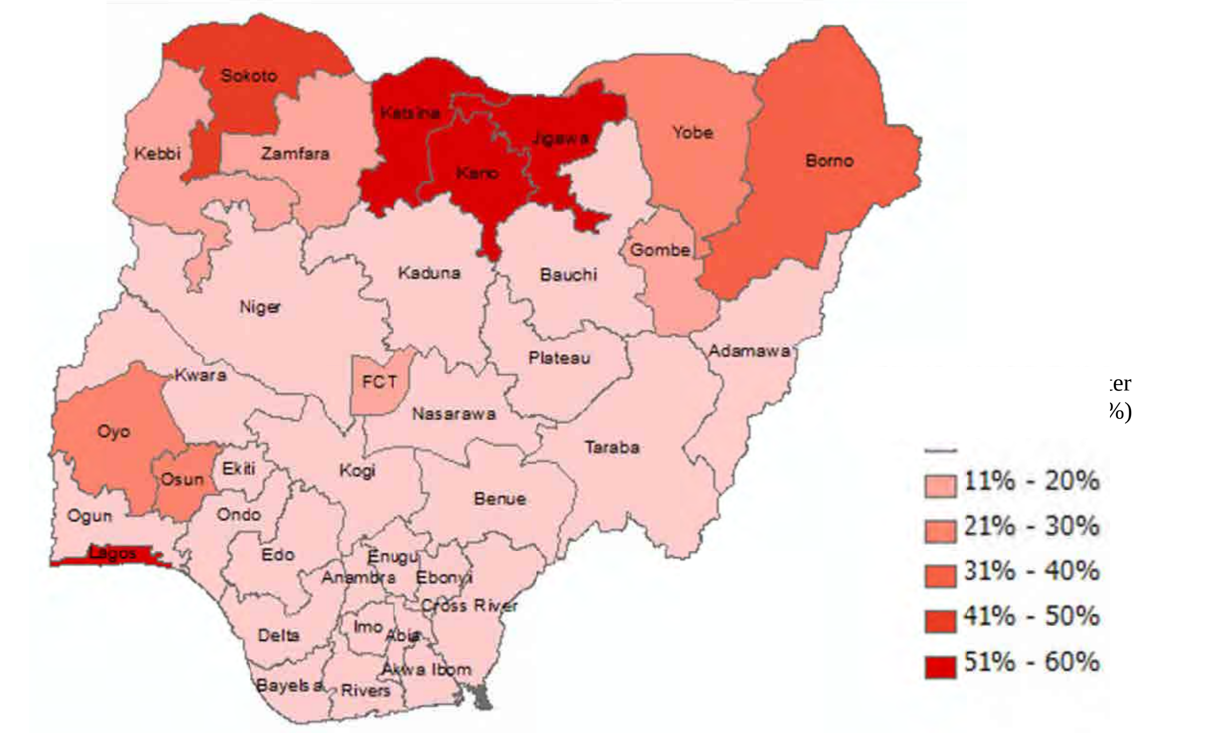
Source: JICA Project Team

Balance of groundwater recharge and demand is shown in Table SR3-4 and Figure SR3-3 by Climate change (scenario case-1). Ratio of groundwater demand/recharge is 8% in national average, which is small increase from 6% of the case without Climate Change. However it is 1 to 94% state by state, showing large difference. Effect of the Climate Change will make difference lager in water balance among states.

Table SR3-4 Groundwater Recharge and Demand by Effect of Climate Change (2030)

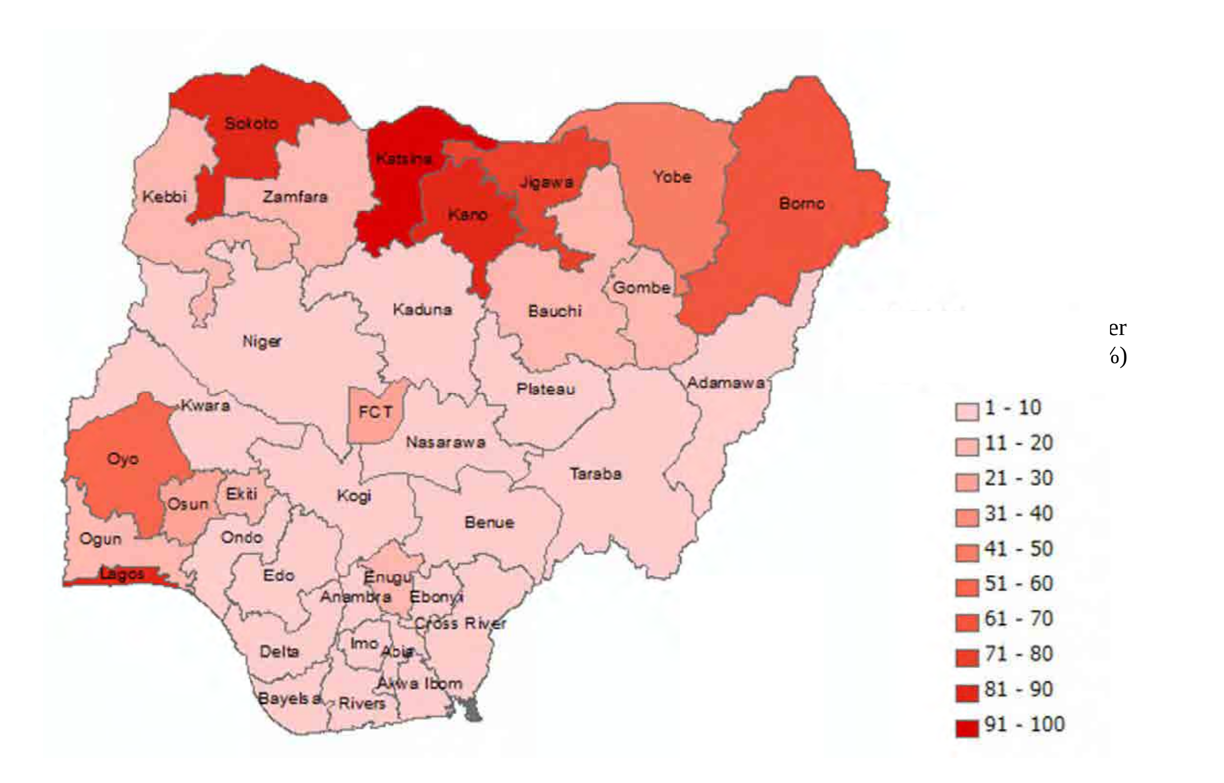
No	state	Groundwater recharge (MCM/year)	Groundwater demand(2030) (MCM/year)					
			Water supply	Private irrigation	Live stock	aquaculture	total	Groundwater demand/ recharge
1	Abia	2,415	165	10	1	7	183	8%
2	Adamawa	2,567	96	29	17	4	145	6%
3	Akwa Ibom	5,086	221	13	1	8	243	5%
4	Anambra	1,383	125	9	2	5	141	10%
5	Bauchi	2,841	205	78	13	3	299	11%
6	Bayelsa	9,892	100	5	1	2	108	1%
7	Benue	9,182	152	55	1	3	211	2%
8	Borno	295	197	53	26	2	278	94%
9	Cross River	13,067	84	26	0	52	162	1%
10	Delta	11,372	260	20	3	344	627	6%
11	Ebonyi	1,776	43	13	3	0	59	3%
12	Edo	5,462	187	42	1	2	232	4%
13	Ekiti	572	59	12	0	11	83	14%
14	Enugu	2,037	171	16	1	1	189	9%
15	Gombe	586	83	23	13	1	120	20%
16	Imo	2,739	195	10	1	9	215	8%
17	Jigawa	229	207	78	14	9	309	135%
18	Kaduna	6,511	157	61	7	8	233	4%
19	Kano	679	354	74	23	102	553	81%
20	Katsina	405	231	83	14	4	333	82%
21	Kebbi	965	126	45	7	8	185	19%
22	Kogi	2,719	148	52	3	5	208	8%
23	Kwara	1,335	87	30	1	12	130	10%
24	Lagos	531	425	14	1	10	450	85%
25	Nasarawa	3,349	67	32	2	11	112	3%
26	Niger	5,616	156	65	7	4	232	4%
27	Ogun	1,298	106	97	1	14	218	17%
28	Ondo	3,005	145	32	0	5	183	6%
29	Osun	593	100	20	1	68	189	32%
30	Oyo	747	154	52	6	81	293	39%
31	Plateau	2,945	113	34	10	27	184	6%
32	Rivers	8,856	370	9	2	41	422	5%
33	Sokoto	152	131	47	27	2	207	136%
34	Taraba	10,723	81	46	4	0	132	1%
35	Yobe	265	118	57	13	1	189	71%
36	Zamfara	1,017	126	58	12	5	202	20%
37	FCT Abuja	964	216	9	1	2	228	24%
	Total	124,178	5,964	1,409	241	875	8,486	7%

Source：JICA Project Team



Source：JICA Project Team

Figure SR3-2 Balance of Groundwater Demand and Recharge in 2030



Source：JICA Project Team

Figure SR3-3 Balance of Groundwater Demand and Recharge in 2030 by Effect of Climate Change

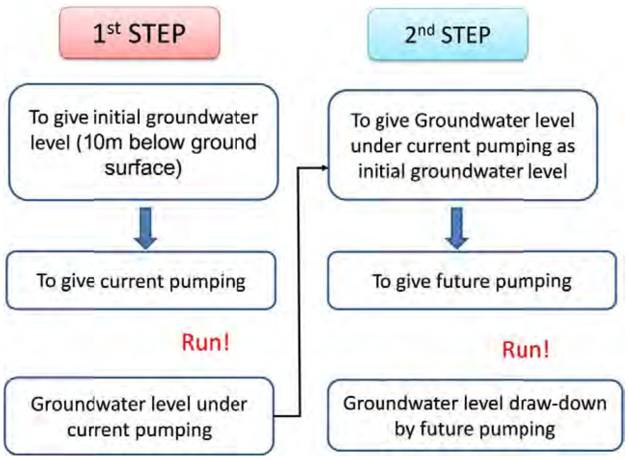
SR3.3.3 Analysis of Groundwater Balance by Groundwater Simulation

(1) Prediction of Groundwater lowering in 2030

Groundwater balance was analyzed State by State in the previous section. However, distribution of groundwater recharge and demand is not even within a state. For example, groundwater demand shows large difference LGA by LGA. Moreover, aquifer expands in wide area crossing state boundary. Therefore, it is not adequate to evaluate groundwater balance within state in hydrogeological viewpoints. To resolve problem mentioned above. Groundwater simulation was performed to analyze more precisely un-even distribution of groundwater recharge, groundwater demand and aquifer.

(2) Procedure of Simulation

Procedure of simulation is shown in Figure SR3-4.



Source：JICA Project Team

Figure SR3-4 Procedure of Groundwater Simulation

Step-1: Current situation will be modeled, and current groundwater level will be calculated.

Step-2: Groundwater development plan will be given to the model. Simulated groundwater level of STEP-1 will be given to the model-2 as the initial groundwater level. Draw down from the initial groundwater level will be presented as draw-down by proposed groundwater level by 2030.

(3) Step-1

Simulation was performed with steady state condition after water balance condition was established in the simulation model. Sustainable groundwater development will be examined whether calculated groundwater level stays in the depth from which planned boreholes can pump up groundwater or not.

Table SR3-5 Outline of Groundwater Simulation Model and Given Condition

item	Content
Software	Visual Modflow
Model structure	Entire Nigeria was modeled with 36,255 cells. Size of one cell is 5km×5km. Model has 10 layers structures in vertical direction expressing 500m depth below the ground surface. Conductivity of the model was given following aquifer type.
Groundwater recharge	Analyzed result of groundwater recharge was given to model.
Water demand	Groundwater demand in LGAs was given to the model by pumping rare (m^3/day) from boreholes. On the other hand, water demand of private irrigation, livestock and aqua-culture were given to the model as negative groundwater recharge.
Boundary and initial condition	As boundary condition, (a) Impermeable boundary was given to Basement rock areas, (b) Constant groundwater level condition was given to sedimentary rock areas. (c) Dain condition was given to along main rivers.

Source: JICA Project Team

Aquifer mode

Each aquifer was given conductivity as shown in Figure SR3-5.

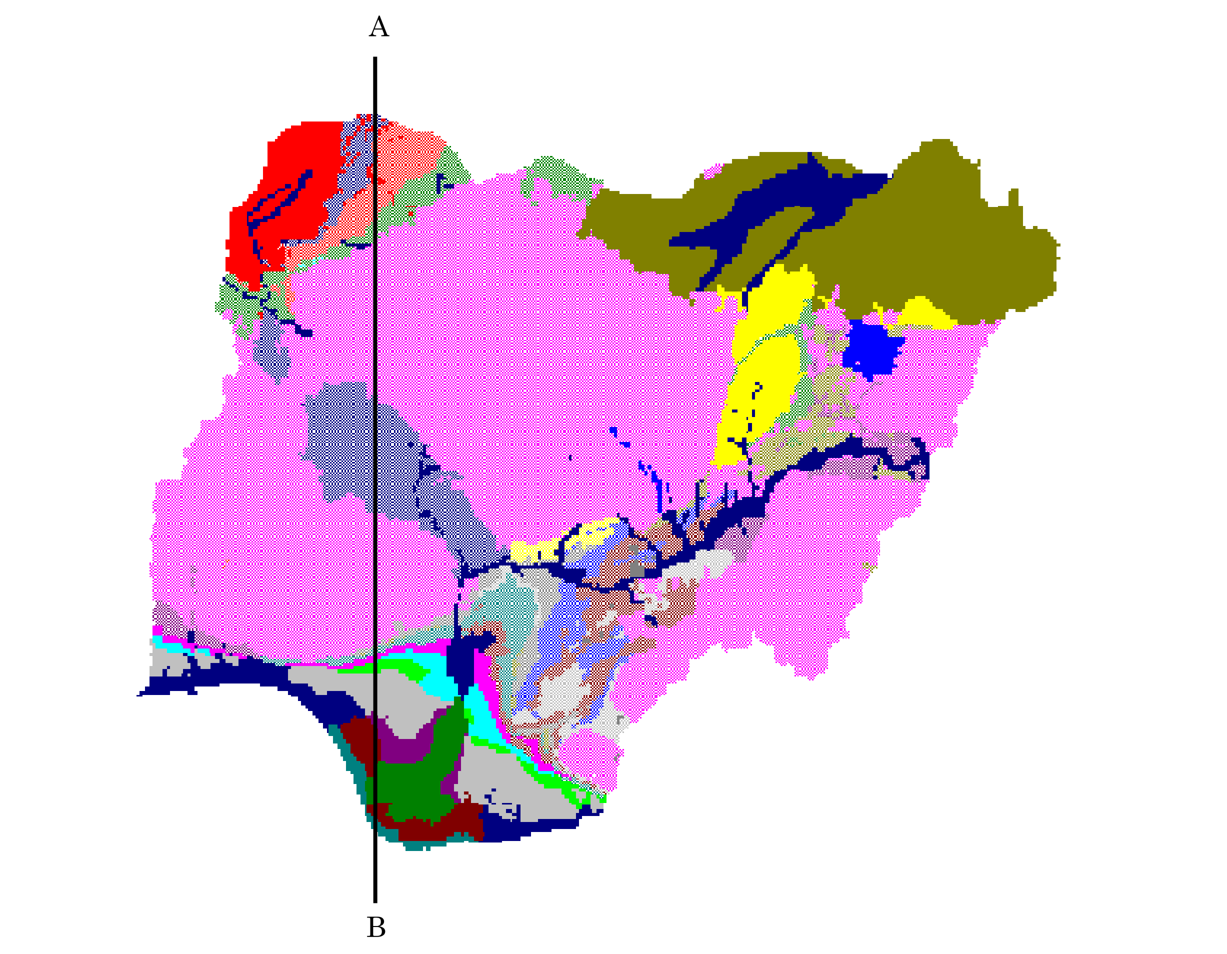
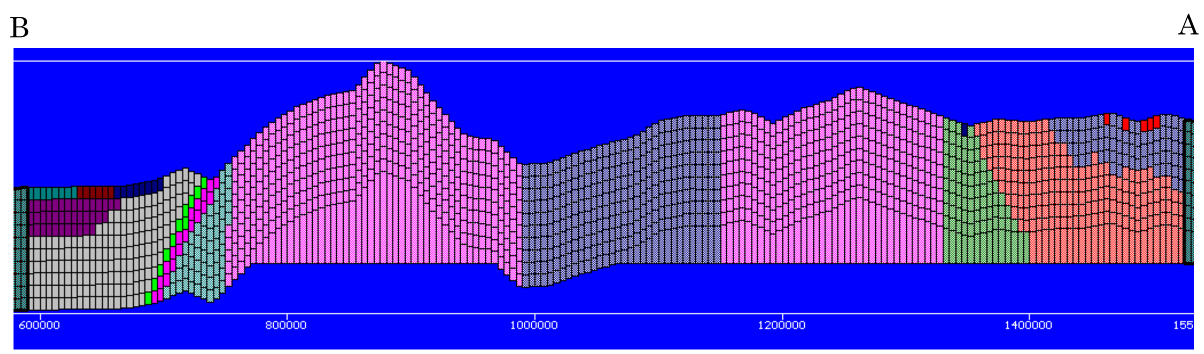


Figure SR3-5 Distribution of aquifer

Section model is shown in Figure. Model section has 10 layers structure, with depth of 50m×10 layers=500m to be analyzed. Conductivity of each aquifer was shown in Table SR3-6.



Note) section line of A-B is shown in Figure SR3-5.

Figure SR3-6 Model Section of N-S direction

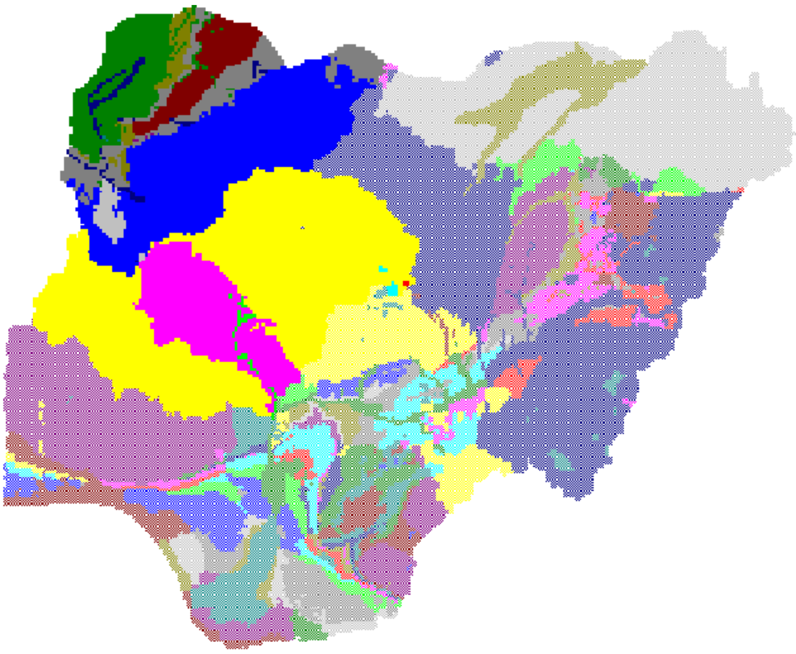
Table SR3-6 Conductivity of Formation

Formation	Aquifer type	Conductivity (m/day)		
		Kx	Ky	Kz
Sediments	MH	4.32	4.32	0.432
Meader belt, Back swamps, Water Swamps	MH	4.32	4.32	0.432
Abandoned Beach Ridge	MH	4.32	4.32	0.432
Mangrove Swamp	MH	4.32	4.32	0.432
Sombreiro Deltaic Formation	MH	4.32	4.32	0.432
Chad Formation	MH	4.32	4.32	0.432
Benin Formation	MH	4.32	4.32	0.432
Newer Basalt	WH	3.46	3.46	0.346
Older Basalt	WL	0.864	0.864	0.0864
Ogwashi-Asaba Formation	WM	1.73	1.73	0.173
Ilaro Formation	MH	4.32	4.32	0.432
Gwandu Formation	MM	0.864	0.864	0.0864
Imo Group	WL	0.864	0.864	0.0864
Keri-Keri Formation	MM	0.864	0.864	0.0864
Sokoto Formation	ML	0.432	0.432	0.0432
Gombe Formation	WL	0.864	0.864	0.0864
Ajali Formation	MH	4.32	4.32	0.432
Nsuka Formation	WL	0.864	0.864	0.0864
Abeokuta Formation	MM	0.864	0.864	0.0864
Mamu Formation	WL	0.864	0.864	0.0864
Bassange Formation	WL	0.864	0.864	0.0864
Nkporo Formation	WL	0.864	0.864	0.0864
Agwu Formation	WH	3.46	3.46	0.346
Taloka Formation	ML	0.432	0.432	0.0432
Dukamaje Formation	WL	0.864	0.864	0.0864
Rima Group	WL	0.864	0.864	0.0864
Pindiga Formation	WL	0.864	0.864	0.0864
Lafia-Wukari Formation	MM	0.864	0.864	0.0864
Nupe Formation	ML	0.432	0.432	0.0432
Gundumi-Illo Formation	MM	0.864	0.864	0.0864
Fika Formation	ML	0.432	0.432	0.0432
Eze-Aku Formation	WM	1.73	1.73	0.173
Yola-Bima-Yolde Formation	WM	1.73	1.73	0.173
Bima Formation	WM	1.73	1.73	0.173
Asu River Group	WL	0.864	0.864	0.0864
Young Granite (37)	WM	1.73	1.73	0.173
Older Granite (38)	WM	1.73	1.73	0.173
Meta Sedimentary (39)	WM	1.73	1.73	0.173
Migmatite Gneiss (40)	WM	1.73	1.73	0.173
Cataclastic (41)	WM	1.73	1.73	0.173

Source：JICA Project Team

<u>Groundwater recharge</u>

Analyzed groundwater recharge is shown in Figure SR3-7.



Source：JICA Project Team

Figure SR3-7 Distribution of Groundwater Recharge

Boundary Condition

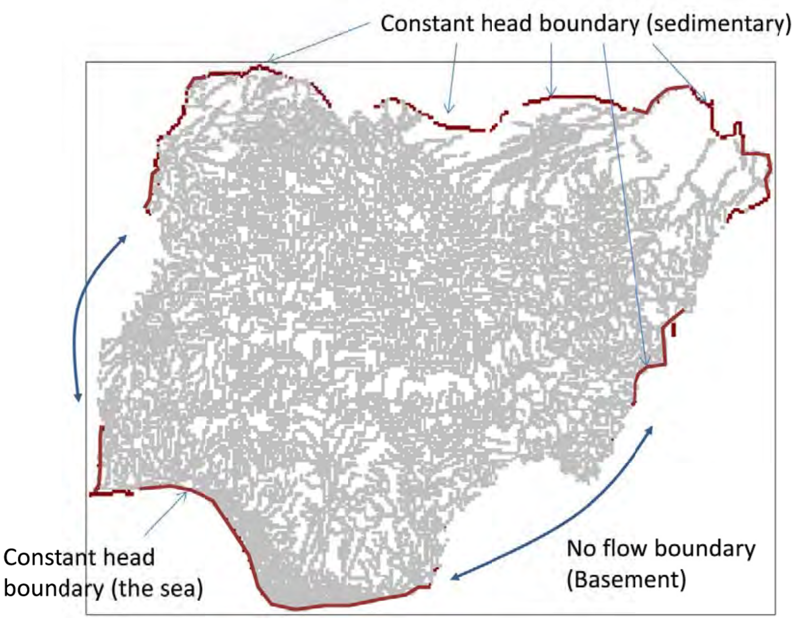
Three type of boundary condition was given to the model.

Table SR3-7 Boundary Condition

Type	Distribution
① Constant head	This condition was given to border in sedimentary rock area and the sea line
② No flow	This condition was given to the border in Basement rock area
③ Drain	This condition was given to main rivers.

Source：JICA Project Team

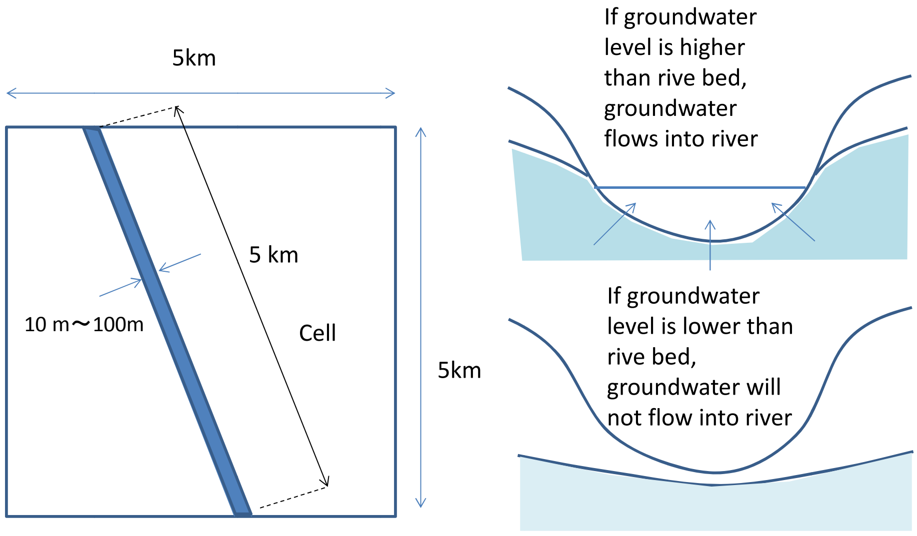
Above condition are shown in Figure SR3-8.



Source：JICA Project Team

Figure SR3-8 Boundary Condition

Content of drain condition is as follows.



Source：JICA Project Team

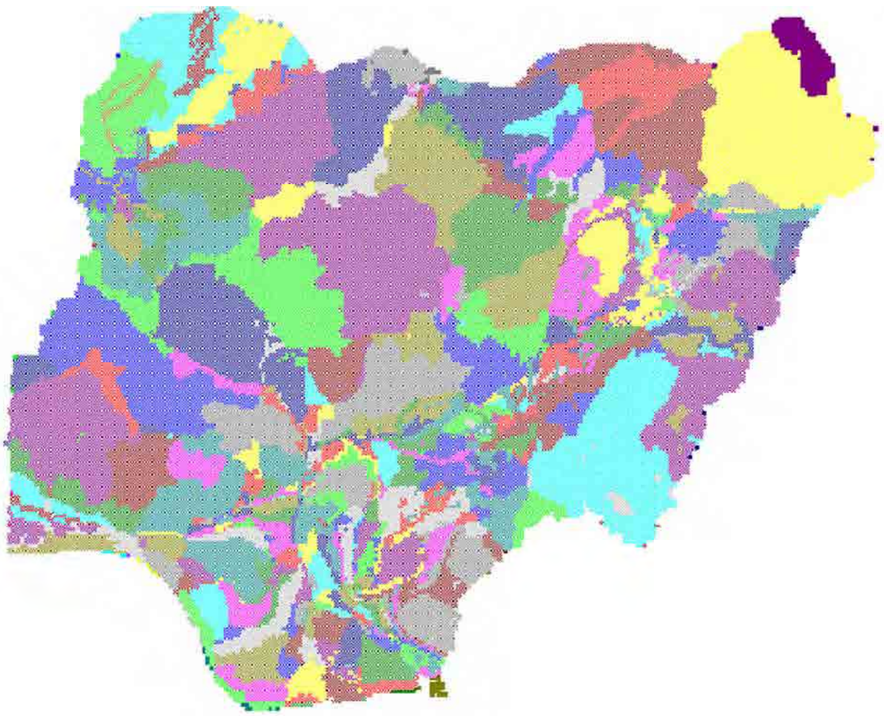
Figure SR3-9 Content of Drain Condition

The drain in the model passes through cells with 5km length as same as cell length. Width of the drain in the Model is 10m to 100m depending on scale of the actual rivers. Under the drain condition, groundwater will flow into rivers if groundwater level is higher than river elevation. On the other hand, if groundwater level is lower than river elevation, no groundwater flow between rivers and groundwater body.

Groundwater usage by private irrigation, livestock and aqua-culture

Usage of groundwater buy private irrigation, livestock and aqua-culture were converted to negative groundwater recharge and subtracted from natural groundwater recharge by State.

As a result, groundwater recharge shows complicated distribution as shown in Figure SR3-10.

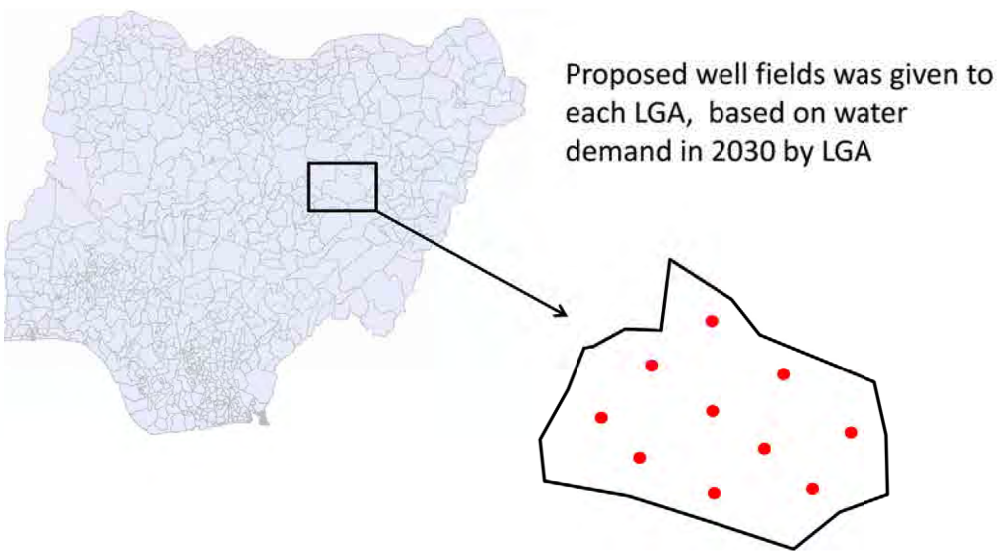


Source：JICA Project Team

Figure SR3-10 Groundwater recharge including effect of Private Irrigation, livestock and Aqua-culture

Existing borehole

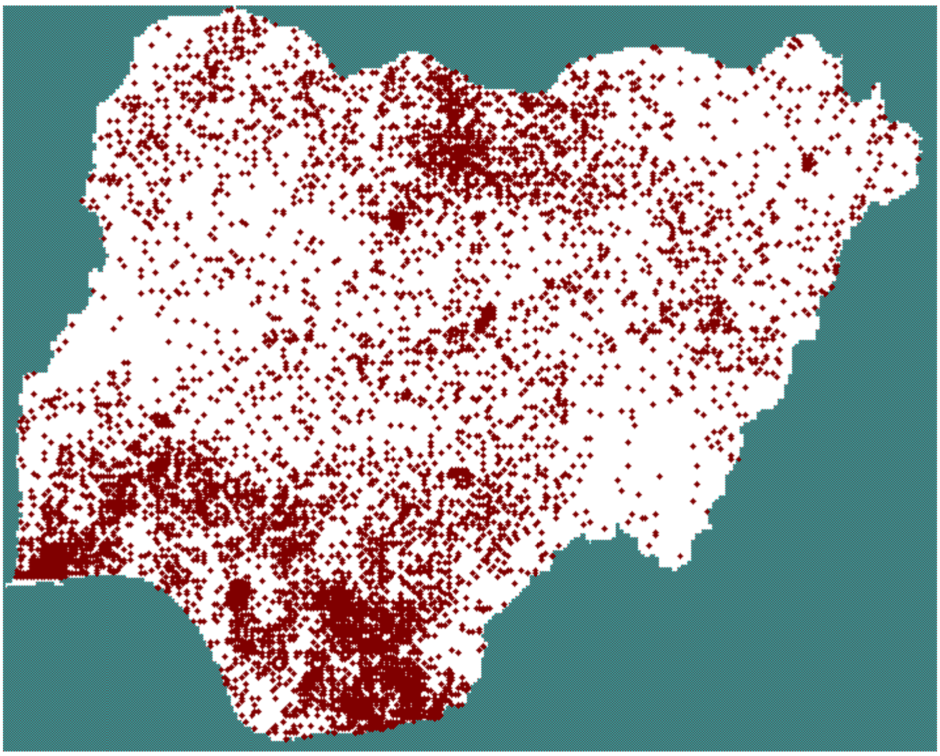
Existing groundwater usage was given to the model by pumping from boreholes by LGA.



Source：JICA Project Team

Figure SR3-11 Model of boreholes in LGA

Model consists of cells with 5km x 5km size. Yield of boreholes within cells is converted into yield of one borehole located in the center of cells in the simulation. Such a borehole can be interpreted as no single borehole but a borehole field. Figure SR3-12 shows distribution of current borehole field in the model.



Source：JICA Project Team

Figure SR3-12 Distribution of Existing Borehole Field in STEP-1 of the Model

(3) Step-2

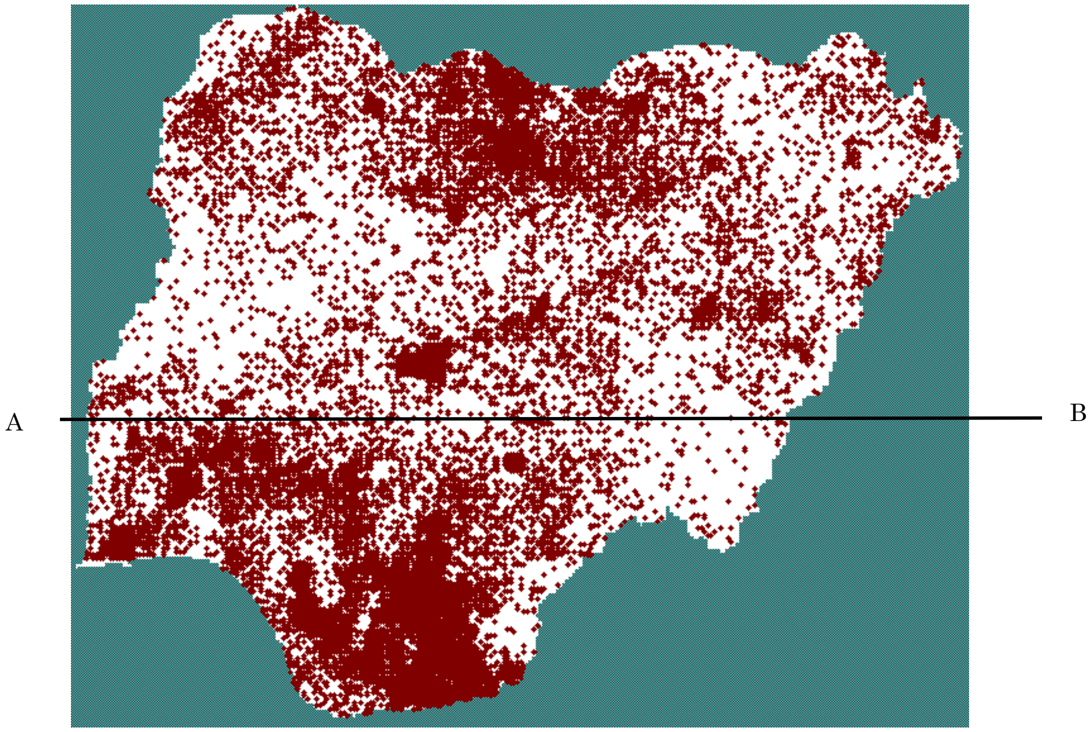
Following step-1, calculation was performed of STEP-2. Calculated groundwater level of STEP-1 was used as the initial groundwater level of STEP-2 simulation.

Condition of STEP-2 was almost as same as STEP-1. However, Yield of boreholes is different. Total yield of borehole is calculated from relation below, and distribution of borehole field is shown in Figure SR3-13.

Yield of STEP-2=Yield of STEP-1＋Newly developed Groundwater by 2030

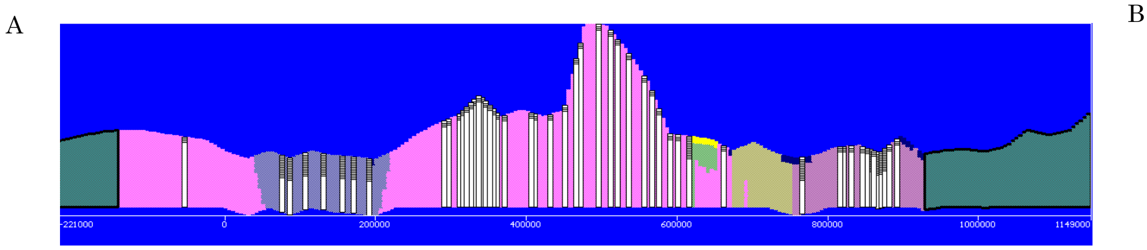
Depth of boreholes in Borehole field is 50m and 100m depending of aquifer type as shown in Figure SR3-14.

- Aquifer type of MH, MM, ML: Borehole depth is 200m
- Aquifer type of WH, WM, WL: Borehole depth is 50m



Source：JICA Project Team

Figure SR3-13 Distribution of Borehole Field in STEP-2 of the Model



Source：JICA Project Team

Figure SR3-14 Boreholes in Simulation Model

(4) Draw-down of groundwater level by Simulation Result

Groundwater level difference between STEP-1 and STEP-2 is interrupted as Draw-down of groundwater level by newly develop groundwater development by 2030.

Draw-down of regional groundwater level, which will be caused by proposed groundwater development, was calculated in steady state condition and simulation result is shown in Figure SR3-15. Important points of the result are as follows.

- Maximum draw-down is less than 20m. Consequently, proposed groundwater development can be available by adjusting borehole depth to meet future draw-down of groundwater level.
- Draw-down of groundwater level will be larger in Kastina, Sokoto and Oshun States than the other states.
- Draw-down will not be so large in Chad Basin area than above area.

(5) Effect of Climate Change

Lowering of Groundwater level in 2030 under the influence of Climate Change (scenario Case-1) was predicted by groundwater simulation. Condition for simulation is shown in Table SR3-8, and simulation result is shown in Figure SR3-16.

Table SR3-8 Outline of Groundwater Simulation Model and Given Condition by Climate Change

Condition	Content
Groundwater recharge	Scenario Case-1 of the Climate Change was applied to estimate groundwater recharge. Groundwater recharge of Table SR3-5 was modified using decreasing rate by HA under the influence of Climate Change.
The others	Other condition is the same as those in Table SR3-5

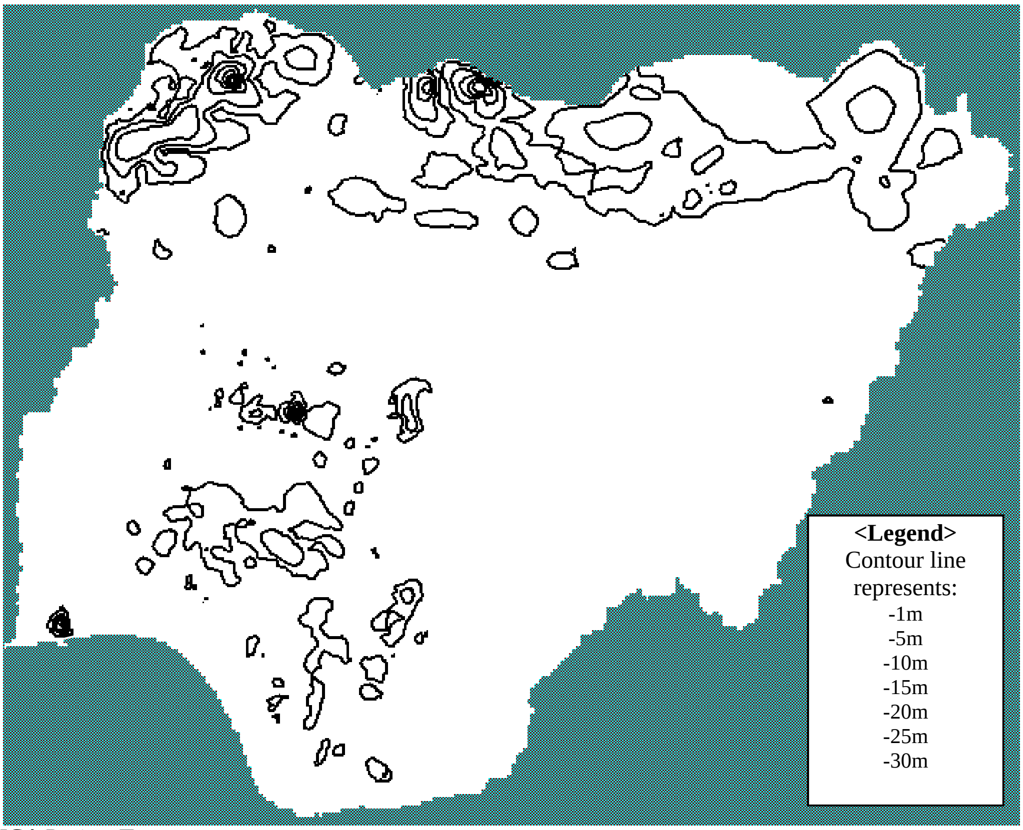
Source：JICA Project Team

Compared with Figure SR3-15, groundwater level in 2030 shown in Figure SR3-16 will be lowered additionally 5 to 20m in the entire Nigeria due to decrease in groundwater recharge under the influence of Climate Change. It should be noticed that lowering of groundwater level without influence of Climate Change is not clear in Plateau high land area compared with other region. However, lowering of groundwater level is quite clear in Plateau high land area by influence of Climate Change. This means that in some area in 2030, groundwater extraction cannot be continued with the current borehole depth, due to serious lowering of groundwater level by Climate Change, even though groundwater recharges is larger than groundwater pumping. As explained in SR2.4.3, lowering of groundwater level by Climate Change is more serious in high elevation area than the other area. Measures below can be proposed for future borehole planning, considering lowering of groundwater level by Climate Change.

- To make depth of borehole 20m deeper than current depth
- To make depth of pump location 20m deeper than now. Such arrangement should be considered in borehole construction plan.

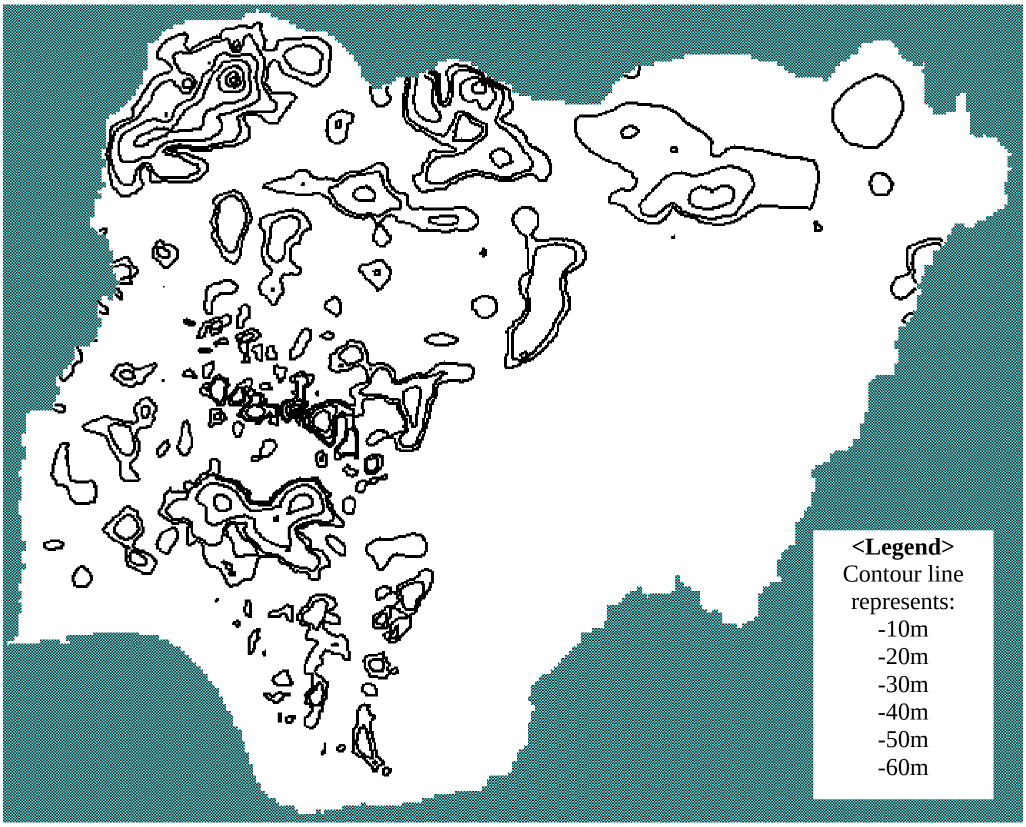
Impact by lowering of groundwater level under influence of Climate Change will be enlarged by borehole interference by over pumping. To prevent such situation, responding to the influence of Climate Change, groundwater pumping must be controlled where there are many boreholes. Legal and institutional framework must be established to support groundwater monitoring system for pumping control. NIWRMC should take responsibility of these activities.

Above discussion is based on uncertain risk of Climate Change. Careful analysis and discussion are necessary in the future.



Source：JICA Project Team

Figure SR3-15 Predicted lowering of groundwater level in 2030



Source：JICA Project Team

Figure SR3-16 Predicted Lowering of Groundwater Level in 2030 by Influence of Climate Change

SR3.4 Balance between Demand and Supply Capacity for Surface Water Source

SR3.4.1 Planning Conditions

In principle, the following planning conditions are applied for water balance study for surface water.

- Flow and Climate Condition
  - Future climate condition is still uncertain. Therefore, the planning will be based on the existing climate and runoff conditions.
  - As a basic condition of the climate, the existing climate condition (40years: 1970-2009) is applied. The arranged climate data shown in SR2 are utilized for the existing climate condition.
  - The quasi-natural monthly flow for the past 40years (1970-2009) estimated in SR2 is used for basic flow condition without influence of significant dams and water uses.
- Target Safety Level for Surface Water Development
  - The following target safety level for surface water development will be basically applied.
    - ✓ Municipal Water Supply= 90% yearly dependable (1/10 years safety level: Lack of water at once in 10years can be accepted.)
    - ✓ Irrigation Water Supply= 80% yearly dependable (1/5 years safety level: Lack of water at once in 5years can be accepted.)
    - ✓ Other Water Supply = 80% yearly dependable (1/5 years safety level: Lack of water at once in 5years can be accepted.)

    It is noted that municipal water supply includes domestic, industrial and commercial through water supply system.
- Priority of Water Use
  - The following principles are considered, when the surface water resources development is planned.
    - ✓ The highest priority is given to domestic water use, without compromising against deterioration of environment.
    - ✓ The second priority is given to irrigation water use in order to keep food security.
  - Based upon the above-mentioned principles, the following priority order of consumptive water use will be basically applied, when the surface water resources development is planned.
    - ✓ 1st priority: Minimum stream flow requirement
    - ✓ 2nd priority: Municipal water supply
    - ✓ 3rd priority: Irrigation water supply
    - ✓ 4th priority : Other water supply, if any
    - ✓ When the hydropower component that is non-consumptive water use is included in the water resources development, the optimum use of hydropower will be considered, under the above-mentioned priority order.
  - For actual operation during extreme event such as drought and flood conditions, the priority should be discussed among stakeholders case by case. This is a part of risk management of water resources.
- Minimum Stream Flow Requirement
  - Q_{97DS}90%Y (90% yearly dependable 97 percentaile daily flow for a single year), which has been estimated in the present project and may represent the drought condition according to the flow regime in each area in Nigeria, will be applied as the minimum stream flow requirement, when the surface water resources development is planned in the present project.
  - In the future, when more data for river discharge and as well as river conditions will be accumulated, more details to set appropriate minimum stream flow requirement should be discussed among stakeholders.
- Climate Change Impact
  - The possible climate change impact on water resources and water demand will be treated as a risk factor which we cannot control as is the case of uncertainty associated with trans-boundary water. The sensitivity of the risk factor may be analyzed.
  - For the climate change scenario, the scenario based on the output of GCM would be applied.
- Trans-boundary Water

- There are large amount of inflow through the Niger River, Benue Rivers and its tributaries, and Cross River. These inflows may be affected by the water resources development and use in the neighboring countries, which is a risk factor that is not basically controlled. The risk factor may be examined by sensitivity analysis, if necessary.
- Especially, i) Operation of Lagdo dam in the Benue River, ii) Operation of Kandaji dam (under construction) in the upper Niger River will be carefully treated. The regulated water by these dams is not considered as a usable water source unless the minimum flow is set, by the assumption that the regulated water is basically utilized in the upstream countries

SR3.4.2 Estimation of Surface Water Supply Capacity with Storage Dams

The usable water throughout a year is limited in quasi-natural condition. The installation and operation of storage dams can increase the stably usable water. In Nigeria, more than 170 dams, which are confirmed in the present project, have been constructed. The supply capacity of surface water source with the storage dams is approximately estimated by assuming a constant demand throughout a year.

The 18 existing large storage dams whose active storage volume is more than 100MCM are modeled as a single dam, because they may affect the flow regimes in wider area. The remaining dams are aggregated by each SHA and considered as a single virtual dam. The dams considered are the existing ones or those under-construction whose location and dimension are known. The Lagdo dam which is located outside Nigeria in the upper reach of the Benue River is also modeled with available information at this moment.

In order to model the storage dams, at least the information on i) active storage volume, ii) reservoir surface area, iii) evaporation is necessary. However, the information is not always available, due to insufficient inventory of the dams. The followings are applied.

- Basically, the active storage volume and reservoir surface area described in the inventory of dams are used.
- There is sometimes no information on the active storage volume and reservoir surface area in the inventory of dams, especially for small dams. The average ratio of the active storage volume against the gross storage volume for the dams in Nigeria is computed at 78.1% based on the available data (see Annex-F SR3-1). This ratio (78.1%) is applied to estimate the active storage volume when the information on only gross storage volume is available.
- The relationship among the reservoir surface area, the height of dam and the gross storage volume is examined (see Annex-F SR3-2). The following relationship is applied to estimate the reservoir surface area when the information on it is not available.

$$A_{\mathrm{o}} = \mathrm{a}\left(\frac{V_G}{H}\right)^b$$

  where A_o = maximum reservoir surface area (km^2), V_G = gross storage volume (MCM), H= height of dam (m), a, b = empirical constants (a=2.441, b=1.107 is applied in the present project).
- The elevation-storage volume-surface area relationship is available only for the following eight significant dams: Kainji, Jebba, Shiroro, Bakolori, Goronyo, Kiri, Dadin Kowa, and Ikere Gorge. The storage volume-surface area relationship for these dams can be approximated by the following equation (see Annex-F SR3-3).

$$\frac{A}{A_o} = \left(\frac{V}{V_{\mathrm{G}}}\right)^{\mathrm{c}}$$

  where A_o = maximum reservoir surface area (km^2), A = reservoir surface area (km^2), V_G = gross storage volume (MCM), V= storage volume (MCM), c = empirical constant (c=0.65 is applied in the present project). This equation is applied for the dams whose elevation-storage volume-surface area relationship is not available.
- As for the evaporation, the observed evaporation data at Kainji, Jebba and Shiroro, which are long-term and stable data, are compared with the estimated PET for each site. The average ratio between the observed evaporation and the estimated PET is computed at 1.24, which is applied to estimate the evaporation at the other dam sites by giving the estimated PET for each dam site.

- Considering the average precipitation pattern for each SHA, net evaporation is given as follows.

$$E_{net} = \begin{cases} E - P & (E > P) \\ 0 & (E < P) \end{cases}$$

where E_{net} = Net Evaporation (mm/month), E = Evaporation (mm/month), P= Precipitation (mm/month).

The storage dams considered for the approximate estimation of supply capacity of surface water source and their active storage volume, reservoir surface area and evaporation are shown in Table SR3-9.

Table SR3-9 Storage Dams considered for Approximate Estimation of Supply Capacity of Surface Water Source

SN	HA	SHA	Name of Dam	Existing			Existing + Under Construction		
				Active Storage Volume (MCM)	Surface Area (km^2)	Evapo-ration (mm/ year)	Active Storage Volume (MCM)	Surface Area (km^2)	Evapo-ration (mm/ year)
5001	1	101	aggregated	58.60	12.00	1,713	58.60	12.00	1,713
5002	1	102	aggregated	7.40	1.79	1,652	7.40	1.79	1,652
5011	1	10606	aggregated	0.58	0.23	1,737	0.58	0.23	1,737
5014	1	106081_i	aggregated	11.72	20.78	1,872	11.72	20.78	1,872
5017	1	106082_i2	aggregated	20.00	9.80	1,906	20.00	9.80	1,906
5024	1	1060863	aggregated	43.41	12.50	1,668	54.01	13.40	1,661
5028	1	1060883	aggregated	4.90	0.08	1,656	4.90	0.08	1,656
5029	1	106089	aggregated	1.95	1.10	1,608	1.95	1.10	1,608
5031	1	106093	aggregated	7.92	3.50	1,639	7.92	3.50	1,639
5039	2	202021	aggregated	10.86	6.79	1,573	10.86	6.79	1,573
5044	2	20401	aggregated	58.30	6.68	1,572	58.30	6.68	1,572
5045	2	20403	aggregated	4.57	0.19	1,606	4.57	0.19	1,606
5047	2	206	aggregated	1.17	1.00	1,497	1.17	1.00	1,497
5052	2	20804	aggregated	53.19	13.73	1,726	53.19	13.73	1,726
5053	2	20805	aggregated	5.00	1.80	1,635	5.00	1.80	1,635
5059	2	20812	aggregated	21.00	4.10	1,831	61.00	7.61	1,780
5060	2	20813	aggregated	2.80	0.65	1,527	2.80	0.65	1,527
5061	2	20814	aggregated	59.30	9.30	1,528	59.30	9.30	1,528
5062	2	20815	aggregated	24.35	8.30	1,509	28.02	8.50	1,508
5063	2	209	aggregated	5.82	1.28	1,310	5.82	1.28	1,310
5065	2	212	aggregated	19.73	5.14	1,465	19.73	5.14	1,465
5068	2	214_i	aggregated	42.70	12.28	1,624	42.70	12.28	1,624
5073	2	218	aggregated	0.58	0.21	1,604	0.58	0.21	1,604
5080	3	304	aggregated	15.70	3.50	1,667	15.70	3.50	1,667
5090	3	311	aggregated	3.50	0.60	1,689	3.50	0.60	1,689
5091	3	312	aggregated	3.50	1.10	1,587	3.50	1.10	1,587
5096	3	31405	aggregated	0.78	0.14	1,729	0.78	0.14	1,729
5099	3	31409	aggregated	72.60	7.50	1,540	72.60	7.50	1,540
5101	3	316	aggregated	92.70	16.91	1,445	92.70	16.91	1,445
5102	3	317	aggregated	0.00	0.00	0	31.72	6.01	1,648
5110	4	402	aggregated	0.43	0.20	1,737	0.43	0.20	1,737
5112	4	404	aggregated	0.40	0.10	1,700	0.40	0.10	1,700
5113	4	405	aggregated	84.60	20.96	1,369	84.60	20.96	1,369
5114	4	406_e	aggregated	4.61	1.53	1,660	4.61	1.53	1,660
5115	4	406_i	aggregated	0.00	0.00	0	0.78	0.16	1,657
5116	4	407	aggregated	5.08	0.20	1,730	5.08	0.20	1,730
5117	4	408	aggregated	3.60	0.13	1,202	3.60	0.13	1,202
5119	4	410	aggregated	7.88	2.23	1,571	7.88	2.23	1,571
5122	5	502	aggregated	0.00	0.00	0	3.05	0.76	1,668
5124	5	50402	aggregated	0.00	0.00	0	2.11	0.30	1,595
5125	5	50403	aggregated	18.97	5.71	1,563	18.97	5.71	1,563
5131	6	602_i	aggregated	4.30	0.15	1,710	4.30	0.15	1,710
5133	6	60401	aggregated	1.56	0.24	1,680	25.00	4.06	1,682
5136	6	604023_i	aggregated	4.71	1.38	1,627	9.91	2.05	1,630
5137	6	60403	aggregated	11.88	2.87	1,639	11.88	2.87	1,639
5138	6	60405	aggregated	5.15	1.45	1,592	5.15	1.45	1,592
5140	6	606	aggregated	6.09	2.24	1,643	6.09	2.24	1,643

SN	HA	SHA	Name of Dam	Existing			Existing + Under Construction		
				Active Storage Volume (MCM)	Surface Area (km^2)	Evapo-ration (mm/ year)	Active Storage Volume (MCM)	Surface Area (km^2)	Evapo-ration (mm/ year)
5142	6	608	aggregated	146.18	28.00	1,600	165.71	31.13	1,600
5144	6	610	aggregated	0.00	0.00	0	10.94	1.67	1,608
5146	6	612	aggregated	7.81	0.40	1,574	35.94	4.80	1,563
5147	6	614	aggregated	34.61	6.96	1,511	92.42	21.79	1,513
5148	6	616	aggregated	1.17	0.38	1,590	1.17	0.38	1,590
5151	7	702	aggregated	0.09	0.06	1,649	0.09	0.06	1,649
5153	7	70401	aggregated	0.00	0.00	0	2.73	0.65	1,635
5154	7	70402	aggregated	0.34	0.37	1,713	15.97	3.72	1,715
5155	7	70403	aggregated	0.04	0.02	1,740	0.04	0.02	1,740
5157	7	704042	aggregated	2.00	0.57	1,587	2.00	0.57	1,587
5158	7	704043	aggregated	0.00	0.00	0	23.44	2.35	1,683
5170	8	806	aggregated	106.00	96.30	1,618	106.00	96.30	1,618
5180	8	808061	aggregated	9.70	4.20	1,691	9.70	4.20	1,691
5181	8	808062	aggregated	0.94	0.60	1,671	0.94	0.60	1,671
5182	8	808063	aggregated	35.86	11.01	1,353	35.86	11.01	1,353
5185	8	8080721_i	aggregated	122.66	35.75	1,681	122.66	35.75	1,681
5186	8	8080723	aggregated	5.20	0.47	1,613	5.20	0.47	1,613
5187	8	808073	aggregated	24.60	4.80	1,647	24.60	4.80	1,647
5191	8	8080743	aggregated	55.36	10.10	1,600	55.36	10.10	1,600
5192	8	8080745	aggregated	16.29	3.00	1,567	41.85	6.57	1,549
5193	8	808075	aggregated	66.22	10.30	1,620	66.22	10.30	1,620
5194	8	808077	aggregated	16.60	3.20	1,569	16.60	3.20	1,569
2	1	106093	Bakolori	403.00	56.20	1,762	403.00	56.20	1,762
4	1	106085_i	Goronyo(Main)	933.00	192.00	1,876	933.00	192.00	1,876
6	1	1060863	Jibiya	121.00	25.00	1,715	121.00	25.00	1,715
7	1	101	Kainji	12,000.00	1,294.00	1,554	12,000.00	1,294.00	1,554
14	1	1060883	Zobe	170.00	38.00	1,625	170.00	38.00	1,625
22	2	20205	Gurara	700.00	61.00	1,517	700.00	61.00	1,517
26	2	211	Jebba(main)	1,000.00	316.50	1,934	1,000.00	316.50	1,934
29	2	20403	Omi	220.00	25.70	1,634	220.00	25.70	1,634
33	2	20809	Shiroro	6,050.00	300.00	1,711	6,050.00	300.00	1,711
38	2	202023	Usuma	100.00	8.90	1,536	100.00	8.90	1,536
43	3	31407	Dadin Kowa	1,770.00	290.00	1,633	1,770.00	290.00	1,633
45	3	31403	Kiri	290.00	107.00	1,756	290.00	107.00	1,756
70	6	60405	Ikere Gorge	565.00	53.00	1,629	565.00	53.00	1,629
81	6	604023_i	Oyan	265.00	44.00	1,713	265.00	44.00	1,713
86	8	8080745	Challawa Gorge	904.00	96.00	1,601	904.00	96.00	1,601
88	8	8080723	Gari	203.00	30.00	1,656	203.00	30.00	1,656
99	8	808077	Tiga	1,222.00	140.00	1,607	1,222.00	140.00	1,607
103	8	80807423	Watari	92.74	17.00	1,623	92.74	17.00	1,623
9001	3	321	Lagdo	4,570.00	800.00	1,750	4,570.00	800.00	1,750

Source: JICA Project Team

The supply capacity of surface water source is estimated under the following assumptions.

- The simulated monthly flow for 40 years from 1970 to 2009 shown in SR2 is given as quasi-natural flow without influence of the storage dams.
- It is assumed that all active storage capacity is utilized for supplying water to fulfill the water demand at downstream. The operation for flood control and hydropower generation is not taken into account.

The followings are procedure for estimating the supply capacity of surface water source with storage dams.

- The reference points to evaluate the supply capacity are set at the downstream end of SHAs. For each reference point, monthly water balance computation is conducted by spreadsheet (MS-Excel).
- At the reference points, by giving the constant demand throughout a year, number of occurrence of shortage during the simulated period is counted to check the safety level for

satisfying the given demand. By changing the demand trial and error, the demand with shortage for three years in 40years and that for seven years in 40years are obtained.

- The demand with shortage in three years in 40years is regarded as 90% yearly dependable and that with shortage for seven years in 40years is regarded as 80% yearly dependable discharge.
- In the water balance computation, the priority is given to the upstream demands and dams. Then, the estimation of 80% and 90% yearly dependable discharge is conducted from the upstream demand one by one. Finally, one can obtains the 80% and 90% yearly dependable discharges for all reference points.
- The volume obtained by integration of the discharge in a year is regarded as the supply capacity for the reference points with certain reliability (80% yearly, 90% yearly).

The estimated supply capacity for surface water source with the storage dams at the representative points for each HA is presented in Table SR3-10. The supply capacity would be increased by the Lagdo dam, which is located in the upper Benue River in Cameroon. The estimated increment is 5,000MCM/year (157m^3/s) with 90% yearly dependability and 5,500MCM/year (175 m^3/s) with 80% yearly dependability. However, such increment is not taken into account in the supply capacity in the table, because it is not under Nigerian control. The values shown in Table SR3-10 have been subtracted by the increment from Lagdo dam.

One can see that at the downstream end of HA-2, 34,000MCM/year (1,080m^3/s) for 90% yearly dependability and 36,000MCM/year (1,140 m^3/s) for 80% yearly dependability could be supplied. The large supply capacity in HA-2 and 5 (downstream reach of HA-2) is the results of regulation of flow by the existing large hydropower dams (Kainji, Jebba and Shiroro). As reference, the supply capacity without developed water volume by the existing large hydropower dams (Kainji, Jebba and Shiroro) is presented in Table SR3-11.

The increase in supply capacity in HA-1 is mainly contributed by Goronyo and Bakolori dams which have large storage capacity. In HA-3 and 4, the effect of Dadin Kowa dam, Kiri dams as the existing dams, and Kashimbilla as dam under-construction are large.

The supply capacities for the reference points by SHAs are presented in Annex-T SR3-1.

Table SR3-10 Estimated Supply Capacity for Surface Water Source with Storage Dams at Representative Points for Each HA

HA	Ref. Points	MSFR (MCM/ year)	Supply Capacity - MSFR					
			90% Yearly Dependable (MCM/Year)			80% Yearly Dependable (MCM/Year)		
			Quasi -Natural	with existing dams	with existing & UC dams	Quasi -Natural	with existing dams	with existing & UC dams
HA-1	Downstream end of HA-1	544	34	1,190	1,208	367	1,665	1,666
HA-2	Downstream end of HA-2	1,993	3	33,647	33,987	572	35,927	36,023
HA-3	Downstream end of HA-3	963	8	2,195	2,306	195	2,421	2,594
HA-4	Downstream end of HA-4	4,083	513	2,496	4,177	1,545	3,993	5,097
HA-5	Sum outlet of rivers in HA-5	13,093	989	33,713	34,589	3,265	38,708	38,933
HA-6	Sum outlet of rivers in HA-6	1,845	33	1,268	1,934	474	2,068	2,958
HA-7	Sum outlet of rivers in HA-7	6,731	460	459	556	1,367	1,427	1,502
HA-8	Before wet land area*	0	0	1,107	1,107	0	1,348	1,348

Note: MSFR=Minimum Stream Flow Requirement, UC=Under-Construction
* Sum of the values at the downstream end of SHA 802_i, 80401, 806, 807, 808061, 8080741, 808075
Source: JICA Project Team

Table SR3-11 Estimated Supply Capacity for Surface Water Source with Storage Dams at Representative Points for Each HA in Case that Existing Large Hydropower Dams (Kainji, Jebba and Shiroro) are not Considered

HA	Ref. Points	MSFR (MCM/ year)	Supply Capacity – MSFR					
			90% Yearly Dependable (MCM/Year)			80% Yearly Dependable (MCM/Year)		
			Quasi -Natural	with existing dams	with existing & UC dams	Quasi -Natural	with existing dams	with existing & UC dams
HA-1	Downstream end of HA-1	544	34	1,190	1,208	367	1,665	1,666
HA-2	Downstream end of HA-2	1,993	3	2,032	2,466	572	3,218	3,492
HA-3	Downstream end of HA-3	963	8	2,195	2,306	195	2,421	2,594
HA-4	Downstream end of HA-4	4,083	513	2,496	4,177	1,545	3,993	5,097
HA-5	Sum outlet of rivers in HA-5	13,093	989	2,098	3,069	3,265	6,000	6,402
HA-6	Sum outlet of rivers in HA-6	1,845	33	1,268	1,934	474	2,068	2,958
HA-7	Sum outlet of rivers in HA-7	6,731	460	459	556	1,367	1,427	1,502
HA-8	Before wet land area*	0	0	1,107	1,107	0	1,348	1,348

Note: MSFR=Minimum Stream Flow Requirement, UC=Under-Construction
* Sum of the values at the downstream end of SHA 802_i, 80401, 806, 807, 808061, 8080741, 808075
Source: JICA Project Team

SR3.4.3 Comparison between Water Demand and Water Supply Capacity at Scale of Entire HA

The comparison between water demand and water supply capacity at the representative point of HA (downstream end of HA) at the scale of HA is presented in Table SR3-12. The table shows the case without large hydropower dams (Kainji, Jebba and Shiroro).

Table SR3-12 Comparison between Water Demand and Water Supply Capacity at Scale of Entire HA

HA	Ref. Points	Supply Capacity – MSFR (without Large hydropower dams (Kainji, Jebbe and Shiroro)***				Water Demand (MCM/year)	
		90% Yearly Dependable (MCM/Year)		80% Yearly Dependable (MCM/Year)			
		with existing dams	with existing & UC dams	with existing dams	with existing & UC dams	Existing (2010)	Future (2030)
HA-1	Downstream end of HA-1	1,190	1,208	1,665	1,666	489	754
HA-2	Downstream end of HA-2	2,032	2,466	3,218	3,492	796	1,783
HA-3	Downstream end of HA-3	2,195	2,306	2,421	2,594	172	1,679
HA-4	Downstream end of HA-4	2,496	4,177	3,993	5,097	275	2,405
HA-5	Sum outlet of rivers in HA-5	2,098	3,069	6,000	6,402	1,150	4,660
HA-6	Sum outlet of rivers in HA-6	1,268	1,934	2,068	2,958	345	1,697
HA-7	Sum outlet of rivers in HA-7	459	556	1,427	1,502	89	341
HA-8	Before wet land area*	1,107	1,107	1,348	1,348	411**	870**

Note: MSFR=Minimum Stream Flow Requirement, UC=Under-Construction
* Sum of the values at the downstream end of SHA 802_i, 80401, 806, 807, 808061, 8080741, 808075
** The water demand whose source is Lake Chad is not included.
***The developed water volume by Lagdo dam is not included.
Source: JICA Project Team

For all HAs, the supply capacity with 90% yearly dependability is larger than the water demand. It could be understood that the water demand in 2030 could be supplied by the existing dams and dams under-construction, if one see the balance in the scale of HA. However, the distance between the existing water source and demand site is usually far, some of the existing sources would not be able to be fully used for the demand. It is thereby necessary to examine local water balance between supply capacity and demand within HA. If the lack of water is expected at local water balance, new water source development may be necessary to be proposed.

SR3.4.4 Detailed Water Balance Study

(1) Consideration of Groundwater Abstraction and Water Use for Livestock/Aquaculture

The change in base flow due to abstraction of groundwater is approximately estimated on the basis of the simulated quasi-natural runoff. The following equations are employed to approximately estimate runoff with groundwater abstraction.

$$RO^{*} = DRO + IF + BF^{*}$$
$$BF^{*} = (1-\alpha)BF$$
$$\alpha = \frac{\overline{AG}}{\overline{LSR}}$$

where *DRO*, *IF*, *BF* = direct runoff, interflow, base flow for quasi-natural condition, RO^*, BF^* = runoff, base flow with groundwater abstraction, α = reduction rate of base flow, $\overline{LSR}$ = average groundwater recharge (late component of surplus), and $\overline{AG}$ = average groundwater abstraction.

The mechanism of reduction of base flow due to groundwater abstraction is complex. However, it is expected that the effect of groundwater abstraction on runoff could appear in relatively large scale, because of the scale of groundwater aquifer. In the present project, reduction rate of base flow α is computed for each HA, and applied it for each HA. The computed α for each HA are shown in Table SR3-13.

Table SR3-13 Reduction Rate of Base Flow due to Groundwater Abstraction

HA	Groundwater Recharge (LSR) (mm/year)	Groundwater Abstraction (2010) (mm/year)	Reduction Rate a (2010)	Groundwater Abstraction (2030) (mm/year)	Reduction Rate a (2030)
1	36.8	2.2	0.06	6.4	0.18
2	132.4	2.1	0.02	6.2	0.05
3	123.4	1.3	0.01	4.4	0.04
4	250.3	1.1	0.00	3.1	0.01
5	591.6	3.1	0.01	8.8	0.01
6	235.6	8.8	0.04	13.6	0.06
7	570.3	2.7	0.00	7.5	0.01
8	24.0	4.8	0.20	11.1	0.46

Source: JICA Project Team

The surface water use for livestock and aquaculture inside SHA is also taken into account as follows.

$$RO^{**} = (1-\beta)RO^{*}$$
$$\beta = \frac{\overline{U_{LA}}}{\overline{RO^{*}}}$$

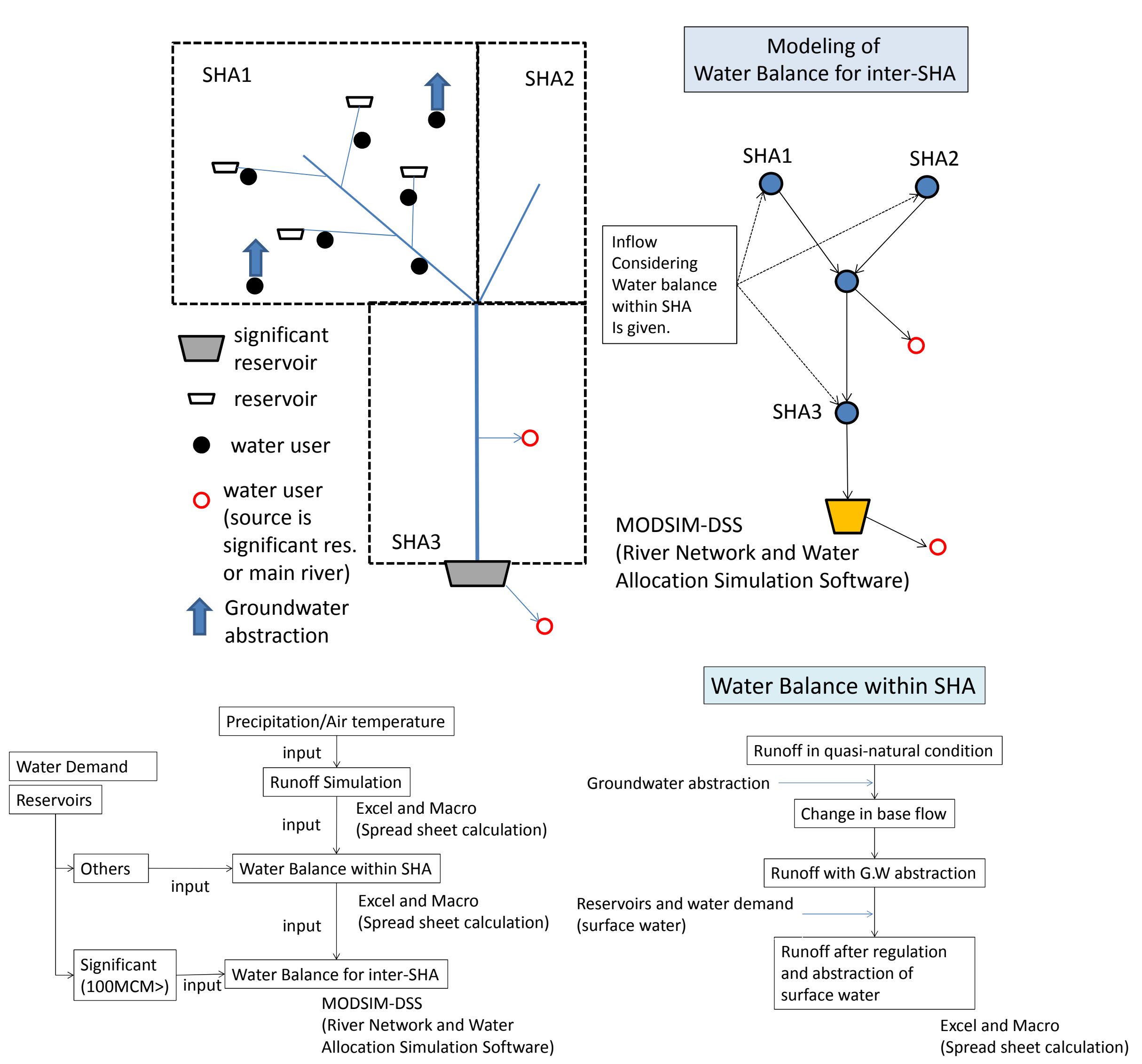
where RO^{**}= runoff with groundwater abstraction and water use for livestock and aquaculture, $\overline{U_{LA}}$ = average surface water use for livestock and aquaculture, $\overline{RO^{*}}$ = average runoff with groundwater abstraction.

The computed runoff reduction for each SHA is shown in Annex-T SR3-2. The reduced runoff by groundwater abstraction and water use for livestock and aquaculture is applied for the detail water balance study.

(2) Classification of Water Use Facilities

It is inefficient to deal with all water use facilities that scatter in nationwide and have various scales in same manner. In the present project, the water balance is examined by classifying the water use facilities into the following two categories (refer to Figure SR3-17).

- Water use facilities whose source is either significant dams or main rivers which flows across SHA
- Water use facilities whose source is in the catchment area of SHA



Source: JICA Project Team

Figure SR3-17 Detail Water Balance Study for Surface Water

(3) Aggregated Water Balance within SHA

Water use facilities whose source is in the catchment area of SHA are aggregated in each SHA, and aggregated water balance inside SHA is computed by spread sheet (MS-Excel). The aggregated dams, water demand for municipal water and irrigation area are shown in Annex-T SR3-3 and SR3-4.

In the water balance computation, the retune of used water is considered as follows.

- It is assumed that the return flow from urban water use is 10% of the demand at source[1].
- It is assumed that the return flow from irrigation water use is set at 10% of the demand at source. The delay of the return flow is considered. The factor of the delay is set at 0.5, which means that 50% of the return flow would return within a month, and the remaining is taken over to the next month[2].

The computed runoff is used for the input data for the model network for water balance study for the inter-SHA.

[1] Considering that the coverage rate of sewerage system in Nigeria is very low, it is assumed that most of supplied piped water for urban water use would not return to river course nearby. For conservative estimation, the 10% return is assumed.

[2] It is assumed that the unused water for crops (50% of diversion water requirement) would be infiltrated into surface soil and eventually run off to river course. The additional runoff volume could be 50% x 24% (average runoff rate in Nigeria) =12% of the diversion water requirement. For conservative estimation, the 10% return is assumed.

(4) Water Balance Study for Inter-SHA

The inter-SHA water balance is directly modeled by the model network in MODSIM-DSS[3] as follows.

- The nodes for inflow are basically given by SHA unit. The computed runoff considering all local water use and return flow inside SHA described in the above Items (1)-(3) is given as inflow data.
- The significant reservoirs whose total storage capacity is more than 100MCM and other important reservoirs are directly modeled by the model network (see Table SR3-14).
- As for water users, 43 locations for municipal water supply, 49 locations for irrigation water supply are considered (see Annex-T SR3-5).

Table SR3-14 Dams Directly Modeled by MODSIM-DSS Model Network

SN	HA	SHA	Dam	Status	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km^2)	Evaporation (mm/year)
2	1	106093	Bakolori	E	450.00	403.00	56.20	1,762
4	1	106085_i	Goronyo(Main)	E	942.00	933.00	192.00	1,876
6	1	1060863	Jibiya	E	142.00	121.00	25.00	1,715
7	1	101	Kainji	E	15,000.00	12,000.00	1,294.00	1,554
14	1	1060883	Zobe	E	177.00	170.00	38.00	1,625
22	2	20205	Gurara	E	880.00	700.00	61.00	1,517
26	2	211	Jebba(main)	E	3,800.00	1,000.00	316.50	1,934
27	2	20813	Kangimi	E	74.10	59.30	9.30	1,528
29	2	20403	Omi	E	250.00	220.00	25.70	1,634
33	2	20809	Shiroro	E	7,000.00	6,050.00	300.00	1,711
38	2	202023	Usuma	E	120.00	100.00	8.90	1,536
39	2	20814	Zaria	E	15.90	12.42	5.60	1,511
43	3	31407	Dadin Kowa	E	2,800.00	1,770.00	290.00	1,633
45	3	31403	Kiri	E	615.00	290.00	107.00	1,756
59	6	608	Asejire	E	32.90	30.50	5.60	1,652
65	6	608	Erinle	E	94.00	92.50	17.20	1,587
70	6	60405	Ikere Gorge	E	690.00	565.00	53.00	1,629
81	6	604023_i	Oyan	E	270.00	265.00	44.00	1,713
86	8	8080745	Challawa Gorge	E	930.00	904.00	96.00	1,601
88	8	8080723	Gari	E	214.00	203.00	30.00	1,656
99	8	808077	Tiga	E	1,345.00	1,222.00	140.00	1,607
103	8	80807423	Watari	E	104.55	92.74	17.00	1,623
117	8	806	Alau	E	112.40	106.00	96.30	1,618
1006	4	406_i	Kashimbilla	U	500.00	390.65	46.34	1,647
1013	2	20814	Galma	U	186.00	145.32	19.85	1,505
1014	2	218	Kontagora (Auna)	U	340.00	180.00	33.39	1,691
2091	3	312	Mayo Belwa	P	240.00	187.51	29.58	1,754
2124	4	410	Shemankar	P	138.50	108.21	25.35	1,774
3001	3	30603_i	Baudeu	P	240.00	187.94	22.00	1,686
3004	3	30603_i	KoginBaba	P	290.00	226.49	21.80	1,623
3005	3	30202	Kwossa	P	400.00	312.52	20.40	1,675
3011	4	402	Ragwa	P	30.00	23.44	4.50	1,698
3012	3	318	Muleng	P	112.84	88.16	8.51	1,693
3501	6	608	Odedele	P	182.60	142.67	22.90	1,675
9001	3	321	Lagdo	E	8,000.00	4,570.00	800.00	1,750

Status: E=Existing, U=Under-construction, P=Proposed
Source: JICA Project Team

The followings are considered for water use by Fadama.

- In case that there are no significant dams, the loss of surface water by recharge in flood plain area is taken in to account in accordance with the abstraction of sub-surface water for water demand for Fadama. The total annual loss is set at the same volume as the annual water demand by Fadama, and the pattern of the loss is assumed to be proportional to river discharge.

[3] MODSIM-DSS is developed by Colorado State University. It supports the water allocation considering priorities among several multi-sector water users with Graphical User Interface. The software can be downloaded from its web-site http://modsim.engr.colostate.edu/ with free.

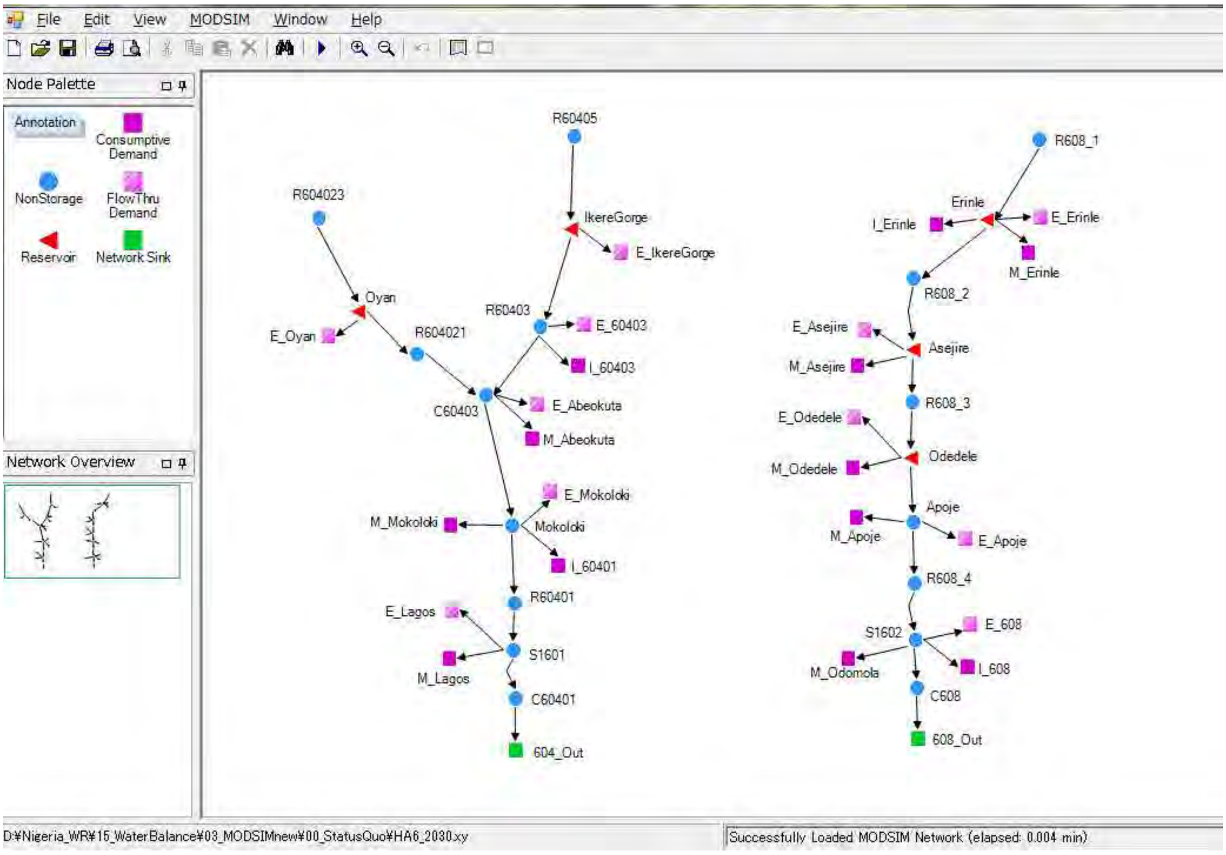
- In case that there are significant dams, the affected reach by the significant dams is firstly specified, and then the constant release of water in accordance with the annual water demand by Fadama in the specified reach is set as the obligatory release from the dams. It is also assumed that the released water is lost by recharge to the shallow groundwater aquifer in the flood plain.

In HA-8, the Catchment Management Plan (CMP) for the part of the HA has been prepared. On the basis of the CMP, the additional flow requirement with 86MCM/year is secured at the downstream reach of the Hadejia River for keeping the wetland area good condition.

In the water balance computation, the retune of used water is considered as follows (same as that used for Aggregated Water Balance within SHA).

- It is assumed that the return flow from urban water use is 10% of the demand at source.
- It is assumed that the return flow from irrigation water use is set at 10% of the demand at source. The delay of the return flow is considered. The factor of the delay is set at 0.5, which means that 50% of the return flow would return within a month, and the remaining is taken over to the next month.

The example of graphical view of the model network using MODSIM-DSS is shown in Figure SR3-18 (see Annex-F SR3-4 for other HAs).



Source: JICA Project Team

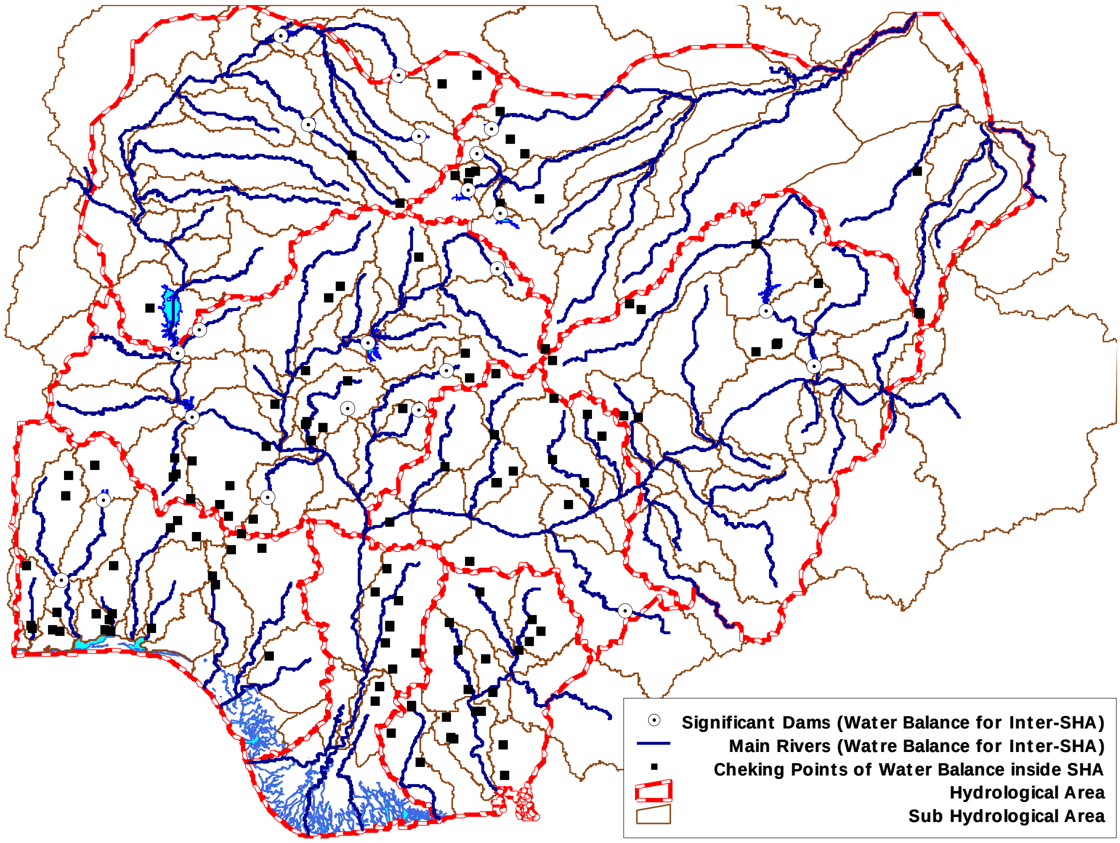
Figure SR3-18 Example of MODSIM-DSS Model Network

(5) Water Balance Study for Water Use Facilities whose source is in the Catchment Area of SHA

For the relatively large scale water use facilities whose source is in the catchment area of SHA, individual water balance is examined and accordingly necessary water resources development is proposed.

- Municipal Water Supply: water purification plants whose volume of water source is more than 3MCM/year (58 locations in total)
- Irrigation Water Supply: Existing large scale irrigation scheme whose planed area is more than 500ha (75 locations in total)

The locations of water balance to be examined are shown in Figure SR3-19.



Source: JICA Project Team

Figure SR3-19 Checking Points of Water Balance inside SHA

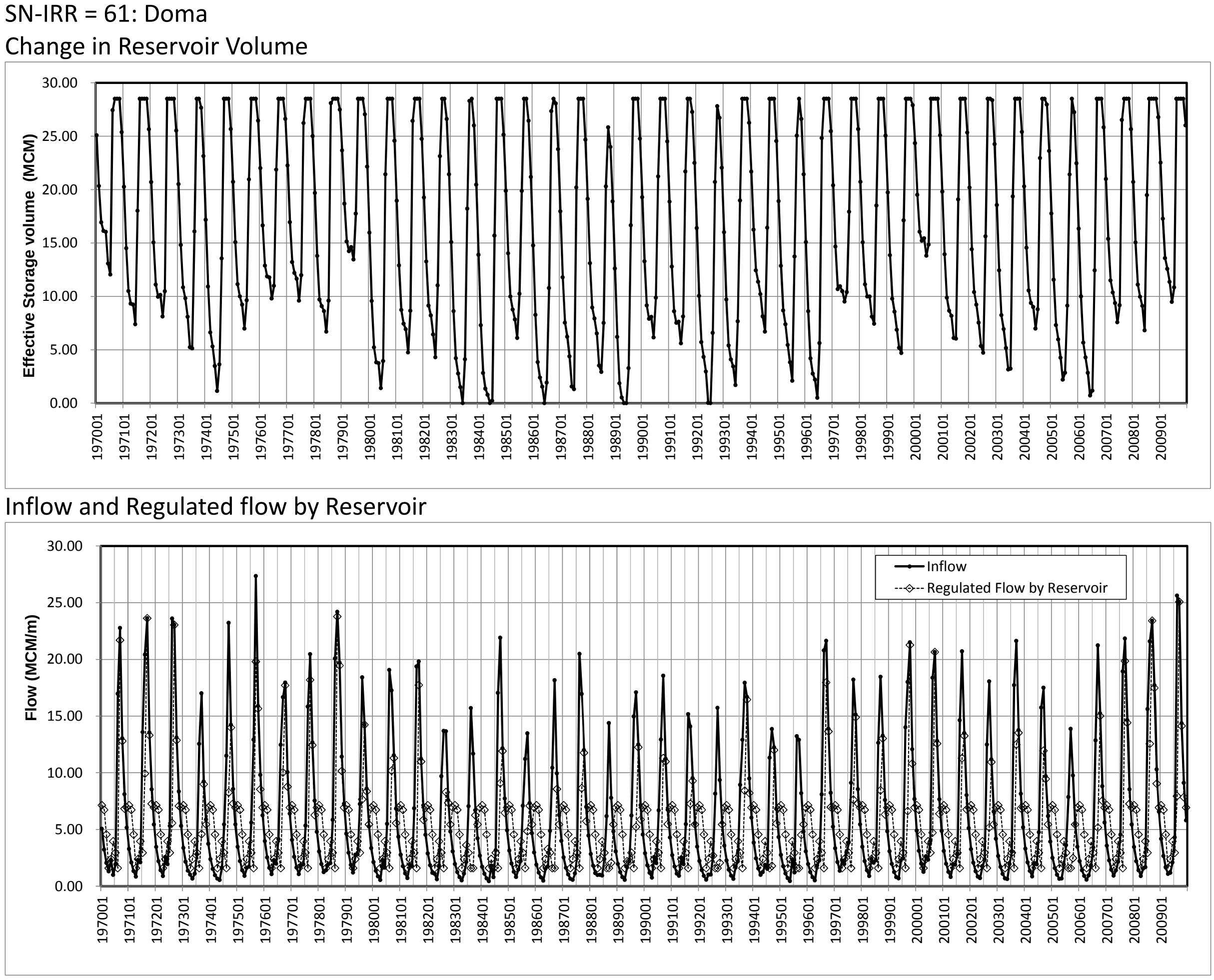
The following conditions are applied for the water balance study.

- Monthly flow pattern for SHA is given by the runoff affected by groundwater abstraction and water use for livestock and aquaculture which is shown in the above Items (1) and (2). Then, the monthly inflow at the checking point is computed by multiplying the ratio of total runoff volume at the checking point and the total runoff volume for the SHA where the checking point is located.
- When other water uses exist in upstream catchment, its catchment area is excluded for estimating inflow at the checking point.
- On the basis of minimum stream flow requirement at the downstream end of SHA, that at the checking point is also estimated by multiplying the ratio of total runoff volume at the checking point and the total runoff volume for the SHA where the checking point is located.
- In case that storage dam supplies water for both municipal and irrigation water, the priority storage zone for municipal water is set by trial and error so as to secure both the safety level of 80% yearly dependability for irrigation water use and that of 90% yearly dependability for municipal water use.

The list of checking points together with main conditions such as catchment area, water source and so on is shown in Annex-T SR3-6 to SR3-9.

An example of reservoir volume change as well as inflow and regulated flow by reservoir as a result of the water balance study is presented in Figure SR3-20.

For the municipal water supply, the available water supply volume with 90% yearly dependability is evaluated. For the irrigation water supply, the irrigable area with 80% yearly dependability in terms of available water supply is evaluated. These results are also shown in Annex-T SR3-7 to SR3-9.



Source: JICA Project Team

Figure SR3-20 Example of Change in Reservoir Volume, Inflow and Regulated Flow by Reservoir

(6) Water Balance Study for Potential Water Resources Development Sites

The water balance study for the potential water resources development sites (288 sites in total) shown in SR4 is also conducted. The results of the water balance study, together with roughly estimated cost for the construction, is utilized for evaluating economic efficiency of each site. The following is considered for the water balance study.

- It is assumed that the obligatory release associated with the existing water use by downstream water users within the same SHA in which the target new dam site is located, together with minimum stream flow requirement, are secured at first priority. The obligatory release is set based on the existing volume of water use and the ratio of the total runoff at the intake point of the existing water users and the runoff at the target new dam site.
- When other water uses exist in upstream catchment, its catchment area is excluded for estimating inflow at the potential dam site.

The main conditions such as catchment area, inflow volume, active storage volume, minimum stream flow requirement, and existing water use by downstream water users considered for each potential site are shown in Annex-T SR3-10.

For the municipal water supply, the available water supply volume with 90% yearly dependability is evaluated. For the irrigation water supply, the irrigable area with 80% yearly dependability in terms of available water supply is evaluated. These results are also shown in Annex-T SR3-10.

(7) Results of Water Balance Study

(7-1) Water Source for Municipal Water Supply

As the results of the water balance study for the relatively large scale water purification plants, it is evaluated that some water sources could experience the deficit for supplying necessary water volume with 90% yearly dependability (see Annex-T SR3-11).

The recommended measures against those deficit as well as the results of the water balance study are summarized in Table SR3-15. The municipal water supply plan in Section SR5.1 as well as surface water development plan in SR4 refers the recommendation shown in the table.

Table SR3-15 Evaluation of Water Source for Municipal Water Supply and Recommended Measures

State	Surface Water Demand (MCM/Year)		Deficit (2030) (MCM /year)	Recommended Measures for Water Source	Recommended Measures for Water Purification Plant
	2010	2030			
Abia	9.18	16.25	-15.05	1. Construction of new dam for Aba Scheme (Dam SN:4012 GS=3.4MCM)	
Adamawa	14.90	52.06	-3.68	1. Construction of new dam for Mubi Scheme (Dam SN:3013 GS=6MCM)	
Anambra	0.00	142.57	-68.71	1. Construction of new dam for Greater Awka Scheme (Dam SN:4009 GS=9.5MCM) 2. Construction of new dam for Ihiala Regional Scheme (Dam SN:4010 GS=3.4MCM) 3. Construction of new dam for Nnewi Regional Scheme (Dam SN:4011 GS=24.2MCM)	
Bauchi	8.66	21.46	0.00	1. Change water source of 3.88MCM at Gubi dam to Waya dam	1. Construction of new WTW at Waya dam instead of at Gubi dam (InsCap=20,000m^3/day) or construction of pipiline from Waya dam to Gubi dam to convey water.
Borno	12.13	27.90	-6.50	1. Installation of diversion weir in Yedseram R. for Alau/Maiduguri Scheme	
Cross River	23.91	60.06	-5.36	1. Construction of new dam for Ogoja Scheme(Dam SN:2245 GS=5.4MCM)	
Ebonyi	4.40	69.10	-7.78	1. Construction of new dam for Ishielu/Ezzilo Scheme (Dam SN:4016 GS=2.3MCM)	
Ekiti	32.25	86.58	-0.38	1. Change water source of 0.38MCM at Ureja dam to Ogbessee dam	1. Construction of new WTW at Ogbesse dam (InsCap=1,240m^3/day at least)
Enugu	13.34	24.83	-23.61	1. Construction of new dam for Ajali Scheme (Dam SN:2185 GS=16.9MCM)	
Imo	18.19	32.19	-31.16	1. Construction of new dam for Okigwe Scheme(Dam SN:4015 GS=9.2MCM) 2. Construction of new dam for Owerri/Otamiri Scheme(Dam SN:4002 GS=3.9MCM)	
Jigawa	2.52	4.46	-1.33	1. Deficit is converted to GW source (additional GW scheme with 1.27MCM(=1.33/1.05) or 3470m^3/day)	
Kaduna	63.45	161.66	-11.02	1. Construction of new dam for Kwoi Scheme(Dam SN:4017 GS=2.5MCM) 2. Construction of new dam for Kafanchan Scheme(Dam SN:4003 GS=3.1MCM) 3. Construction of new dam for Kachia Scheme(Dam SN:4004 GS=3.5MCM)	
Kano	52.32	296.11	-21.06	1. Change water source of 6.44MCM at Guzuguzu, 3.38MCM at Karaye dam and 10.93MCM at Watari dam to Challawa R.	1. Construction of new WTW along Challawa R. (InsCap=67,667m^3/day at least)
Katsina	27.62	52.05	-8.32	1. Change water source of 8.32MCM at Ajiwa dam to Zobe dam	1. Construction of new WTW at Zobe dam (InsCap=27,136m^3/day at least)
Kwara	27.28	48.29	-3.92	1. Construction of new dam for Oyun Scheme (Dam SN:2023 GS=18.9MCM)	
Lagos	93.71	678.51	-5.58	1. Construction of new dam for Otta Ikosi Scheme (Dam SN:2205 GS=20.6MCM)	1. Postponement of construction of the following WTWs (for demand up to 2030) 1) Yewa Phase-2 (WTW, Desalination) (InsCap=227,300m^3/day) 2) Odomola Phase-3 (WTW) (InsCap=431,870m^3/day)
Nasarawa	10.99	31.67	-15.89	1. Change water source of 3.09MCM at Lafia to Doma dam. 2. Construction of new dam for Keffi/Mada Scheme (Dam SN:4005 GS=3.1MCM)	1. Construction of new WTW at Doma dam (InsCap=10,078m^3/day at least)
Niger	31.57	62.77	-9.20	1. Construction of new dam for Bida Scheme	

State	Surface Water Demand (MCM/Year)		Deficit (2030) (MCM /year)	Recommended Measures for Water Source	Recommended Measures for Water Purification Plant
	2010	2030			
				(Dam SN:2067 GS=3.2MCM)	
Ogun	30.17	159.77	-15.21	1. Constructon of new dam for Ota Scheme (Dam SN:4014 GS=6.4MCM) 2. Construction of new dam for Ijebu-Ode/Yemoji Scheme (Dam SN:4018 GS=3.3MCM) 3. Construction of new dam for Ogere & Shagamu Scheme (Dam SN:2205 GS=20.6MCM)	1. Postponement of construction of the following WTWs (for demand upto 2030) 1) Yewa Regional-1 (WTW) (InsCap=100,000m^3/day) 2) Yewa Regional-2 (WTW) (InsCap=100,000m^3/day) 3) Apoje Regional-2 (WTW) (InsCap=200,000m3/day) 4) Mokoloki Regional Phase-2 (WTW) (InsCap=250,000m^3/day) 5) Mokoloki Regional Phase-3 (WTW) (InsCap=200,000m^3/day)
Oyo	43.49	205.58	-109.92	1. Constructon of proposed Odedele dam for Odedele/Ibadan Scheme (Dam SN:3501 GS=182MCM)	
Plateau	21.30	43.18	-13.33	1. Construction of new dam and change of water source of 13.33MCM at Yakubu Gowon/Jos Scheme to Barakin dam (Dam SN:4007 GS=20.1MCM)	1. Construction of new WTW at the new dam (Dam SN:4007) (InsCap=43,477m^3/day at least)
Zamfara	8.38	28.63	-10.59	1. Construction of new dam for Gusau Scheme (Dam SN:4008 GS=29.7MCM)	

Remarks
1) GS＝Gross storage volume
2) For the states that are not shown in the table, it is evaluated that the water source for the water purification plants whose volume of water source is more than 3MCM/year can be supplied with 90% yearly dependability.

Source: JICA Project Team

(7-2) Water Source for Irrigation Water Supply

As the results of the water balance study for the existing large irrigation schemes whose planned area is more than 500ha, it is evaluated that the irrigable area in terms of stable water supply with 80% yearly dependability is less than the planned area in some schemes. The evaluated irrigable area for these schemes is shown in Table SR3-16. The irrigation development plan in Section SR5.2 as well as surface water development plan in SR4 refers the evaluated results shown in the table.

Table SR3-16 Evaluation of Existing Irrigation Schemes in Terms of Availability of Water Source

SN	HA	Irrigation Scheme	Planned Area (ha)	Developed Area (ha)	Evaluated Irrigable Area(ha)	Remarks
1	1	Jibiya	3,500	3,000	2,300	In case that municipal water supply is prioritized.
2	1	Zobe	8,200	60	2,000	In case that municipal water supply is prioritized.
6	1	Sabke	1,200	540	130	In case that municipal water supply is prioritized.
7	1	Ajiwa	1,900	500	0	In case that municipal water supply is prioritized.
14	2	Omu-Aran	1,300	400	0	
19	2	Oke Oyi	500	100	60	
20	2	Oloru	500	20	0	
22	2	Oro-Ago	500	80	10	
25	2	Agaie/ Lapai	1,000	20	1,000	It is assumed that new dam (Dam SN：2028) is installed.
27	2	Duku-Lade	2,000	200	1,200	It is assumed that new dam (Dam SN：2043) is installed.
29	2	Guzan	1,500	400	0	
34	2	Zara	500	50	0	
35	2	Tubo	620	100	600	
37	2	Manta	500	300	0	Inundated by construction of Zungel dam
38	2	Badeggi	830	830	830	It is assumed that new dam (Dam SN：2066) is installed.
47	3	Wase	500	100	90	
50	3	Bagal	5,700	10	1,600	
51	3	Balanga	4,400	500	3,800	In case that municipal water supply is prioritized.
52	3	Kaititingo	2,300	0	0	
57	4	Longkat	2,000	800	1,100	In case that municipal water supply is prioritized.
62	4	Awe	500	0	80	
63	4	Umogidi	1,500	0	660	
66	4	Bokkos	1,000	18	370	
77	5	Ejule Ojebe	2,000	25	1,100	
78	5	Ofarachi	1,000	10	520	
80	5	Ada-Rice	5,000	1,000	1,000	
81	5	Uzo Uwani	1,000	315	50	
82	6	Upper Ogun	2,000	10	600	
83	6	Ofiki(A)	2,000	24	60	
85	6	Sepeteri(A)	2,000	24	30	
87	6	Iwo	1,000	0	0	
88	6	Ilero	2,000	0	70	
89	6	Otta	1,000	340	0	
90	6	Eyinwa	1,000	300	10	
91	6	Oke-Odan	600	250	400	
93	6	Okuku	600	0	30	
94	6	Igbonla	1,500	130	130	
96	6	Oye	500	100	0	
99	7	Nkari	2,080	0	610	
100	7	Ijegu Yala	2,000	80	910	
102	7	Imo (Igwu and Ibu)	1,200	80	0	In case that municipal water supply is prioritized.
105	7	Isi-Uzo	500	71	360	
107	7	Igbere	1,300	250	440	
109	7	Adim Rice	1,000	545	340	
110	7	Idomi	1,000	100	530	
115	8	Kano River Phase II	40,000	203	15,000	In case that municipal water supply is prioritized.
120	8	Jere Bowl Rice	1,300	0	0	In case that municipal water supply is prioritized.
122	8	Michika	500	200	0	
124	8	Gari	4,100	2,200	300	In case that municipal water supply is prioritized.
126	8	Jakara	2,000	820	430	
127	8	Baguwai (Watari)	872	273	0	In case that municipal water supply is prioritized.
130	8	Dembo	700	60	0	n case that municipal water supply is prioritized.
131	8	Guzuguzu	530	530	0	In case that municipal water supply is prioritized.
132	8	Magaga	600	300	70	In case that municipal water supply is prioritized.
133	8	Bagauda	610	300	430	
140	8	Gwarzo	600	0	0	In case that municipal water supply is prioritized.

Remarks: For the irrigation schemes which are not shown in the table, it is evaluated that the stable water supply with 80% yearly dependability can be secured for the planned irrigation area. It should be noted that the irrigation schemes whose source is wetland area or Lake Chad are not evaluated by the water balance study.
Source: JICA Project Team

(7-3) Hydropower Generation by Significant Dams

On the basis of the simulated results by the water balance study for the water demand in 2030, the hydropower generation by the significant dams as well as large hydropower dams (Kainji, Jebba, Shiroro) is estimated. The results are shown in Table SR3-17.

Table SR3-17 Estimated Hydropower Generation by Significant Dams

	Dam	Install Capacity (MW)	Average Generated Energy (GWh/year)	80% yearly dependable Generated Energy (GWh/year)	Remarks
1	Gurara	30	45.9	36.2	It is assumed that the hydropower is generated by the release from dam except the transferred water to Abuja.
2	Oyan	9	24.9	15.2	It is assumed that all released water is used for hydropower generation.
3	Ikere George	6	21.9	16.7	It is assumed that all released water is used for hydropower generation.
4	Bakolori	3	13.2	11.8	It is assumed that all released water is used for hydropower generation.
5	Dadin Kowa	34	94.6	80.2	It is assumed that the hydropower is generated by the release from dam except the water volume directly supplied to municipal water supply from dam.
6	Tiga	6	26.1	19.8	It is assumed that all released water is used for hydropower generation.
7	Kiri	20	60.4	47.3	It is assumed that the hydropower is generated by the release from dam except the water volume directly supplied to irrigation scheme from dam.
8	Jibiya	3	0.7	0.3	It is assumed that all released water is used for hydropower generation.
9	Challawa Gorge	6	10.6	5.7	It is assumed that all released water is used for hydropower generation.
10	Zobe	3	1.9	0.9	It is assumed that all released water is used for hydropower generation.
11	Omi	2	5.9	4.5	It is assumed that all released water is used for hydropower generation.
12	Kashimbilla	40	216.0	206.2	It is assumed that the hydropower is generated by the release from dam except the water volume directly supplied to municipal water supply from dam.
13	Kainji	500	1,825.9	1,325.7	It is assumed that all released water is used for hydropower generation. It is also assumed that almost constant volume with 80% yearly dependability is released.
14	Jebba	540	2,026.0	1,601.0	It is assumed that all released water is used for hydropower generation. It is also assumed that almost constant volume with 80% yearly dependability is released.
15	Shiroro	550	1,408.4	1,177.2	It is assumed that all released water is used for hydropower generation. It is also assumed that almost constant volume with 80% yearly dependability is released.

Remarks:
1) It is assumed that overall efficiency is 0.7.
2) As for Oyan, Ikere Gorge, Bakolori, Dadin Kowa, Kiri, Kainji, Jebbea, Shiroro dams whose H-V-A relation is available for the present project, the fluctuation of water level is taken into account for estimating hydropower generation. For other dams, the head is approximated at 50% of the maximum water depth for estimating hydropower generation.

Source: JICA Project Team

(7-4) Excess Storage Volume in Significant Dams

It is clarified that there could be excess storage volume in some significant dams, even if the demand for irrigation and municipal water supply in 2030 is considered. The possible additional water supply volume with 90% yearly dependability as well as excess storage volume is shown in Table SR3-18. The excess storage volume can be utilized for several different purposes such as irrigation, municipal water supply, enhancement of firm energy of hydropower generation, reduction of peak flood discharge and enhancement of river environment. It is necessary to discuss how to use the excess storage volume by stakeholders in each of hydrological area. It would be one of important topics during formulation of the CMP.

Table SR3-18 Excess Storage Volume in Significant Dams

No	Dam	HA	Effective Storage Volume (MCM)	Excess Storage Volume (MCM)	Location to Evaluate Possible Additional Water supply Volume	Possible Additional Water Supply Volume with 90% yearly dependability (MCM/year)
1	Jibiya	1	121	0		0
2	Zobe	1	170	0		0
3	Goronyo & Bakolori	1	1,336	906	Wamako	216
4	Galma	2	141	91	Downstream of Galma dam	132
5	Aula	2	180	150	Downstream of Aula dam	156
6	Gurara	2	700	700	Downstream of Gurara dam	708
7	Omi	2	220	190	Downstream of Omi dam	144
8	Usuma	2	100	0		0
9	Dadin Kowa & Kiri	3	3,090	2,540	Downstream of Kiri dam	2,280
10	Kashimbilla	4	378	368	Downstream of Kashimbilla dam	1,680
11	Oyan & Ikere Gorge	6	830	365	Intake point of Akute in Lagos State	360
12	Tiga & Challawa Gorge	8	2,126	0		0
13	Watari	8	93	0		0
14	Gari	8	203	0		0
15	Alau	8	106	0		0

Source: JICA Project Team

(7-5) Water Balance at Representative Points

The results of water balance study by MODSIM-DSS model at some representative points are presented in Annex-F SR3-5 and Annex-T SR3-12.

(7-6) Remarks on Water Balance Study

The water balance study in the present project has been conducted by utilizing the currently available data and information on water use facilities as well as the estimated water quasi-natural flow. There are also many assumptions such as the setting of minimum stream flow requirement. All of these may affect the results of the water balance study. It should be noted that the results of the water balance study are based on those data, information and the assumptions.

It is recommended that the effort to refine the estimation of flow condition by improving hydrological observation and the data/information on water use facilities be continued, in order to proceed to the next step for implementation of the water resources project. The refined water balance study should be conducted when the individual project will be implemented.

SR3.4.5 Estimation of Risk Associated with Climate Change and Trans-boundary Water

(1) Risk related to Water Supply-Demand Balance Associated with Climate Change

In order to estimate the risk on water supply-demand balance associated with climate change, the water balance study with the runoff and water demand considering under the climate change scenario of Case-1 shown in SR2. The Case-1 considers only changes in air temperature and gives smaller runoff compared to Case-2.

As the results of the water balance study for the relatively large scale water purification plants whose abstraction volume is more than 3MCM/year under the climate change scenario of Case-1, it is expected that the safety level of water supply could be lower than 90% yearly dependability in some places, as shown in Table SR3-19. There could be many intake points whose safety level is expected to be lower than 80% yearly dependability in HA-3 and 8. The impact of climate change on municipal water supply tends to be larger in these HAs.

As the results of the water balance study for the existing large irrigation schemes whose planned area is more than 500ha under the climate change scenario of Case-1, it is expected that the available irrigation area in terms of stable water supply with 80% yearly dependability could decrease in some irrigation schemes, as shown in Table SR3-20. The significant reduction could be expected in HA-8, in which both irrigation and municipal water demand are large.

Although it is evaluated that there is the excess storage volume in Oyan and Ikere Gorge dams in the Ogun river basin in HA-6 in case of base climate condition, the excess volume becomes zero in case of climate change of Case-1, because of the significant reduction of runoff in the river basin and subsequently the lowered turn-over rate in these dams. Furthermore, it is executed that the safety level of municipal water supply could become lower than 90% yearly dependability in Oshun river basin.

In HA-8, supplying stable water to Kano River Phase-2 with 40,000ha could become impossible. Furthermore, the available irrigation area in Hadejia Valley could become to about 3,000ha.

Table SR3-19 Estimated Lowering on Safety Level for Municipal Water Supply by Climate Change Scenario of Case-1

HA	Number of Water Sources for Municipal Water Supply				
	More than 90% yearly dependability	80-90% yearly dependability	50-80% yearly dependability	Less than 50% yearly dependability	Total
1	5	4	1	0	10
2	9	5	1	0	15
3	8	0	1	2	11
4	10	0	0	0	10
5	6	0	0	0	6
6	19	5	1	0	25
7	7	5	0	0	12
8	8	3	4	0	15

Source: JICA Project Team

Table SR3-20 Reduction of Irrigable Area in Terms of Stable Water Supply in Case of Climate Change Scenario of Case-1

HA	Ratio of Irrigable Area in case of climate change scenario of case-1 and that of base climate condition (%)
1	92
2	94
3	87
4	84
5	93
6	99
7	97
8	52

Remarks: Only the results for the large irrigation scheme whose planned area is more than 500ha are compiled.
Source: JICA Project Team

The hydropower generation by the significant dams as well as large hydropower dams (Kainji, Jebba, Shiroro) could be reduced to 60-90% of the base climate condition, in case of climate change scenario of Case-1, as shown in Table SR3-21.

Table SR3-21 Reduction of Hydropower Generation in Case of Climate Change Scenario of Case-1

	Dam	Install Capacity (MW)	Ratio of average hydropower generation in case of climate change scenario of case-1 and that of base climate condition (%)
1	Gurara	30	77
2	Oyan	9	73
3	Ikere George	6	81
4	Bakolori	3	78
5	Dadin Kowa	34	81
6	Tiga	6	73
7	Kiri	20	78
8	Jibiya	3	47
9	Challawa Gorge	6	63
10	Zobe	3	63
11	Omi	2	76
12	Kashimbilla	40	97
13	Kainji	500	87
14	Jebba	540	87
15	Shiroro	550	75

Source: JICA Project Team

(2) Risk related to Water Supply-Demand Balance Associated with Trans-boundary Water

As discussed in SR2, about 24% of the total water resources potential in Nigeria relies on trans-boundary water. Because most of the trans-boundary water is the inflow through the Niger and Benue rivers, the impact of trans-boundary water would mainly appear along the main course of the Niger and Benue rivers.

There are large hydropower dams constructed along the main course of the Niger River. It is possible that hydropower generation by these dams be affected by the change in inflow from the upstream countries. Although it is difficult to predict the change in the inflow, the effect on the hydropower generation is estimated under the scenario that the average inflow would be reduced.

The scenarios are that only average inflow volume is reduced by 10, 30 and 50%, with the flow pattern unchanged with the past 40years (1970-2009) at Malanville in Benin. The water balance study with these scenarios is examined. The estimated hydropower generation at Kainji and Jebba dams is shown in Table SR3-22. The reduction rate of generated energy is almost same as that of inflow to Nigeria when the reduction rate is small, however, the higher reduction rate the lower impact on generated power.

Table SR3-22 Reduction of Hydropower Generation of Kainji and Jebba Dams due to Reduction of Inflow from Upstream Countries of Niger River

Dam	Reduction Rate of hydropower generation against base vase (Last 40yeras (1970-2009))		
	10% Reduction of average inflow	30% Reduction of average inflow	50% Reduction of average inflow
Kainji	-9%	-23%	-38%
Jebba	-6%	-18%	-30%

Source: JICA Project Team

In addition to the long-term regime change of inflow, sudden change in flow due to operation of dams in upstream countries should be taken care. In order to flexibly cope with the sudden change in flow condition, the real-time monitoring of flow condition as well as close communicant and information exchange with neighboring countries should be established.

Annex-T SR3-1 Supply Capacities with Storage Dams at Downstream End of SHAs (1/3)

HA	SHA	SN-SHA	Area (km2)	Quasi-Natural Flow		MSFR (MCM/y)	Available Water (Supply Capacity - MSFR)					
							Quasi-Natural		With Existing Dams		With Existing +Under Construction Dams	
				Qave (m3/s)	Q_{97DS}90%Y (m3/s)		Q90%Y (MCM/y)	Q80%Y (MCM/y)	Q90%Y (MCM/y)	Q80%Y (MCM/y)	Q90%Y (MCM/y)	Q80%Y (MCM/y)
1	101	1	9,355.4	1,112.8	17.2	544	34	367	1,190	1,665	1,208	1,666
	102	2	9,127.2	52.4	0.1	3	0	0	30	34	30	34
	103	3	3,387.3	1,027.2	17.0	536	34	369	670	1,005	676	1,006
	104	4	2,933.6	11.0	0.0	0	0	0	0	0	0	0
	105	5	3,456.6	1,003.4	17.0	535	0	370	666	1,006	667	1,007
	10601	6	689.1	138.5	0.5	15	0	24	663	661	687	667
	10602	7	10,960.3	36.6	0.4	13	0	15	0	12	0	12
	10603	8	1,084.9	100.8	0.1	2	0	1	663	598	688	604
	10604	9	17,476.6	36.6	0.0	1	0	2	0	2	0	2
	10605	10	6,335.9	63.2	0.0	0	0	0	652	597	672	597
	10606	11	5,817.2	4.5	0.0	0	0	0	0	0	0	0
	10607	12	2,706.1	56.8	0.0	0	0	0	637	638	660	641
	106081	13	2,220.3	0.2	0.0	0	0	0	0	0	0	0
		14	4,132.3	31.1	0.0	0	0	0	281	432	281	433
	106082	15	80,006.8	4.3	0.0	0	0	0	12	20	19	22
		16	1,322.2	4.5	0.0	0	0	0	12	20	19	22
		17	6,043.4	2.0	0.0	0	0	0	12	20	19	22
	106083	18	412.5	25.6	0.0	0	0	0	281	405	281	405
	106085	19	290.3	0.0	0.0	0	0	0	0	0	0	0
		20	1,499.6	25.5	0.0	0	0	0	74	89	74	89
	1060861	21	6,067.9	3.3	0.0	0	0	0	22	28	22	28
		22	164.7	3.4	0.0	0	0	0	22	28	22	28
		23	548.0	2.5	0.0	0	0	0	22	28	22	28
	1060863	24	3,509.3	2.2	0.0	0	0	0	6	6	6	6
	106087	25	632.3	0.1	0.0	0	0	0	0	0	0	0
		26	1,216.5	22.0	0.0	0	0	0	60	71	60	71
	1060881	27	5,750.6	10.2	0.0	0	0	0	60	72	60	72
	1060883	28	2,513.8	6.4	0.0	0	0	0	2	2	2	2
	106089	29	8,354.1	11.5	0.0	0	0	0	9	11	9	11
	106091	30	7,636.2	24.8	0.0	0	0	0	414	439	414	439
	106093	31	4,746.6	22.5	0.0	0	0	0	18	23	18	23
	107	32	1,924.1	4.9	0.0	1	0	1	0	1	0	1
		33	6,223.4	855.2	15.4	486	0	272	0	151	0	151
	108	34	63,517.4	4.3	0.0	0	0	0	0	0	0	0
		35	7,724.9	3.0	0.0	0	0	0	0	0	0	0
	109	36	14,037.5	836.1	14.3	451	0	136	0	136	0	136
2	201	37	2,646.9	2,136.9	63.2	1,993	3	572	33,647	35,927	33,987	36,023
	20201	38	5,088.0	163.1	10.2	322	26	86	1,166	1,282	1,166	1,282
	202021	39	2,739.0	29.4	1.8	56	4	10	292	305	292	305
	202023	40	190.7	2.8	0.2	7	0	1	0	1	0	1
	20203	41	4,599.3	94.0	6.3	197	7	41	900	924	900	924
	20205	42	2,636.8	39.7	2.6	83	0	0	4	9	4	9
	203	43	4,436.7	1,954.7	49.9	1,573	0	323	32,772	34,448	31,969	34,614
	20401	44	5,985.0	35.5	0.1	3	0	4	225	271	225	271
	20403	45	1,596.0	10.1	0.0	1	0	1	5	9	5	9
	205	46	375.0	1,892.0	46.4	1,464	0	257	31,916	34,513	31,293	34,694
	206	47	7,358.0	40.9	0.3	8	0	0	160	167	160	167
	207	48	1,056.1	1,849.8	46.1	1,455	0	243	31,925	34,346	31,139	34,527
	20801	49	1,936.8	496.4	8.3	262	26	86	7,052	7,361	7,143	7,453
	20802	50	2,240.6	12.6	0.0	1	0	0	0	0	0	0
	20803	51	725.1	475.9	8.1	256	32	108	7,088	7,366	7,149	7,459
	20804	52	17,359.5	129.9	0.3	9	0	0	32	35	32	35
	20805	53	4,325.9	342.5	7.7	244	32	83	7,067	7,354	7,165	7,458
	20806	54	3,503.9	27.4	0.1	2	0	0	0	0	0	0
	20807	55	557.0	281.6	7.6	239	31	88	7,013	7,276	7,013	7,276
	20809	56	3,692.3	278.0	7.6	239	31	88	277	356	517	613
	20810	57	3,449.6	36.5	1.9	61	2	14	2	20	2	20
	20811	58	1,561.0	203.8	3.1	98	0	22	287	322	531	591
	20812	59	5,919.2	27.6	0.3	9	0	1	15	21	16	21
	20813	60	2,483.4	161.8	1.6	50	0	10	310	344	533	593
	20814	61	6,713.9	35.1	0.0	0	0	0	50	62	288	322
	20815	62	10,882.2	104.4	0.5	15	0	1	40	45	40	45
	209	63	15,015.3	1,350.8	34.1	1,077	0	218	25,742	27,077	25,970	27,158
	211	64	6.2	1,290.6	29.2	920	44	309	24,140	25,640	24,203	25,640
	212	65	6,740.8	29.3	0.0	0	0	0	83	118	83	118
	213	66	4,145.9	1,261.3	27.5	867	0	0	24,183	25,693	24,181	25,693
	214	67	257.9	1.3	0.0	0	0	0	0	1	0	1
		68	9,792.7	44.5	0.1	3	0	0	0	1	0	1
	215	69	2,109.7	1,200.4	22.1	696	0	224	24,314	25,864	24,314	25,864
	216	70	3,698.9	18.4	0.0	0	0	0	0	0	0	0
		71	7,957.2	55.2	0.1	3	0	2	0	2	0	2
	217	72	127.2	1,137.0	18.0	569	9	333	24,441	25,991	24,441	25,991
	218	73	4,644.4	23.7	0.0	1	0	1	41	50	311	330
	219	74	19.0	1,112.8	17.2	544	34	367	24,466	26,016	24,466	26,016

MSFR =Minimum Stream Flow Requirement

Annex-T SR3-1 Supply Capacities with Storage Dams at Downstream End of SHAs (2/3)

HA	SHA	SN-SHA	Area (km2)	Quasi-Natural Flow		MSFR (MCM/y)	Available Water (Supply Capacity - MSFR)					
							Quasi-Natural		With Existing Dams		With Existing +Under Construction Dams	
				Qave (m3/s)	Q_{97DS}90%Y (m3/s)		Q90%Y (MCM/y)	Q80%Y (MCM/y)	Q90%Y (MCM/y)	Q80%Y (MCM/y)	Q90%Y (MCM/y)	Q80%Y (MCM/y)
3	30201	75	587.0	398.7	14.0	443	0	49	0	49	0	49
	30202	76	5,145.8	89.7	0.3	10	0	0	0	0	0	0
	30203	77	2,826.1	78.0	3.6	114	6	22	6	22	6	22
		78	11,384.8	307.0	13.5	427	0	45	0	45	0	45
	303	79	1,463.0	1,388.2	16.5	520	8	147	2,195	2,372	2,306	2,545
	304	80	4,997.2	34.2	0.2	7	0	1	21	25	21	25
	305	81	808.7	1,348.3	16.1	506	10	156	2,184	2,354	2,258	2,527
	30601	82	2,266.4	292.1	0.9	30	0	4	0	4	0	4
	30602	83	5,395.0	51.0	0.0	1	0	0	0	0	0	0
	30603	84	559.0	13.0	0.1	2	0	0	0	0	0	0
		85	13,799.2	229.0	0.8	25	0	3	0	3	0	3
	307	86	5,737.4	1,053.4	12.2	385	40	106	1,638	2,465	1,607	2,593
	308	87	15,173.5	75.9	0.1	4	0	4	0	4	0	4
	309	88	87.1	952.8	11.8	371	19	108	901	2,472	920	2,599
	310	89	2,512.7	15.2	0.1	4	0	1	0	1	0	1
	311	90	11,883.8	937.4	11.5	363	21	116	768	2,445	755	2,557
	312	91	2,748.4	13.8	0.1	2	0	1	5	7	5	7
	313	92	48.5	869.4	10.7	338	28	95	313	2,461	306	2,573
	31401	93	717.6	163.4	1.0	33	0	11	2,337	2,593	2,337	2,593
	31403	94	1,658.9	161.0	1.0	33	0	11	2,060	2,271	2,060	2,271
	31404	95	11,229.0	35.2	0.0	0	0	0	0	0	0	0
	31405	96	6,890.1	119.8	0.9	30	0	11	2,064	2,285	2,064	2,285
	31407	97	7,702.1	98.4	0.9	28	0	10	296	327	296	329
	31408	98	5,303.7	6.8	0.0	0	0	0	0	0	0	0
	31409	99	19,178.0	77.9	0.9	28	0	5	296	328	296	329
	315	100	1,616.6	706.0	7.3	232	8	114	0	26	75	139
	316	101	5,536.5	41.0	0.4	13	0	2	0	2	113	123
	317	102	3,400.3	661.4	6.9	218	11	126	0	25	0	25
	318	103	5,441.5	18.2	0.1	2	0	1	0	1	0	1
	319	104	2,088.9	6.4	0.0	0	0	1	0	1	0	1
		105	1,726.6	632.2	6.4	203	7	125	0	11	0	11
	320	106	25,211.5	283.0	5.3	168	6	47	6	54	5	54
		107	2,106.7	14.6	0.2	8	0	1	0	1	0	1
	321	108	65,499.3	338.2	0.7	21	0	9	0	0	0	0
4	401	109	3,642.9	3,244.0	129.5	4,083	513	1,545	2,496	3,993	4,177	5,097
	402	110	9,075.9	100.6	6.6	208	26	60	32	65	32	65
	403	111	4,906.6	3,118.7	115.2	3,634	440	1,022	2,623	3,662	4,139	5,006
	404	112	9,347.8	122.0	9.4	297	15	47	488	516	488	516
	405	113	11,303.0	2,959.0	98.4	3,102	187	830	2,259	3,283	3,720	4,578
	406	114	10,331.5	477.0	17.5	551	0	58	0	65	1,861	2,282
		115	12,618.8	857.1	27.2	857	0	259	0	266	1,797	2,312
	407	116	4,277.1	2,000.9	40.5	1,277	0	218	2,329	2,647	2,438	2,759
	408	117	10,587.4	125.3	1.6	50	0	8	38	48	38	48
	409	118	2,471.0	1,845.2	37.4	1,180	0	155	2,270	2,552	2,369	2,663
	410	119	4,839.1	39.8	0.3	10	0	2	40	48	40	48
	411	120	1,449.1	1,792.3	36.2	1,141	0	143	2,258	2,531	2,259	2,642
5	500	121	19,112.1	817.9	86.3	2,721	133	351	133	351	133	351
	502	122	3,156.9	69.2	6.8	215	0	25	0	25	35	54
	50401	123	1,580.8	5,667.7	312.9	9,869	850	2,851	33,574	38,291	34,416	38,491
	50402	124	14,104.9	156.4	10.8	340	44	113	44	118	68	141
	50403	125	11,821.3	5,478.3	290.1	9,149	647	2,819	33,670	38,420	34,682	38,585
	506	126	4,137.6	98.0	9.1	288	6	38	6	38	6	38
6	60001	127	2,701.1	32.1	0.4	11	0	5	0	5	0	5
	60002	128	8,252.4	271.1	27.8	877	0	156	0	156	0	156
	601	129	391.8	1.9	0.0	0	0	0	0	0	0	0
	602	130	844.5	2.1	0.0	0	0	0	0	0	0	0
		131	3,311.6	12.0	0.0	0	0	0	10	12	10	12
	603	132	1,965.7	14.0	0.0	1	0	0	0	0	0	0
	60401	133	2,034.9	101.8	0.0	1	0	1	491	632	635	870
	604021	134	168.9	39.9	0.0	0	0	0	318	380	318	380
	604023	135	72.9	0.4	0.0	0	0	0	0	0	0	0
		136	9,040.6	39.3	0.0	0	0	0	6	9	17	9
	60403	137	6,011.7	52.1	0.0	1	0	0	473	536	473	536
	60405	138	4,704.2	23.9	0.0	0	0	0	13	15	13	15
	605	139	2,167.8	17.3	0.0	1	0	1	0	1	0	1
	606	140	3,425.1	23.3	0.1	2	0	2	19	27	19	27
	607	141	325.1	3.2	0.0	0	0	0	0	1	0	1
	608	142	9,764.4	75.0	0.3	8	0	3	400	460	400	460
	609	143	113.5	1.3	0.0	0	0	0	0	0	0	0
	610	144	6,462.0	56.7	0.3	10	0	15	0	14	53	14
	611	145	4,227.7	59.4	1.2	39	0	0	0	0	0	0
	612	146	5,869.5	76.3	1.8	56	0	5	70	86	196	86
	614	147	13,271.7	131.6	6.8	215	0	89	277	495	487	495
	616	148	8,417.4	173.1	14.7	462	29	166	42	181	42	181
	617	149	1,896.8	57.1	5.2	164	4	29	8	29	8	29
	699	150	4,809.4	25.0	0.0	0	0	0	0	0	0	0

MSFR =Minimum Stream Flow Requirement

Annex-T SR3-1 Supply Capacities with Storage Dams at Downstream End of SHAs (3/3)

HA	SHA	SN-SHA	Area (km2)	Quasi-Natural Flow		MSFR (MCM/y)	Available Water (Supply Capacity - MSFR)					
							Quasi-Natural		With Existing Dams		With Existing +Under Construction Dams	
				Qave (m3/s)	Q_{97DS}90%Y (m3/s)		Q90%Y (MCM/y)	Q80%Y (MCM/y)	Q90%Y (MCM/y)	Q80%Y (MCM/y)	Q90%Y (MCM/y)	Q80%Y (MCM/y)
7	702	151	8,146.5	292.6	47.1	1,485	87	289	87	289	87	289
	703	152	4,318.8	173.4	29.3	924	76	197	76	197	76	197
	70401	153	6,054.6	1,831.9	94.4	2,976	115	601	114	662	211	736
	70402	154	7,090.9	144.4	2.8	88	0	11	0	11	128	173
	70403	155	3,625.5	1,506.3	61.3	1,934	23	646	23	498	23	534
	704041	156	1,236.3	411.4	5.2	164	0	26	0	45	0	193
	704042	157	7,702.7	203.3	2.4	74	0	18	13	41	0	41
	704043	158	7,382.6	168.5	1.5	46	0	0	0	0	177	177
	70405	159	13,407.4	750.7	36.0	1,135	53	153	53	153	53	153
		160	6,028.1	1,010.7	45.5	1,434	138	266	138	266	138	266
	705	161	5,854.2	234.5	42.7	1,347	182	281	182	281	182	281
8	800	162	5,221.9	0.6	0.0							
	802	163	13,857.3	7.7	0.0	0	0	0	0	0	0	0
		164	2,422.8	8.3	0.0	0	0	0	0	0	0	0
	80401	165	4,647.6	13.5	0.0	0	0	0	0	0	0	0
	80402	166	626.1	0.6	0.0	0	0	0	0	0	0	0
		167	7,171.8	4.2	0.0	0	0	0	0	0	0	0
	80403	168	253.1	0.6	0.0	0	0	0	0	0	0	0
		169	6,656.5	7.9	0.0	0	0	0	0	0	0	0
	806	170	21,903.0	13.4	0.0	0	0	0	48	54	48	54
	807	171	14,280.8	2.6	0.0	0	0	0	0	0	0	0
	80801	172	1,438.6	0.0	0.0							
		173	946.1	11.8	0.3							
	80802	174	30,141.6	9.1	0.0							
	80803	175	8,391.9	0.2	0.0							
		176	1,528.3	30.2	0.3							
	80804	177	21,200.9	1.3	0.0							
		178	6,230.7	2.1	0.0							
	80805	179	9,381.6	27.6	0.3							
	808061	180	5,200.0	87.3	0.0	0	0	0	87	90	87	90
	808062	181	6,129.6	20.2	0.0	0	0	0	2	2	2	2
	808063	182	12,632.1	61.7	0.0	0	0	0	73	74	73	74
	808071	183	274.9	36.5	0.0							
	8080721	184	19,574.1	2.6	0.0							
		185	18,041.8	12.2	0.0	0	0	0	72	108	72	108
	8080723	186	1,145.5	1.0	0.0	0	0	0	6	6	6	6
	808073	187	9,609.9	60.1	0.0	0	0	0	888	1,178	911	1,214
	8080741	188	244.3	23.5	0.0	0	0	0	360	443	360	443
	80807421	189	861.8	2.7	0.0	0	0	0	12	5	12	5
	80807423	190	653.9	1.1	0.0	0	0	0	0	0	0	0
	8080743	191	1,581.2	20.3	0.0	0	0	0	365	443	365	443
	8080745	192	3,841.5	16.8	0.0	0	0	0	22	28	55	64
	808075	193	1,196.2	32.6	0.0	0	0	0	612	762	612	762
	808077	194	6,537.9	30.4	0.0	0	0	0	28	30	28	30

MSFR =Minimum Stream Flow Requirement

Annex-T SR3-2 Reduction of Runoff by Groundwater Abstraction and Water Use for Livestock/Aquaculture (1/3)

SN	HA	SHA	Quasi - Natural (MCM/year)	2010		2030	
				with GW Abstraction (MCM/year)	with GW abstrcaton + Water Use for Livestock /Aquaculture (MCM/year)	with GW Abstraction (MCM/year)	with GW abstrcaton + Water Use for Livestock /Aquaculture (MCM/year)
1	1	101	1,045	994	994	995	957
2	1	102	1,654	1,556	1,556	1,557	1,552
3	1	103	402	380	380	381	362
4	1	104	348	329	329	329	329
5	1	105	308	293	293	294	294
6	1	10601	34	31	31	31	31
7	1	10602	1,156	1,067	1,066	1,068	1,068
8	1	10603	30	28	28	28	28
9	1	10604	1,156	1,093	1,090	1,093	1,095
10	1	10605	61	59	58	59	60
11	1	10606	141	131	129	131	110
12	1	10607	26	25	24	25	25
13	1	106081_e	5	5	5	5	5
14	1	106081_i	27	26	25	26	16
15	1	106082_e	73	73	73	73	73
16	1	106082_i1	5	5	5	5	5
17	1	106082_i2	64	61	60	61	41
18	1	106083	2	2	2	2	2
19	1	106085_e	1	1	1	1	1
20	1	106085_i	6	6	6	6	6
21	1	1060861_e	25	25	25	25	25
22	1	1060861_i1	0	0	0	0	0
23	1	1060861_i2	9	9	9	9	9
24	1	1060863	71	69	68	69	70
25	1	106087_e	3	3	3	3	3
26	1	106087_i	5	5	5	5	5
27	1	1060881	117	114	113	114	115
28	1	1060883	203	194	193	194	193
29	1	106089	364	352	351	352	349
30	1	106091	76	73	72	73	74
31	1	106093	706	679	678	679	650
32	1	107_e	153	139	139	139	139
33	1	107_i	313	286	285	286	286
34	1	108_e	94	94	94	94	94
35	1	108_i	40	40	38	40	39
36	1	109	1,085	982	982	983	983
37	2	201	600	586	585	586	587
38	2	20201	1,251	1,220	1,220	1,221	1,221
39	2	202021	840	819	819	820	812
40	2	202023	87	85	85	85	86
41	2	20203	1,711	1,665	1,665	1,667	1,669
42	2	20205	1,253	1,219	1,219	1,221	1,213
43	2	203	861	841	841	842	841
44	2	20401	801	791	790	791	790
45	2	20403	318	313	313	313	300
46	2	205	42	42	42	42	42
47	2	206	1,290	1,269	1,269	1,270	1,153
48	2	207	84	84	84	84	84
49	2	20801	247	244	244	244	243
50	2	20802	398	392	392	392	392
51	2	20803	112	110	110	110	110
52	2	20804	4,097	4,031	4,029	4,034	3,954
53	2	20805	1,055	1,038	1,038	1,039	1,026
54	2	20806	864	850	850	851	848
55	2	20807	114	112	112	112	112
56	2	20809	1,189	1,158	1,158	1,160	1,160
57	2	20810	1,150	1,119	1,119	1,121	1,116
58	2	20811	456	444	444	444	444
59	2	20812	875	860	859	861	854
60	2	20813	700	685	684	685	685
61	2	20814	1,108	1,093	1,092	1,094	1,092
62	2	20815	3,293	3,237	3,236	3,240	3,236
63	2	209	1,896	1,871	1,870	1,872	1,836
64	2	211	1	1	1	1	1
65	2	212	924	911	910	912	858
66	2	213	519	512	512	512	512
67	2	214_e	40	39	39	39	39
68	2	214_i	1,363	1,343	1,342	1,344	1,342
69	2	215	257	253	253	254	254
70	2	216_e	581	573	573	573	573
71	2	216_i	1,159	1,142	1,142	1,143	1,143
72	2	217	17	16	16	16	16
73	2	218	747	736	736	737	732
74	2	219	1	1	1	1	1

Annex-T SR3-2 Reduction of Runoff by Groundwater Abstraction and Water Use for Livestock/Aquaculture (2/3)

SN	HA	SHA	Quasi - Natural (MCM/year)	2010		2030	
				with GW Abstraction (MCM/year)	with GW abstrcaton + Water Use for Livestock /Aquaculture (MCM/year)	with GW Abstraction (MCM/year)	with GW abstrcaton + Water Use for Livestock /Aquaculture (MCM/year)
75	3	30201	63	62	62	62	62
76	3	30202	2,831	2,766	2,766	2,770	2,770
77	3	30203_e	2,458	2,407	2,407	2,410	2,410
78	3	30203_i	7,211	7,066	7,066	7,074	7,074
79	3	303	177	175	175	175	175
80	3	304	1,080	1,064	1,063	1,065	1,031
81	3	305	89	88	88	88	88
82	3	30601	382	376	376	376	377
83	3	30602	1,609	1,579	1,579	1,581	1,581
84	3	30603_e	410	402	402	402	402
85	3	30603_i	6,813	6,683	6,683	6,690	6,690
86	3	307	781	771	770	771	770
87	3	308	2,393	2,360	2,358	2,362	2,363
88	3	309	6	6	6	6	6
89	3	310	480	473	473	474	474
90	3	311	1,706	1,684	1,683	1,685	1,685
91	3	312	436	431	430	431	431
92	3	313	2	2	2	2	2
93	3	31401	74	73	73	73	73
94	3	31403	189	187	186	187	187
95	3	31404	1,109	1,096	1,095	1,097	1,085
96	3	31405	675	667	666	667	630
97	3	31407	433	429	428	429	431
98	3	31408	213	212	211	212	212
99	3	31409	2,458	2,426	2,423	2,427	2,362
100	3	315	116	114	114	114	115
101	3	316	1,292	1,273	1,272	1,274	1,177
102	3	317	343	337	336	337	337
103	3	318	575	563	562	563	561
104	3	319_e	201	197	197	198	198
105	3	319_i	145	142	142	142	142
106	3	320_e	8,464	8,286	8,286	8,296	8,296
107	3	320_i	462	452	452	453	452
108	3	321	10,656	10,556	10,556	10,561	10,561
109	4	401	777	772	772	772	765
110	4	402	3,174	3,153	3,152	3,153	3,152
111	4	403	1,190	1,183	1,183	1,183	1,182
112	4	404	3,846	3,821	3,820	3,820	3,762
113	4	405	3,183	3,166	3,165	3,165	3,146
114	4	406_e	15,041	14,916	14,916	14,913	14,913
115	4	406_i	11,996	11,900	11,899	11,898	11,879
116	4	407	958	954	954	954	939
117	4	408	3,953	3,934	3,932	3,933	3,917
118	4	409	413	411	411	411	412
119	4	410	1,257	1,251	1,249	1,250	1,231
120	4	411	170	169	169	169	169
121	5	500	25,792	25,582	25,566	25,583	25,594
122	5	502	2,182	2,165	2,152	2,165	2,146
123	5	50401	1,041	1,033	1,029	1,033	1,029
124	5	50402	4,932	4,896	4,894	4,896	4,792
125	5	50403	3,072	3,050	3,046	3,050	3,008
126	5	506	3,091	3,066	3,064	3,066	3,038
127	6	60001	1,012	988	987	989	993
128	6	60002	8,549	8,268	8,242	8,283	8,249
129	6	601	60	59	59	59	59
130	6	602_e	65	64	64	64	64
131	6	602_i	313	307	307	308	304
132	6	603	443	433	432	434	462
133	6	60401	310	303	303	304	298
134	6	604021	17	17	17	17	17
135	6	604023_e	12	12	12	12	12
136	6	604023_i	1,229	1,213	1,209	1,214	1,203
137	6	60403	891	880	877	880	867
138	6	60405	753	744	741	744	739
139	6	605	547	304	303	304	294
140	6	606	734	925	923	926	909
141	6	607	101	128	128	129	129
142	6	608	2,365	2,328	2,317	2,330	2,173
143	6	609	42	41	41	41	41
144	6	610	1,787	1,747	1,739	1,749	1,720
145	6	611	1,872	1,828	1,827	1,830	1,831
146	6	612	2,399	2,342	2,342	2,345	2,316
147	6	614	4,149	4,025	4,023	4,032	3,956
148	6	616	5,457	5,283	5,274	5,292	5,285
149	6	617	1,799	1,740	1,732	1,744	1,734
150	6	699	789	778	777	779	777

Annex-T SR3-2 Reduction of Runoff by Groundwater Abstraction and Water Use for Livestock/Aquaculture (3/3)

SN	HA	SHA	Quasi - Natural (MCM/year)	2010		2030	
				with GW Abstraction (MCM/year)	with GW abstrcaton + Water Use for Livestock /Aquaculture (MCM/year)	with GW Abstraction (MCM/year)	with GW abstrcaton + Water Use for Livestock /Aquaculture (MCM/year)
151	7	702	9,216	9,150	9,146	9,149	9,119
152	7	703	5,468	5,429	5,428	5,428	5,436
153	7	70401	5,719	5,682	5,679	5,681	5,665
154	7	70402	4,553	4,528	4,527	4,527	4,488
155	7	70403	2,648	2,634	2,633	2,633	2,625
156	7	704041	1,247	1,240	1,239	1,240	1,239
157	7	704042	6,411	6,372	6,370	6,371	6,345
158	7	704043	5,315	5,283	5,283	5,283	5,236
159	7	70405_e	23,674	23,492	23,492	23,490	23,490
160	7	70405_i	8,183	8,127	8,124	8,126	8,121
161	7	705	7,394	7,341	7,338	7,340	7,312
162	8	800	19	19	19	19	19
163	8	802_e	241	236	236	236	236
164	8	802_i	21	20	20	20	21
165	8	80401	44	43	43	43	42
166	8	80402_e	18	17	17	17	17
167	8	80402_i	116	115	114	115	115
168	8	80403_e	17	16	16	16	16
169	8	80403_i	232	221	220	221	210
170	8	806	424	411	409	411	413
171	8	807	81	81	80	81	83
172	8	80801_e	3	3	3	3	3
173	8	80801_i	3	3	3	3	3
174	8	80802	903	850	847	848	853
175	8	80803_e	8	8	8	8	8
176	8	80803_i	6	6	6	6	6
177	8	80804_e	40	40	40	40	40
178	8	80804_i	27	27	26	27	27
179	8	80805	135	132	131	132	134
180	8	808061	168	159	158	159	156
181	8	808062	638	576	574	575	573
182	8	808063	1,940	1,789	1,788	1,786	1,774
183	8	808071	2	2	2	2	2
184	8	8080721_e	82	82	82	82	82
185	8	8080721_i	271	250	243	250	205
186	8	8080723	31	28	27	28	27
187	8	808073	379	321	313	320	309
188	8	8080741	16	13	12	13	15
189	8	80807421	50	41	40	41	41
190	8	80807423	36	30	29	29	29
191	8	8080743	112	91	89	91	75
192	8	8080745	529	484	482	483	474
193	8	808075	68	58	56	57	43
194	8	808077	959	905	900	903	892

Annex-T SR3-3 Aggregated Dams and Water Demand inside SHA (2010) (1/3)

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/ year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5001	1	101	1	aggregated	75.0	58.6	12.00	1,713	3.54	5.80	1.28	10.61	0.080	0.00	0.00	200	0.43	0.04
5002	1	102	2	aggregated	9.1	7.4	1.79	1,652	6.69	1.40	1.51	9.60	0.079	0.00	1.07	300	0.50	0.03
5003	1	103	3	aggregated	0.0	0.0	0.00	0	2.13	1.00	0.69	3.82	0.078	0.00	0.00	0	0.23	0.06
5004	1	104	4	aggregated	0.7	0.6	0.23	1,737	2.65	1.00	0.69	4.35	0.076	0.10	0.00	0	0.23	0.07
5005	1	105	5	aggregated	0.0	0.0	0.00	0	1.60	0.60	0.86	3.05	0.075	7.80	0.00	0	0.29	0.10
5006	1	10601	6	aggregated	0.0	0.0	0.00	0	0.34	0.40	0.19	0.93	0.075	2.30	0.00	0	0.06	0.21
5007	1	10602	7	aggregated	0.0	0.0	0.00	0	8.78	3.00	3.91	15.69	0.080	2.50	0.00	0	1.30	0.12
5008	1	10603	8	aggregated	0.0	0.0	0.00	0	1.01	0.80	0.30	2.11	0.075	2.90	0.00	0	0.10	0.36
5009	1	10604	9	aggregated	0.0	0.0	0.00	0	21.64	7.60	7.18	36.42	0.081	7.30	0.00	0	2.39	0.22
5010	1	10605	10	aggregated	0.0	0.0	0.00	0	6.08	5.00	1.75	12.84	0.075	13.20	0.00	0	0.58	0.99
5011	1	10606	11	aggregated	15.0	11.7	20.78	1,872	8.23	6.20	3.36	17.78	0.079	0.60	0.00	470	1.12	0.86
5012	1	10607	12	aggregated	0.0	0.0	0.00	0	5.01	1.00	1.64	7.65	0.078	4.70	0.00	0	0.55	2.21
5013	1	106081_e	13	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5014	1	106081_i	14	aggregated	25.0	20.0	9.80	1,906	8.07	2.40	2.61	13.08	0.078	8.20	0.00	0	0.87	3.31
5015	1	106082_e	15	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5016	1	106082_i1	16	aggregated	0.0	0.0	0.00	0	2.63	0.00	0.84	3.47	0.078	6.20	0.00	0	0.28	5.53
5017	1	106082_i2	17	aggregated	55.6	43.4	12.50	1,668	16.06	9.40	3.38	28.84	0.072	1.20	8.23	1,280	1.13	1.85
5018	1	106083	18	aggregated	0.0	0.0	0.00	0	0.51	0.00	0.26	0.77	0.078	1.10	0.00	0	0.09	4.82
5019	1	106085_e	19	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5020	1	106085_i	20	aggregated	0.0	0.0	0.00	0	1.49	0.00	0.95	2.43	0.078	2.60	0.00	0	0.32	5.42
5021	1	1060861_e	21	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5022	1	1060861_i1	22	aggregated	0.0	0.0	0.00	0	0.16	0.00	0.10	0.26	0.078	0.30	0.00	0	0.03	7.18
5023	1	1060861_i2	23	aggregated	0.0	0.0	0.00	0	0.75	0.40	0.29	1.44	0.073	0.00	0.00	0	0.10	1.09
5024	1	1060863	24	aggregated	5.4	4.9	0.08	1,656	5.81	3.80	1.93	11.54	0.071	0.00	0.00	50	0.64	0.93
5025	1	106087_e	25	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5026	1	106087_i	26	aggregated	0.0	0.0	0.00	0	1.13	0.00	0.76	1.89	0.078	0.90	0.00	0	0.25	4.88
5027	1	1060881	27	aggregated	0.0	0.0	0.00	0	9.03	4.00	2.65	15.68	0.080	2.30	0.00	0	0.88	0.77
5028	1	1060883	28	aggregated	2.5	2.0	1.10	1,608	5.35	3.60	2.82	11.76	0.078	2.10	0.59	0	0.94	0.48
5029	1	106089	29	aggregated	10.1	7.9	3.50	1,639	17.20	9.70	3.74	30.64	0.081	2.70	1.01	0	1.25	0.35
5030	1	106091	30	aggregated	0.0	0.0	0.00	0	14.83	4.20	4.00	23.03	0.080	3.70	0.00	0	1.33	1.82
5031	1	106093	31	aggregated	13.7	10.9	6.79	1,573	7.70	4.80	2.01	14.50	0.080	0.00	11.00	76	0.67	0.10
5032	1	107_e	32	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5033	1	107_i	33	aggregated	0.0	0.0	0.00	0	2.80	2.20	1.55	6.55	0.075	7.90	0.00	0	0.52	0.18
5034	1	108_e	34	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5035	1	108_i	35	aggregated	0.0	0.0	0.00	0	3.28	3.60	3.98	10.86	0.076	0.10	0.00	0	1.33	3.35
5036	1	109	36	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5037	2	201	37	aggregated	0.0	0.0	0.00	0	2.50	1.40	0.51	4.41	0.085	2.10	0.00	23	0.17	0.03
5038	2	20201	38	aggregated	0.0	0.0	0.00	0	2.37	2.30	0.97	5.63	0.085	1.30	0.00	0	0.32	0.03
5039	2	202021	39	aggregated	63.8	58.3	6.68	1,572	8.08	1.00	0.52	9.60	0.086	0.00	8.66	0	0.17	0.02
5040	2	202023	40	aggregated	0.0	0.0	0.00	0	0.39	0.10	0.04	0.52	0.089	0.00	0.00	0	0.01	0.02
5041	2	20203	41	aggregated	0.0	0.0	0.00	0	7.15	1.70	0.91	9.76	0.080	0.00	0.00	112	0.30	0.02
5042	2	20205	42	aggregated	0.0	0.0	0.00	0	4.66	1.10	0.64	6.40	0.076	0.00	2.13	44	0.21	0.02
5043	2	203	43	aggregated	0.0	0.0	0.00	0	3.25	2.50	0.65	6.41	0.083	11.70	0.56	0	0.22	0.03
5044	2	20401	44	aggregated	5.9	4.6	0.19	1,606	5.06	2.80	1.31	9.17	0.084	1.30	0.62	183	0.44	0.06
5045	2	20403	45	aggregated	1.5	1.2	1.00	1,497	2.48	1.10	1.25	4.82	0.079	0.00	0.87	200	0.42	0.13
5046	2	205	46	aggregated	0.0	0.0	0.00	0	0.40	0.20	0.05	0.64	0.082	2.20	0.19	0	0.02	0.04
5047	2	206	47	aggregated	62.7	53.2	13.73	1,726	14.34	3.70	0.81	18.85	0.082	2.30	19.64	1,493	0.27	0.02
5048	2	207	48	aggregated	0.0	0.0	0.00	0	1.17	0.70	0.17	2.04	0.082	5.20	0.00	0	0.06	0.07
5049	2	20801	49	aggregated	0.0	0.0	0.00	0	2.34	0.70	0.21	3.25	0.082	3.10	0.00	599	0.07	0.03
5050	2	20802	50	aggregated	0.0	0.0	0.00	0	1.96	0.20	0.24	2.41	0.082	0.00	0.00	0	0.08	0.02
5051	2	20803	51	aggregated	0.0	0.0	0.00	0	0.69	0.30	0.08	1.07	0.082	1.80	0.00	0	0.03	0.02
5052	2	20804	52	aggregated	5.5	5.0	1.80	1,635	11.70	3.30	3.52	18.52	0.081	0.80	0.45	410	1.17	0.03
5053	2	20805	53	aggregated	22.0	21.0	4.10	1,831	3.65	1.40	0.47	5.52	0.082	0.10	0.00	800	0.16	0.02
5054	2	20806	54	aggregated	0.0	0.0	0.00	0	2.66	0.10	0.50	3.26	0.080	0.00	0.00	150	0.17	0.02
5055	2	20807	55	aggregated	0.0	0.0	0.00	0	0.40	0.20	0.06	0.66	0.082	0.00	0.00	0	0.02	0.02
5056	2	20809	56	aggregated	0.0	0.0	0.00	0	3.10	0.90	0.62	4.62	0.079	0.00	0.00	0	0.21	0.02
5057	2	20810	57	aggregated	0.0	0.0	0.00	0	3.48	0.40	0.77	4.66	0.077	0.00	0.00	460	0.26	0.02
5058	2	20811	58	aggregated	0.0	0.0	0.00	0	1.57	0.10	0.34	2.02	0.077	0.00	0.00	0	0.11	0.03
5059	2	20812	59	aggregated	3.5	2.8	0.65	1,527	9.44	3.90	1.75	15.09	0.075	4.90	0.00	280	0.58	0.07
5060	2	20813	60	aggregated	0.0	0.0	0.00	0	12.46	1.20	0.60	14.26	0.076	0.40	0.00	120	0.20	0.03
5061	2	20814	61	aggregated	17.4	11.9	2.70	1,507	21.47	6.10	2.78	30.35	0.076	3.50	0.00	0	0.93	0.08
5062	2	20815	62	aggregated	7.4	5.8	1.28	1,310	15.00	5.30	3.94	24.23	0.078	1.40	0.61	310	1.31	0.04
5063	2	209	63	aggregated	21.6	19.7	5.14	1,465	19.66	6.50	4.43	30.59	0.080	22.00	18.48	800	1.48	0.08
5064	2	211	64	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.081	0.00	0.00	0	0.00	0.06
5065	2	212	65	aggregated	53.6	42.7	12.28	1,624	15.17	3.80	4.41	23.37	0.082	0.00	27.46	49	1.47	0.16
5066	2	213	66	aggregated	0.0	0.0	0.00	0	2.08	0.50	0.50	3.08	0.082	0.00	0.00	10	0.17	0.03
5067	2	214_e	67	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5068	2	214_i	68	aggregated	0.7	0.6	0.21	1,604	6.50	1.00	4.95	12.45	0.085	0.00	0.12	5	1.65	0.12
5069	2	215	69	aggregated	0.0	0.0	0.00	0	0.69	0.20	0.32	1.21	0.081	0.00	0.00	0	0.11	0.04
5070	2	216_e	70	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5071	2	216_i	71	aggregated	0.0	0.0	0.00	0	2.03	0.40	1.53	3.96	0.081	0.00	0.00	0	0.51	0.04
5072	2	217	72	aggregated	0.0	0.0	0.00	0	0.04	0.00	0.01	0.06	0.082	0.00	0.00	0	0.00	0.03
5073	2	218	73	aggregated	17.7	15.7	3.50	1,667	2.54	1.70	0.50	4.74	0.082	0.10	0.78	0	0.17	0.02
5074	2	219	74	aggregated	0.0	0.0	0.00	0	0.01	0.00	0.00	0.01	0.082	0.00	0.00	0	0.00	0.07

Annex-T SR3-3 Aggregated Dams and Water Demand inside SHA (2010) (2/3)

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/ year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5075	3	30201	75	aggregated	0.0	0.0	0.00	0	0.14	0.30	0.03	0.47	0.077	1.10	0.00	0	0.01	0.02
5076	3	30202	76	aggregated	0.0	0.0	0.00	0	0.71	2.00	0.30	3.01	0.077	0.70	0.00	0	0.10	0.00
5077	3	30203_e	77	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5078	3	30203_i	78	aggregated	0.0	0.0	0.00	0	2.52	2.90	0.66	6.08	0.079	2.70	0.42	0	0.22	0.00
5079	3	303	79	aggregated	0.0	0.0	0.00	0	0.46	0.80	0.37	1.63	0.083	3.30	0.00	0	0.12	0.07
5080	3	304	80	aggregated	4.6	3.5	0.60	1,689	3.69	3.20	4.16	11.05	0.087	0.30	3.12	100	1.39	0.13
5081	3	305	81	aggregated	0.0	0.0	0.00	0	0.16	0.20	0.29	0.65	0.082	1.00	0.00	0	0.10	0.11
5082	3	30601	82	aggregated	0.0	0.0	0.00	0	0.39	1.70	0.13	2.22	0.077	3.50	0.00	0	0.04	0.01
5083	3	30602	83	aggregated	0.0	0.0	0.00	0	0.60	0.40	0.70	1.70	0.070	0.70	0.00	0	0.23	0.01
5084	3	30603_e	84	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5085	3	30603_i	85	aggregated	0.0	0.0	0.00	0	0.84	0.80	1.91	3.55	0.074	0.30	0.08	0	0.64	0.01
5086	3	307	86	aggregated	0.0	0.0	0.00	0	1.19	1.20	2.83	5.21	0.083	13.00	0.00	0	0.94	0.12
5087	3	308	87	aggregated	0.0	0.0	0.00	0	9.86	4.70	5.70	20.25	0.085	2.70	0.00	0	1.90	0.08
5088	3	309	88	aggregated	0.0	0.0	0.00	0	0.02	0.00	0.01	0.02	0.077	0.50	0.00	0	0.00	0.03
5089	3	310	89	aggregated	0.0	0.0	0.00	0	0.34	1.20	0.14	1.69	0.077	0.00	0.00	0	0.05	0.01
5090	3	311	90	aggregated	5.0	3.5	1.10	1,587	4.23	2.30	2.03	8.57	0.074	24.50	0.00	115	0.68	0.04
5091	3	312	91	aggregated	1.0	0.8	0.14	1,729	0.84	1.40	0.82	3.06	0.061	1.10	0.00	0	0.27	0.06
5092	3	313	92	aggregated	0.0	0.0	0.00	0	0.01	0.00	0.02	0.03	0.046	0.50	0.00	0	0.01	0.38
5093	3	31401	93	aggregated	0.0	0.0	0.00	0	0.16	0.20	0.27	0.64	0.046	1.70	0.00	0	0.09	0.12
5094	3	31403	94	aggregated	0.0	0.0	0.00	0	0.69	0.80	0.64	2.14	0.051	0.10	0.17	0	0.21	0.11
5095	3	31404	95	aggregated	0.0	0.0	0.00	0	6.58	2.80	3.42	12.80	0.086	0.00	0.26	20	1.14	0.10
5096	3	31405	96	aggregated	84.1	72.6	7.50	1,540	6.85	4.60	3.02	14.48	0.086	0.40	0.00	500	1.01	0.15
5097	3	31407	97	aggregated	0.0	0.0	0.00	0	7.95	3.90	3.37	15.22	0.084	0.20	0.00	0	1.12	0.26
5098	3	31408	98	aggregated	0.0	0.0	0.00	0	3.37	1.80	1.25	6.43	0.085	3.20	0.00	0	0.42	0.20
5099	3	31409	99	aggregated	119.1	92.7	16.91	1,445	19.22	8.70	7.97	35.89	0.087	5.20	23.11	240	2.66	0.11
5100	3	315	100	aggregated	0.0	0.0	0.00	0	0.37	0.40	0.62	1.39	0.046	3.40	0.00	0	0.21	0.18
5101	3	316	101	aggregated	0.0	0.0	0.00	0	0.99	1.80	2.10	4.88	0.046	2.50	0.69	50	0.70	0.05
5102	3	317	102	aggregated	0.6	0.4	0.20	1,737	1.19	0.80	1.29	3.28	0.046	2.50	0.00	0	0.43	0.13
5103	3	318	103	aggregated	0.0	0.0	0.00	0	0.81	1.50	2.07	4.39	0.046	0.20	0.00	200	0.69	0.12
5104	3	319_e	104	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5105	3	319_i	105	aggregated	0.0	0.0	0.00	0	0.27	0.40	0.66	1.32	0.046	1.00	0.00	0	0.22	0.15
5106	3	320_e	106	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5107	3	320_i	107	aggregated	0.0	0.0	0.00	0	0.16	0.00	0.80	0.96	0.046	1.60	0.00	0	0.27	0.06
5108	3	321	108	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5109	4	401	109	aggregated	0.0	0.0	0.00	0	2.73	2.10	0.81	5.63	0.085	5.00	0.58	100	0.27	0.03
5110	4	402	110	aggregated	0.6	0.4	0.10	1,700	9.33	3.10	2.71	15.14	0.082	1.10	0.39	0	0.90	0.03
5111	4	403	111	aggregated	0.0	0.0	0.00	0	3.56	3.00	1.15	7.71	0.084	8.40	0.58	50	0.38	0.03
5112	4	404	112	aggregated	102.3	84.6	20.96	1,369	13.27	4.40	3.32	20.99	0.080	3.20	12.69	2,030	1.11	0.03
5113	4	405	113	aggregated	6.1	4.6	1.53	1,660	21.07	8.00	1.54	30.60	0.085	5.70	0.00	145	0.51	0.02
5114	4	406_e	114	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5115	4	406_i	115	aggregated	0.0	0.0	0.00	0	18.14	6.80	1.85	26.78	0.085	0.00	1.71	0	0.62	0.01
5116	4	407	116	aggregated	6.5	5.1	0.20	1,730	4.65	1.50	0.67	6.82	0.084	2.40	0.00	20	0.22	0.02
5117	4	408	117	aggregated	5.0	3.6	0.13	1,202	9.53	3.20	5.77	18.50	0.083	3.20	0.19	398	1.92	0.05
5118	4	409	118	aggregated	0.0	0.0	0.00	0	1.24	1.70	0.25	3.18	0.082	2.50	0.00	0	0.08	0.02
5119	4	410	119	aggregated	11.0	7.9	2.23	1,571	3.95	3.10	4.19	11.25	0.087	3.60	0.78	1,300	1.40	0.11
5120	4	411	120	aggregated	0.0	0.0	0.00	0	0.42	0.40	0.30	1.12	0.082	2.80	0.00	0	0.10	0.06
5121	5	500	121	aggregated	0.0	0.0	0.00	0	115.35	3.40	49.35	168.10	0.091	1.50	0.00	139	16.45	0.06
5122	5	502	122	aggregated	0.0	0.0	0.00	0	9.68	1.90	40.08	51.66	0.090	0.00	0.00	0	13.36	0.62
5123	5	50401	123	aggregated	0.0	0.0	0.00	0	12.97	0.40	12.61	25.98	0.093	5.70	0.00	0	4.20	0.41
5124	5	50402	124	aggregated	0.0	0.0	0.00	0	37.57	10.60	4.81	52.98	0.089	0.20	14.01	5,970	1.60	0.03
5125	5	50403	125	aggregated	24.3	19.0	5.71	1,563	43.59	8.60	11.73	63.92	0.093	9.60	2.08	50	3.91	0.13
5126	5	506	126	aggregated	0.0	0.0	0.00	0	45.41	2.70	5.89	54.00	0.090	0.20	0.00	0	1.96	0.06
5127	6	60001	127	aggregated	0.0	0.0	0.00	0	74.51	0.90	4.24	79.65	0.099	0.00	0.00	0	1.41	0.14
5128	6	60002	128	aggregated	0.0	0.0	0.00	0	25.28	1.30	78.62	105.20	0.090	0.00	0.00	0	26.21	0.32
5129	6	601	129	aggregated	0.0	0.0	0.00	0	2.00	0.40	0.23	2.63	0.094	0.00	0.00	0	0.08	0.13
5130	6	602_e	130	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5131	6	602_i	131	aggregated	5.5	4.3	0.15	1,710	10.42	3.40	1.93	15.75	0.094	0.00	0.46	250	0.64	0.21
5132	6	603	132	aggregated	0.0	0.0	0.00	0	322.47	1.40	2.25	326.12	0.099	0.00	1.59	340	0.75	0.17
5133	6	60401	133	aggregated	2.0	1.6	0.24	1,680	39.01	1.90	1.27	42.18	0.097	0.00	2.08	45	0.42	0.14
5134	6	604021	134	aggregated	0.0	0.0	0.00	0	1.10	0.10	0.10	1.29	0.094	0.00	0.00	0	0.03	0.19
5135	6	604023_e	135	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5136	6	604023_i	136	aggregated	5.7	4.7	1.38	1,627	19.57	6.20	13.49	39.26	0.088	0.00	0.23	44	4.50	0.37
5137	6	60403	137	aggregated	14.6	11.9	2.87	1,639	20.99	5.70	9.21	35.90	0.087	0.00	2.23	0	3.07	0.35
5138	6	60405	138	aggregated	6.4	5.1	1.45	1,592	8.58	2.20	7.89	18.67	0.087	0.00	0.26	24	2.63	0.35
5139	6	605	139	aggregated	0.0	0.0	0.00	0	26.93	2.40	1.09	30.41	0.098	0.00	2.60	0	0.36	0.12
5140	6	606	140	aggregated	7.8	6.1	2.24	1,643	56.88	3.00	4.37	64.25	0.089	0.00	7.84	451	1.46	0.16
5141	6	607	141	aggregated	0.0	0.0	0.00	0	3.89	0.30	0.49	4.68	0.095	0.00	0.00	0	0.16	0.13
5142	6	608	142	aggregated	28.4	23.2	5.20	1,595	74.51	8.80	33.79	117.09	0.083	0.00	7.75	1,050	11.26	0.48
5143	6	609	143	aggregated	0.0	0.0	0.00	0	0.09	0.10	0.07	0.25	0.094	0.00	0.00	0	0.02	0.05
5144	6	610	144	aggregated	0.0	0.0	0.00	0	24.62	5.00	24.22	53.84	0.080	0.00	2.23	200	8.07	0.46
5145	6	611	145	aggregated	0.0	0.0	0.00	0	14.69	3.60	1.17	19.46	0.087	0.00	0.39	0	0.39	0.02
5146	6	612	146	aggregated	10.0	7.8	0.40	1,574	19.43	4.00	1.82	25.25	0.087	0.00	4.86	500	0.61	0.03
5147	6	614	147	aggregated	37.8	34.6	6.96	1,511	57.10	11.50	4.67	73.27	0.088	0.00	14.75	882	1.56	0.04
5148	6	616	148	aggregated	1.5	1.2	0.38	1,590	54.04	7.30	25.16	86.50	0.095	0.00	2.60	25	8.39	0.16
5149	6	617	149	aggregated	0.0	0.0	0.00	0	13.49	2.10	24.09	39.69	0.090	0.00	0.00	100	8.03	0.46
5150	6	699	150	aggregated	0.0	0.0	0.00	0	5.64	1.80	4.38	11.82	0.086	0.00	0.00	0	1.46	0.19

Annex-T SR3-3 Aggregated Dams and Water Demand inside SHA (2010) (3/3)

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/ year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5151	7	702	151	aggregated	0.1	0.1	0.06	1,649	94.46	6.00	11.57	112.03	0.089	0.00	27.37	490	3.86	0.04
5152	7	703	152	aggregated	0.0	0.0	0.00	0	60.11	3.10	4.10	67.31	0.091	0.00	0.00	239	1.37	0.03
5153	7	70401	153	aggregated	0.0	0.0	0.00	0	38.56	4.30	7.19	50.05	0.091	0.00	0.00	1,905	2.40	0.04
5154	7	70402	154	aggregated	0.4	0.3	0.37	1,713	29.44	5.80	2.36	37.60	0.083	0.00	4.40	1,216	0.79	0.02
5155	7	70403	155	aggregated	0.1	0.0	0.02	1,740	10.30	2.60	2.94	15.85	0.084	1.00	0.00	1,000	0.98	0.04
5156	7	704041	156	aggregated	0.0	0.0	0.00	0	1.45	0.70	1.52	3.67	0.084	0.50	0.00	0	0.51	0.04
5157	7	704042	157	aggregated	2.5	2.0	0.57	1,587	14.26	5.80	5.73	25.79	0.085	0.30	0.00	235	1.91	0.03
5158	7	704043	158	aggregated	0.0	0.0	0.00	0	18.64	5.90	1.32	25.85	0.085	0.50	0.94	150	0.44	0.01
5159	7	70405_e	159	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5160	7	70405_i	160	aggregated	0.0	0.0	0.00	0	2.56	1.50	9.28	13.33	0.087	0.30	0.00	62	3.09	0.04
5161	7	705	161	aggregated	0.0	0.0	0.00	0	5.05	1.30	9.01	15.35	0.087	0.00	15.59	50	3.00	0.04
5162	8	800	162	aggregated	0.0	0.0	0.00	0	3.05	0.00	1.39	4.44	0.090	0.00	0.00	0	0.46	2.44
5163	8	802_e	163	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5164	8	802_i	164	aggregated	0.0	0.0	0.00	0	2.14	0.00	0.65	2.78	0.090	0.00	0.00	0	0.22	1.05
5165	8	80401	165	aggregated	0.0	0.0	0.00	0	3.38	1.00	1.24	5.62	0.090	0.00	0.00	600	0.41	0.95
5166	8	80402_e	166	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5167	8	80402_i	167	aggregated	0.0	0.0	0.00	0	7.21	1.30	1.95	10.46	0.089	0.00	0.00	0	0.65	0.57
5168	8	80403_e	168	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5169	8	80403_i	169	aggregated	0.0	0.0	0.00	0	5.22	5.00	2.05	12.27	0.082	0.00	3.20	880	0.68	0.31
5170	8	806	170	aggregated	0.0	0.0	0.00	0	20.90	8.50	5.77	35.17	0.090	0.00	0.00	0	1.92	0.47
5171	8	807	171	aggregated	0.0	0.0	0.00	0	9.72	0.00	3.80	13.52	0.090	0.00	0.00	0	1.27	1.57
5172	8	80801_e	172	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5173	8	80801_i	173	aggregated	0.0	0.0	0.00	0	0.47	0.00	0.25	0.72	0.090	0.80	0.00	0	0.08	2.92
5174	8	80802	174	aggregated	0.0	0.0	0.00	0	28.51	16.30	7.70	52.51	0.086	11.70	0.00	0	2.57	0.30
5175	8	80803_e	175	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5176	8	80803_i	176	aggregated	0.0	0.0	0.00	0	0.66	0.00	0.36	1.02	0.085	1.80	0.00	0	0.12	2.07
5177	8	80804_e	177	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5178	8	80804_i	178	aggregated	0.0	0.0	0.00	0	3.00	0.00	1.46	4.46	0.085	0.10	0.00	0	0.49	1.83
5179	8	80805	179	aggregated	0.0	0.0	0.00	0	10.35	4.40	2.20	16.95	0.086	10.60	0.00	0	0.73	0.56
5180	8	808061	180	aggregated	12.3	9.7	4.20	1,691	18.49	6.20	3.64	28.34	0.085	9.10	0.00	40	1.21	0.76
5181	8	808062	181	aggregated	1.2	0.9	0.60	1,671	19.34	6.50	6.05	31.89	0.086	5.80	0.79	40	2.02	0.35
5182	8	808063	182	aggregated	44.1	35.9	11.01	1,353	18.80	8.70	3.78	31.28	0.087	4.70	3.12	142	1.26	0.07
5183	8	808071	183	aggregated	0.0	0.0	0.00	0	0.54	0.00	0.09	0.63	0.084	1.10	0.00	0	0.03	1.36
5184	8	8080721_e	184	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5185	8	8080721_i	185	aggregated	139.1	122.7	35.75	1,681	98.32	23.90	22.15	144.37	0.088	3.40	2.15	1,220	7.38	2.95
5186	8	8080723	186	aggregated	5.5	5.2	0.47	1,613	3.30	1.60	2.60	7.50	0.086	0.00	0.00	0	0.87	3.12
5187	8	808073	187	aggregated	31.1	24.6	4.80	1,647	59.96	11.20	24.80	95.95	0.089	31.20	0.83	0	8.27	2.58
5188	8	8080741	188	aggregated	0.0	0.0	0.00	0	20.94	0.30	0.96	22.20	0.092	0.00	0.10	0	0.32	2.53
5189	8	80807421	189	aggregated	0.0	0.0	0.00	0	11.72	1.50	3.40	16.61	0.092	0.20	0.00	0	1.13	2.75
5190	8	80807423	190	aggregated	0.0	0.0	0.00	0	4.20	1.10	2.58	7.88	0.092	0.00	0.00	0	0.86	2.91
5191	8	8080743	191	aggregated	61.5	55.4	10.10	1,600	11.15	2.60	6.23	19.98	0.092	0.00	3.30	830	2.08	2.28
5192	8	8080745	192	aggregated	18.8	16.3	3.00	1,567	12.86	6.00	7.26	26.12	0.086	0.00	1.11	0	2.42	0.50
5193	8	808075	193	aggregated	80.1	66.2	10.30	1,620	8.17	1.90	4.72	14.79	0.092	0.00	0.00	300	1.57	2.72
5194	8	808077	194	aggregated	20.8	16.6	3.20	1,569	15.73	6.10	13.68	35.51	0.088	0.00	1.75	0	4.56	0.50

Annex-T SR3-4 Aggregated Dams and Water Demand inside SHA (2030) (1/3)

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5001	1	101	1	aggregated	75.0	58.6	12.00	1,713	9.67	15.00	1.86	26.52	0.076	0.00	0.00	2,900	0.62	0.06
5002	1	102	2	aggregated	9.1	7.4	1.79	1,652	20.75	3.50	2.20	26.45	0.076	0.00	1.90	300	0.73	0.05
5003	1	103	3	aggregated	21.0	16.4	5.21	1,704	7.37	2.40	1.01	10.78	0.075	0.00	0.00	1,500	0.34	0.09
5004	1	104	4	aggregated	0.7	0.6	0.23	1,737	11.76	2.50	1.02	15.28	0.075	0.20	0.31	0	0.34	0.10
5005	1	105	5	aggregated	0.0	0.0	0.00	0	7.27	1.50	1.26	10.03	0.075	13.40	0.00	0	0.42	0.14
5006	1	10601	6	aggregated	0.0	0.0	0.00	0	1.61	1.20	0.28	3.09	0.075	3.90	0.00	0	0.09	0.30
5007	1	10602	7	aggregated	0.0	0.0	0.00	0	28.59	7.40	5.68	41.67	0.075	4.20	0.00	0	1.89	0.18
5008	1	10603	8	aggregated	0.0	0.0	0.00	0	4.27	1.90	0.44	6.61	0.075	5.00	0.00	0	0.15	0.53
5009	1	10604	9	aggregated	0.0	0.0	0.00	0	66.09	19.50	10.35	95.93	0.075	12.40	0.00	0	3.45	0.32
5010	1	10605	10	aggregated	0.0	0.0	0.00	0	28.41	12.50	2.59	43.49	0.075	22.50	0.00	0	0.86	1.47
5011	1	10606	11	aggregated	15.0	11.7	20.78	1,872	24.73	16.00	4.82	45.56	0.075	1.10	0.00	470	1.61	1.23
5012	1	10607	12	aggregated	0.0	0.0	0.00	0	15.66	2.70	2.36	20.72	0.075	8.00	0.00	0	0.79	3.17
5013	1	106081_e	13	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5014	1	106081_i	14	aggregated	25.0	20.0	9.80	1,906	23.44	5.90	3.75	33.09	0.075	14.00	0.00	0	1.25	4.76
5015	1	106082_e	15	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5016	1	106082_i1	16	aggregated	0.0	0.0	0.00	0	8.76	0.00	1.20	9.96	0.075	10.70	0.00	0	0.40	7.94
5017	1	106082_i2	17	aggregated	66.8	54.0	13.40	1,661	88.78	23.80	4.77	117.35	0.079	2.00	9.16	370	1.59	2.61
5018	1	106083	18	aggregated	0.0	0.0	0.00	0	1.73	0.00	0.37	2.10	0.075	1.90	0.00	0	0.12	6.92
5019	1	106085_e	19	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5020	1	106085_i	20	aggregated	0.0	0.0	0.00	0	4.21	0.00	1.36	5.57	0.075	4.40	0.00	0	0.45	7.78
5021	1	1060861_e	21	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5022	1	1060861_i1	22	aggregated	0.0	0.0	0.00	0	0.42	0.00	0.15	0.57	0.075	0.50	0.00	0	0.05	10.32
5023	1	1060861_i2	23	aggregated	0.0	0.0	0.00	0	3.38	1.10	0.41	4.89	0.078	0.00	0.00	0	0.14	1.54
5024	1	1060863	24	aggregated	5.4	4.9	0.08	1,656	31.67	9.90	2.74	44.31	0.078	0.00	0.00	50	0.91	1.32
5025	1	106087_e	25	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5026	1	106087_i	26	aggregated	0.0	0.0	0.00	0	3.30	0.00	1.09	4.39	0.075	1.60	0.00	0	0.36	7.01
5027	1	1060881	27	aggregated	0.0	0.0	0.00	0	29.32	10.40	3.79	43.51	0.076	3.90	0.00	0	1.26	1.10
5028	1	1060883	28	aggregated	2.5	2.0	1.10	1,608	23.56	9.20	4.21	36.97	0.079	3.50	1.04	0	1.40	0.72
5029	1	106089	29	aggregated	10.1	7.9	3.50	1,639	49.95	24.80	5.35	80.11	0.076	4.60	1.79	0	1.78	0.51
5030	1	106091	30	aggregated	0.0	0.0	0.00	0	41.54	10.50	5.74	57.79	0.075	6.20	0.00	0	1.91	2.62
5031	1	106093	31	aggregated	43.4	34.1	12.39	1,590	22.09	12.10	2.87	37.06	0.076	0.00	19.47	76	0.96	0.14
5032	1	107_e	32	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5033	1	107_i	33	aggregated	0.0	0.0	0.00	0	11.75	5.70	2.28	19.74	0.075	13.50	0.00	0	0.76	0.27
5034	1	108_e	34	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5035	1	108_i	35	aggregated	0.0	0.0	0.00	0	12.62	9.00	5.74	27.37	0.075	0.20	0.00	0	1.91	4.84
5036	1	109	36	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5037	2	201	37	aggregated	0.0	0.0	0.00	0	13.10	3.60	0.77	17.47	0.083	3.60	0.00	23	0.26	0.04
5038	2	20201	38	aggregated	0.0	0.0	0.00	0	20.77	5.60	1.45	27.82	0.092	2.30	2.45	0	0.48	0.04
5039	2	202021	39	aggregated	63.8	58.3	6.68	1,572	120.38	2.60	0.78	123.75	0.095	0.00	16.25	0	0.26	0.03
5040	2	202023	40	aggregated	0.0	0.0	0.00	0	13.03	0.10	0.06	13.19	0.096	0.00	0.00	0	0.02	0.02
5041	2	20203	41	aggregated	0.0	0.0	0.00	0	59.82	4.20	1.35	65.38	0.089	0.00	0.00	415	0.45	0.03
5042	2	20205	42	aggregated	6.0	4.7	2.60	1,451	11.75	2.90	0.95	15.60	0.066	0.00	7.14	44	0.32	0.03
5043	2	203	43	aggregated	0.0	0.0	0.00	0	12.06	6.40	0.97	19.43	0.081	20.00	1.92	0	0.32	0.04
5044	2	20401	44	aggregated	5.9	4.6	0.19	1,606	24.67	6.70	2.02	33.38	0.082	2.10	1.10	233	0.67	0.09
5045	2	20403	45	aggregated	1.5	1.2	1.00	1,497	7.72	2.80	1.97	12.49	0.077	0.00	3.07	1,200	0.66	0.21
5046	2	205	46	aggregated	0.0	0.0	0.00	0	1.16	0.70	0.07	1.93	0.079	3.70	0.34	0	0.02	0.05
5047	2	206	47	aggregated	171.8	138.4	37.68	1,772	35.99	9.10	1.17	46.26	0.078	3.90	36.59	6,273	0.39	0.03
5048	2	207	48	aggregated	0.0	0.0	0.00	0	5.33	1.50	0.27	7.10	0.078	8.90	0.00	0	0.09	0.11
5049	2	20801	49	aggregated	0.0	0.0	0.00	0	6.79	1.80	0.30	8.89	0.077	5.30	0.00	199	0.10	0.04
5050	2	20802	50	aggregated	0.0	0.0	0.00	0	4.53	0.40	0.35	5.28	0.077	0.00	0.00	0	0.12	0.03
5051	2	20803	51	aggregated	0.0	0.0	0.00	0	1.51	0.90	0.11	2.52	0.077	3.10	0.00	0	0.04	0.03
5052	2	20804	52	aggregated	47.0	37.4	6.65	1,679	27.51	8.20	5.12	40.83	0.075	1.40	0.80	8,440	1.71	0.04
5053	2	20805	53	aggregated	65.0	61.0	7.61	1,780	8.45	3.50	0.68	12.63	0.077	0.20	0.00	800	0.23	0.02
5054	2	20806	54	aggregated	0.0	0.0	0.00	0	5.55	0.20	0.73	6.48	0.075	0.00	0.00	400	0.24	0.03
5055	2	20807	55	aggregated	0.0	0.0	0.00	0	0.89	0.50	0.09	1.47	0.077	0.00	0.00	0	0.03	0.03
5056	2	20809	56	aggregated	0.0	0.0	0.00	0	8.35	2.10	0.91	11.35	0.073	0.00	0.00	0	0.30	0.03
5057	2	20810	57	aggregated	0.0	0.0	0.00	0	7.36	1.20	1.15	9.71	0.068	0.00	0.00	485	0.38	0.03
5058	2	20811	58	aggregated	0.0	0.0	0.00	0	2.72	0.20	0.51	3.44	0.068	0.00	0.00	0	0.17	0.04
5059	2	20812	59	aggregated	3.5	2.8	0.65	1,527	26.73	9.40	2.57	38.70	0.072	8.40	0.00	780	0.86	0.10
5060	2	20813	60	aggregated	0.0	0.0	0.00	0	16.64	3.00	0.89	20.53	0.066	0.60	0.00	120	0.30	0.04
5061	2	20814	61	aggregated	22.1	15.6	2.90	1,508	37.21	15.00	4.21	56.42	0.067	6.00	0.00	0	1.40	0.13
5062	2	20815	62	aggregated	7.4	5.8	1.28	1,310	38.45	13.10	5.98	57.53	0.069	2.50	1.07	310	1.99	0.06
5063	2	209	63	aggregated	51.1	42.8	9.31	1,541	55.57	16.00	6.93	78.49	0.079	37.60	33.63	290	2.31	0.12
5064	2	211	64	aggregated	0.0	0.0	0.00	0	0.01	0.00	0.00	0.01	0.079	0.00	0.00	0	0.00	0.09
5065	2	212	65	aggregated	72.5	57.5	15.76	1,618	33.73	9.20	6.96	49.89	0.080	0.00	49.82	29	2.32	0.25
5066	2	213	66	aggregated	0.0	0.0	0.00	0	5.16	1.30	0.73	7.19	0.078	0.00	0.00	10	0.24	0.05
5067	2	214_e	67	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5068	2	214_i	68	aggregated	0.7	0.6	0.21	1,604	14.24	2.30	7.81	24.36	0.077	0.00	0.22	5	2.60	0.19
5069	2	215	69	aggregated	0.0	0.0	0.00	0	2.07	0.40	0.48	2.95	0.079	0.00	0.00	0	0.16	0.06
5070	2	216_e	70	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5071	2	216_i	71	aggregated	0.0	0.0	0.00	0	6.80	1.00	2.35	10.16	0.080	0.00	0.00	0	0.78	0.07
5072	2	217	72	aggregated	0.0	0.0	0.00	0	0.10	0.00	0.02	0.12	0.077	0.00	0.00	0	0.01	0.04
5073	2	218	73	aggregated	17.7	15.7	3.50	1,667	5.14	4.10	0.73	9.96	0.077	0.10	2.30	0	0.24	0.03
5074	2	219	74	aggregated	0.0	0.0	0.00	0	0.02	0.00	0.00	0.02	0.077	0.00	0.00	0	0.00	0.10

Annex-T SR3-4 Aggregated Dams and Water Demand inside SHA (2030) (2/3)

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5075	3	30201	75	aggregated	0.0	0.0	0.00	0	1.05	1.00	0.05	2.10	0.074	1.80	0.00	0	0.02	0.03
5076	3	30202	76	aggregated	0.0	0.0	0.00	0	5.66	5.10	0.42	11.18	0.074	1.20	0.00	0	0.14	0.01
5077	3	30203_e	77	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5078	3	30203_i	78	aggregated	0.0	0.0	0.00	0	17.18	7.10	0.93	25.21	0.074	4.60	1.06	0	0.31	0.00
5079	3	303	79	aggregated	0.0	0.0	0.00	0	3.08	2.00	0.57	5.65	0.075	5.70	0.00	0	0.19	0.11
5080	3	304	80	aggregated	33.2	25.8	10.70	1,720	16.97	8.00	6.47	31.44	0.075	0.50	5.52	2,290	2.16	0.20
5081	3	305	81	aggregated	0.0	0.0	0.00	0	0.98	0.40	0.44	1.82	0.075	1.80	0.00	0	0.15	0.17
5082	3	30601	82	aggregated	0.0	0.0	0.00	0	2.87	4.10	0.18	7.15	0.074	5.90	0.00	0	0.06	0.02
5083	3	30602	83	aggregated	0.0	0.0	0.00	0	4.92	1.00	1.02	6.94	0.073	1.20	0.00	0	0.34	0.02
5084	3	30603_e	84	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5085	3	30603_i	85	aggregated	0.0	0.0	0.00	0	7.30	1.90	2.77	11.97	0.074	0.40	0.14	0	0.92	0.01
5086	3	307	86	aggregated	0.0	0.0	0.00	0	6.63	3.20	4.38	14.20	0.075	22.20	0.00	0	1.46	0.19
5087	3	308	87	aggregated	0.0	0.0	0.00	0	47.42	11.60	8.31	67.33	0.076	4.60	0.00	0	2.77	0.12
5088	3	309	88	aggregated	0.0	0.0	0.00	0	0.12	0.00	0.01	0.12	0.074	0.90	0.00	0	0.00	0.04
5089	3	310	89	aggregated	0.0	0.0	0.00	0	2.43	2.90	0.20	5.53	0.074	0.10	0.00	0	0.07	0.01
5090	3	311	90	aggregated	5.0	3.5	1.10	1,587	36.04	5.70	2.93	44.67	0.074	41.80	0.00	115	0.98	0.06
5091	3	312	91	aggregated	1.0	0.8	0.14	1,729	8.31	3.50	1.20	13.01	0.072	2.00	0.31	0	0.40	0.09
5092	3	313	92	aggregated	0.0	0.0	0.00	0	0.11	0.00	0.03	0.14	0.071	0.80	0.00	0	0.01	0.55
5093	3	31401	93	aggregated	0.0	0.0	0.00	0	2.64	0.60	0.40	3.64	0.071	2.80	0.00	0	0.13	0.18
5094	3	31403	94	aggregated	0.0	0.0	0.00	0	11.73	1.90	0.94	14.57	0.071	0.20	0.31	0	0.31	0.17
5095	3	31404	95	aggregated	0.0	0.0	0.00	0	25.51	6.80	4.92	37.24	0.078	0.00	15.79	20	1.64	0.15
5096	3	31405	96	aggregated	84.1	72.6	7.50	1,540	27.14	11.50	4.30	42.94	0.077	0.70	0.00	3,800	1.43	0.21
5097	3	31407	97	aggregated	0.0	0.0	0.00	0	35.50	9.80	4.78	50.08	0.076	0.30	0.00	0	1.59	0.37
5098	3	31408	98	aggregated	0.0	0.0	0.00	0	13.12	4.50	1.75	19.37	0.081	5.50	0.00	0	0.58	0.28
5099	3	31409	99	aggregated	139.2	108.4	19.71	1,407	75.24	21.50	11.73	108.47	0.076	8.90	53.75	460	3.91	0.16
5100	3	315	100	aggregated	0.0	0.0	0.00	0	4.91	1.10	0.90	6.91	0.071	5.70	0.00	0	0.30	0.26
5101	3	316	101	aggregated	113.2	88.4	23.12	1,694	10.60	4.40	3.08	18.08	0.071	4.30	1.23	9,050	1.03	0.08
5102	3	317	102	aggregated	0.6	0.4	0.20	1,737	14.08	1.80	1.90	17.78	0.071	4.20	0.00	0	0.63	0.19
5103	3	318	103	aggregated	0.0	0.0	0.00	0	9.08	3.60	3.04	15.72	0.071	0.30	0.31	200	1.01	0.18
5104	3	319_e	104	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5105	3	319_i	105	aggregated	0.0	0.0	0.00	0	2.80	1.10	0.97	4.86	0.071	1.80	0.00	0	0.32	0.23
5106	3	320_e	106	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5107	3	320_i	107	aggregated	0.0	0.0	0.00	0	1.86	0.00	1.18	3.04	0.071	2.70	0.31	0	0.39	0.09
5108	3	321	108	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5109	4	401	109	aggregated	0.0	0.0	0.00	0	11.56	5.30	1.24	18.10	0.082	8.60	1.03	1,000	0.41	0.05
5110	4	402	110	aggregated	0.6	0.4	0.10	1,700	59.32	7.60	4.23	71.15	0.087	1.90	4.83	0	1.41	0.04
5111	4	403	111	aggregated	0.0	0.0	0.00	0	12.40	7.50	1.79	21.69	0.078	14.30	1.03	50	0.60	0.05
5112	4	404	112	aggregated	108.5	89.4	23.26	1,403	39.69	10.90	5.15	55.74	0.073	5.50	30.55	2,467	1.72	0.04
5113	4	405	113	aggregated	22.8	17.7	8.97	1,674	49.88	20.00	2.41	72.29	0.074	9.80	0.00	2,145	0.80	0.03
5114	4	406_e	114	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5115	4	406_i	115	aggregated	20.9	16.3	4.72	1,657	45.78	16.70	2.90	65.37	0.073	0.00	3.04	2,000	0.97	0.01
5116	4	407	116	aggregated	20.7	16.2	4.85	1,728	12.79	3.70	1.05	17.54	0.074	4.10	0.00	1,600	0.35	0.04
5117	4	408	117	aggregated	5.0	3.6	0.13	1,202	33.83	8.00	9.00	50.82	0.076	5.50	0.34	2,098	3.00	0.08
5118	4	409	118	aggregated	0.0	0.0	0.00	0	4.85	4.20	0.37	9.42	0.074	4.20	0.00	0	0.12	0.03
5119	4	410	119	aggregated	11.0	7.9	2.23	1,571	19.15	7.70	6.53	33.38	0.075	6.10	1.38	2,100	2.18	0.17
5120	4	411	120	aggregated	0.0	0.0	0.00	0	2.95	0.90	0.45	4.30	0.075	4.70	0.00	0	0.15	0.09
5121	5	500	121	aggregated	0.0	0.0	0.00	0	437.18	8.40	78.77	524.35	0.090	2.50	0.00	150	26.26	0.10
5122	5	502	122	aggregated	3.9	3.0	0.76	1,668	32.81	4.60	64.18	101.59	0.089	0.00	0.00	0	21.39	0.99
5123	5	50401	123	aggregated	0.0	0.0	0.00	0	31.77	1.00	20.17	52.93	0.086	9.70	0.00	0	6.72	0.65
5124	5	50402	124	aggregated	29.1	22.7	6.32	1,635	168.21	26.40	7.26	201.86	0.085	0.40	56.68	7,960	2.42	0.05
5125	5	50403	125	aggregated	76.7	59.9	11.08	1,591	117.96	21.30	18.62	157.88	0.087	16.40	6.44	4,350	6.21	0.20
5126	5	506	126	aggregated	27.6	21.6	4.90	1,666	137.41	6.60	9.21	153.22	0.084	0.30	38.33	0	3.07	0.10
5127	6	60001	127	aggregated	0.0	0.0	0.00	0	61.16	2.20	6.63	69.99	0.097	0.00	0.00	0	2.21	0.22
5128	6	60002	128	aggregated	0.0	0.0	0.00	0	90.47	3.30	125.87	219.64	0.088	0.00	0.00	0	41.96	0.51
5129	6	601	129	aggregated	0.0	0.0	0.00	0	1.60	1.00	0.36	2.96	0.078	0.00	0.00	0	0.12	0.20
5130	6	602_e	130	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5131	6	602_i	131	aggregated	5.5	4.3	0.15	1,710	9.44	8.60	3.05	21.09	0.078	0.00	0.81	250	1.02	0.33
5132	6	603	132	aggregated	6.4	5.0	1.50	1,660	365.48	3.40	3.53	372.40	0.097	0.00	5.64	0	1.18	0.27
5133	6	60401	133	aggregated	32.0	25.0	4.06	1,682	38.99	4.60	2.00	45.59	0.086	0.00	3.68	302	0.67	0.22
5134	6	604021	134	aggregated	0.0	0.0	0.00	0	0.86	0.30	0.16	1.32	0.078	0.00	0.00	0	0.05	0.31
5135	6	604023_e	135	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5136	6	604023_i	136	aggregated	11.3	9.9	2.05	1,630	25.96	15.50	21.35	62.81	0.072	0.00	4.09	114	7.12	0.59
5137	6	60403	137	aggregated	14.6	11.9	2.87	1,639	26.37	14.40	14.57	55.34	0.071	0.00	9.47	0	4.86	0.55
5138	6	60405	138	aggregated	6.4	5.1	1.45	1,592	10.89	5.50	12.49	28.88	0.071	0.00	0.46	30	4.16	0.56
5139	6	605	139	aggregated	20.6	16.1	4.61	1,673	21.72	6.00	1.71	29.43	0.093	0.00	10.17	0	0.57	0.19
5140	6	606	140	aggregated	11.1	8.7	3.74	1,660	58.60	7.50	6.92	73.01	0.073	0.00	16.63	161	2.31	0.25
5141	6	607	141	aggregated	0.0	0.0	0.00	0	3.24	0.80	0.77	4.81	0.082	0.00	0.00	0	0.26	0.20
5142	6	608	142	aggregated	53.4	42.7	8.33	1,596	122.48	21.80	53.90	198.18	0.072	0.00	144.85	1,580	17.97	0.77
5143	6	609	143	aggregated	0.0	0.0	0.00	0	0.11	0.20	0.11	0.42	0.078	0.00	0.00	0	0.04	0.09
5144	6	610	144	aggregated	14.0	10.9	1.67	1,608	46.15	12.20	38.69	97.04	0.072	0.00	13.15	700	12.90	0.74
5145	6	611	145	aggregated	0.0	0.0	0.00	0	27.82	8.80	1.84	38.46	0.078	0.00	0.69	0	0.61	0.03
5146	6	612	146	aggregated	46.0	35.9	4.80	1,563	41.17	9.90	2.86	53.92	0.079	0.00	27.00	500	0.95	0.04
5147	6	614	147	aggregated	121.4	99.9	23.38	1,524	136.34	28.40	7.34	172.08	0.080	0.00	57.91	2,282	2.45	0.06
5148	6	616	148	aggregated	1.5	1.2	0.38	1,590	118.28	18.00	40.21	176.49	0.089	0.00	4.60	25	13.40	0.25
5149	6	617	149	aggregated	0.0	0.0	0.00	0	50.43	5.20	38.58	94.21	0.089	0.00	0.00	100	12.86	0.74
5150	6	699	150	aggregated	0.0	0.0	0.00	0	10.12	4.30	6.93	21.35	0.073	0.00	0.00	0	2.31	0.30

Annex-T SR3-4 Aggregated Dams and Water Demand inside SHA (2030) (3/3)

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5151	7	702	151	aggregated	16.6	13.0	6.26	1,630	296.18	15.10	18.25	329.53	0.086	0.00	48.44	520	6.08	0.07
5152	7	703	152	aggregated	0.0	0.0	0.00	0	159.42	7.80	6.47	173.69	0.086	0.00	0.00	462	2.16	0.04
5153	7	70401	153	aggregated	3.5	2.7	0.65	1,635	103.93	10.60	11.41	125.95	0.084	0.00	0.00	2,700	3.80	0.07
5154	7	70402	154	aggregated	22.7	17.8	4.22	1,715	128.49	14.30	3.53	146.33	0.081	0.00	32.92	2,116	1.18	0.03
5155	7	70403	155	aggregated	0.1	0.0	0.02	1,740	19.69	6.50	4.61	30.80	0.061	1.70	0.00	1,000	1.54	0.06
5156	7	704041	156	aggregated	0.0	0.0	0.00	0	3.33	1.90	2.41	7.65	0.064	0.80	0.00	0	0.80	0.06
5157	7	704042	157	aggregated	23.9	18.7	9.09	1,652	39.76	14.50	9.15	63.40	0.071	0.50	8.29	1,735	3.05	0.05
5158	7	704043	158	aggregated	79.7	62.3	16.32	1,710	46.84	14.60	2.04	63.48	0.073	0.80	6.25	4,350	0.68	0.01
5159	7	70405_e	159	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5160	7	70405_i	160	aggregated	0.0	0.0	0.00	0	11.32	3.80	14.82	29.94	0.070	0.40	0.00	62	4.94	0.06
5161	7	705	161	aggregated	0.0	0.0	0.00	0	29.12	3.30	14.39	46.81	0.070	0.00	27.59	50	4.80	0.07
5162	8	800	162	aggregated	0.0	0.0	0.00	0	9.98	0.00	1.97	11.95	0.082	0.00	0.00	0	0.66	3.46
5163	8	802_e	163	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5164	8	802_i	164	aggregated	0.0	0.0	0.00	0	7.19	0.00	0.91	8.11	0.082	0.00	0.00	0	0.30	1.49
5165	8	80401	165	aggregated	0.0	0.0	0.00	0	12.23	2.60	1.75	16.58	0.082	0.00	0.00	600	0.58	1.35
5166	8	80402_e	166	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5167	8	80402_i	167	aggregated	0.0	0.0	0.00	0	23.14	3.30	2.77	29.21	0.081	0.00	0.00	0	0.92	0.81
5168	8	80403_e	168	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5169	8	80403_i	169	aggregated	6.0	4.7	0.90	1,511	22.85	12.50	2.95	38.30	0.077	0.00	6.29	680	0.98	0.45
5170	8	806	170	aggregated	0.0	0.0	0.00	0	57.83	21.30	8.17	87.30	0.082	0.00	0.00	0	2.72	0.66
5171	8	807	171	aggregated	0.0	0.0	0.00	0	44.22	0.00	5.38	49.60	0.082	0.00	0.00	0	1.79	2.22
5172	8	80801_e	172	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5173	8	80801_i	173	aggregated	0.0	0.0	0.00	0	1.60	0.00	0.36	1.96	0.082	1.40	0.00	0	0.12	4.14
5174	8	80802	174	aggregated	0.0	0.0	0.00	0	105.95	41.10	10.75	157.80	0.079	20.00	0.00	0	3.58	0.42
5175	8	80803_e	175	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5176	8	80803_i	176	aggregated	0.0	0.0	0.00	0	2.36	0.00	0.50	2.86	0.081	3.10	0.00	0	0.17	2.89
5177	8	80804_e	177	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5178	8	80804_i	178	aggregated	0.0	0.0	0.00	0	11.44	0.00	2.03	13.48	0.081	0.20	0.00	0	0.68	2.56
5179	8	80805	179	aggregated	0.0	0.0	0.00	0	39.54	11.00	3.09	53.62	0.079	18.20	0.00	0	1.03	0.78
5180	8	808061	180	aggregated	12.3	9.7	4.20	1,691	42.70	15.60	4.97	63.27	0.082	15.60	0.00	40	1.66	1.04
5181	8	808062	181	aggregated	1.2	0.9	0.60	1,671	44.84	16.20	8.86	69.90	0.081	10.00	1.40	40	2.95	0.51
5182	8	808063	182	aggregated	44.1	35.9	11.01	1,353	63.95	21.90	5.37	91.22	0.077	8.00	5.52	200	1.79	0.10
5183	8	808071	183	aggregated	0.0	0.0	0.00	0	1.59	0.00	0.13	1.72	0.081	1.90	0.00	0	0.04	1.85
5184	8	8080721_e	184	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5185	8	8080721_i	185	aggregated	139.1	122.7	35.75	1,681	226.00	60.20	32.32	318.52	0.081	5.80	3.57	830	10.77	4.30
5186	8	8080723	186	aggregated	5.5	5.2	0.47	1,613	9.28	4.00	3.99	17.27	0.079	0.00	0.00	0	1.33	4.78
5187	8	808073	187	aggregated	31.1	24.6	4.80	1,647	118.49	28.20	37.76	184.45	0.081	53.40	2.58	0	12.59	3.92
5188	8	8080741	188	aggregated	0.0	0.0	0.00	0	40.82	0.80	1.49	43.11	0.080	0.00	0.18	0	0.50	3.92
5189	8	80807421	189	aggregated	0.0	0.0	0.00	0	23.69	3.90	5.27	32.86	0.080	0.40	0.00	0	1.76	4.26
5190	8	80807423	190	aggregated	0.0	0.0	0.00	0	8.29	2.70	4.00	14.98	0.080	0.00	0.00	0	1.33	4.50
5191	8	8080743	191	aggregated	61.5	55.4	10.10	1,600	21.73	6.40	9.66	37.79	0.080	0.00	4.59	70	3.22	3.53
5192	8	8080745	192	aggregated	49.4	41.8	6.57	1,549	32.27	15.10	11.11	58.47	0.079	0.00	1.96	0	3.70	0.76
5193	8	808075	193	aggregated	80.1	66.2	10.30	1,620	16.41	4.80	7.31	28.51	0.080	0.00	0.00	300	2.44	4.22
5194	8	808077	194	aggregated	20.8	16.6	3.20	1,569	32.76	15.30	21.12	69.19	0.077	0.00	4.19	0	7.04	0.78

Annex-T SR3-5 Water Users Directly Considered in MODSIM-DSS Model Network (1/2)

No	Name of Node in MODSIM-DSS	Demand (MCM/year)		SN of Source	SN-WTP	HA	SHA	SN-SHA	State	SN-State	Name	Operation Rate (%)		Install Capacity (m3/day)	Demand (MCM/year)	
		2010	2030									2010	2030		2010	2030
1	M_Bakolori	0.35	14.42	2	240	1	106093	31	Zamfara	36	Maradun (P-WTW)	45.2	80.0	900	0.16	0.28
				2	241	1	106093	31	Zamfara	36	Talata Mafara (P-WTW)	45.2	80.0	1,125	0.19	0.34
				2	1106	1	106093	31	Zamfara	36	Talata Mafara (WTW)	0.0	80.0	45,000	0.00	13.80
2	M_Jibiya	1.04	1.84	6	101	1	1060863	24	Katsina	20	Jibia (WTW)	45.2	80.0	6,000	1.04	1.84
3	M_Kainji	1.73	3.07	7	133	1	101	1	Niger	26	New Bussa (WTW)	45.2	80.0	10,000	1.73	3.07
4	M_Zobe	13.86	32.96	14	98	1	1060883	28	Katsina	20	Zobe (WTW)	45.2	80.0	80,000	13.86	24.53
				14	1048	1	1060883	28	Katsina	20	Zobe (WTW)	0.0	80.0	27,500	0.00	8.43
5	M_Usuma	41.57	222.29	38	242	2	202023	40	FCT Abuja	37	Abuja/Usuma1 (WTW)	45.2	80.0	120,000	20.79	36.79
				38	243	2	202023	40	FCT Abuja	37	Abuja/Usuma2 (WTW)	45.2	80.0	120,000	20.79	36.79
				38	1109	2	202023	40	FCT Abuja	37	Abuja/Usuma3 (WTW)	0.0	80.0	240,000	0.00	73.58
				38	1110	2	202023	40	FCT Abuja	37	Abuja/Usuma4 (WTW)	0.0	80.0	240,000	0.00	73.58
				38	1111	2	202023	40	FCT Abuja	37	Kuje (WTW)	0.0	80.0	5,000	0.00	1.53
6	M_Zaira	10.39	64.39	39	74	2	20814	61	Kaduna	18	Zaria New (WTW)	45.2	80.0	50,000	8.66	15.33
				39	75	2	20814	61	Kaduna	18	Zaria Old (WTW)	45.2	80.0	10,000	1.73	3.07
				39	1034	2	20814	61	Kaduna	18	Zaria (WTW)	0.0	80.0	150,000	0.00	45.99
7	M_DadinKowa	8.66	23.00	43	61	3	31407	97	Gombe	15	Dadin-Kowa (WTW)	45.2	80.0	50,000	8.66	15.33
				43	1032	3	31407	97	Gombe	15	Dadin-Kowa (WTW)	0.0	80.0	25,000	0.00	7.67
8	M_Kiri	0.00	1.53	45	1005	3	31403	94	Adamawa	2	Shelleng (M-WTW)	0.0	80.0	5,000	0.00	1.53
9	M_Asejire	34.63	66.21	59	211	6	608	142	Oyo	30	Ibadan/Asejire (WTW)	45.2	80.0	186,000	32.22	57.03
				59	212	6	608	142	Oyo	30	Ibadan/Osegere (WTW)	45.2	80.0	13,500	2.34	4.14
				59	218	6	608	142	Oyo	30	Lalupon (Partial-WTW)	45.2	80.0	436	0.08	0.13
				59	1093	6	608	142	Oyo	30	Lagelu (WTW)	0.0	80.0	8,000	0.00	2.45
				59	1096	6	608	142	Oyo	30	Ona-Ara (WTW)	0.0	80.0	8,000	0.00	2.45
10	M_Erinle	32.74	57.95	66	179	6	608	142	Osun	29	Ede/Old (WTW)	45.2	80.0	9,000	1.56	2.76
				66	180	6	608	142	Osun	29	Ede/New (WTW)	45.2	80.0	180,000	31.18	55.19
11	M_Gari	0.83	2.58	88	89	8	8080723	186	Kano	19	Gari (P-WTW)	45.2	80.0	4,800	0.83	1.47
				88	1042	8	8080723	186	Kano	19	Gari Regional (WTW)	0.0	80.0	3,600	0.00	1.10
12	M_Tiga	1.66	6.01	99	92	8	808077	194	Kano	19	Tiga-Tiga & Tiga-Rano (Disinfection)	45.2	80.0	9,600	1.66	2.94
				99	1045	8	808077	194	Kano	19	Tiga-Tiga & Tiga-Rano Regional (WTW)	0.0	80.0	10,000	0.00	3.07
13	M_Watari	0.00	12.07	103	77	8	80807423	190	Kano	19	Watari Old (P-WTW)	0.0	0.0	9,600	0.00	0.00
				103	505	8	80807423	190	Kano	19	Watari New (P-WTW)	0.0	42.0	75,000	0.00	12.07
14	M_Alau	11.61	23.30	117	40	8	806	170	Borno	8	Maidugri (WTW)	45.2	80.0	67,000	11.61	20.54
				117	1014	8	806	170	Borno	8	Maiduguri/Bulunkutu	0.0	80.0	9,000	0.00	2.76
15	M_Kashimbilla	0.00	18.40	1006	1104	4	406_i	115	Taraba	34	Takum/Kashimbilla (WTW)	0.0	80.0	60,000	0.00	18.40
16	M_Odedele	0.00	109.92	3501	1097	6	608	142	Oyo	30	Ibadan/Odedele-1 (WTW)	0.0	80.0	120,000	0.00	36.79
				3501	1098	6	608	142	Oyo	30	Ibadan/Odedele-2 (WTW)	0.0	80.0	120,000	0.00	36.79
				3501	1099	6	608	142	Oyo	30	Ibadan/Odedele-3 (WTW)	0.0	79.0	120,000	0.00	36.33
17	M_Numan	2.08	3.68	8001	11	3	313	92	Adamawa	2	Numan (WTW)	45.2	80.0	12,000	2.08	3.68
18	M_yola	9.01	38.57	8002	13	3	317	102	Adamawa	2	Jimeta (WTW)	45.2	80.0	28,000	4.85	8.58
				8002	14	3	317	102	Adamawa	2	Yola (WTW)	45.2	80.0	24,000	4.16	7.36
				8002	1001	3	317	102	Adamawa	2	Fufore (M-WTW)	0.0	80.0	5,000	0.00	1.53
				8002	1007	3	317	102	Adamawa	2	Yola (WTW)	0.0	80.0	68,800	0.00	21.09
19	M_KatsinaAla	0.94	6.25	8003	28	4	406_i	115	Benue	7	Katsina-Ala Old (WTW)	45.2	80.0	5,400	0.94	1.66
				8003	501	4	406_i	115	Benue	7	Katsina-Ala New (WTW)	0.0	80.0	15,000	0.00	4.60
20	M_Makurdi	3.12	36.18	8004	32	4	405	113	Benue	7	Makurdi Old (WTW)	45.2	80.0	18,000	3.12	5.52
				8004	502	4	405	113	Benue	7	Greater Makurdi New(WTW)	0.0	80.0	100,000	0.00	30.66
21	M_CrossR	8.31	16.56	8005	41	7	70403	155	Cross River	9	Ugep/Ediba (WTW)	45.2	80.0	48,000	8.31	14.72
				8005	42	7	70403	155	Cross River	9	Itigidi (Partial WTW)	0.0	0.0	450	0.00	0.00
				8005	46	7	70403	155	Cross River	9	Obubra (WTW)	0.0	0.0	450	0.00	0.00
				8005	1015	7	70403	155	Cross River	9	Itigidi (WTW)	0.0	80.0	3,000	0.00	0.92
				8005	1018	7	70403	155	Cross River	9	Obubra (WTW)	0.0	80.0	3,000	0.00	0.92
22	M_Ikom	0.00	7.62	8006	45	7	70405_i	160	Cross River	9	Ikom (WTW)	0.0	0.0	900	0.00	0.00
				8006	1016	7	70405_i	160	Cross River	9	Ikom Phase-1 (WTW)	0.0	80.0	9,300	0.00	2.85
				8006	1017	7	70405_i	160	Cross River	9	Ikom Phase-2 (WTW)	0.0	80.0	15,560	0.00	4.77
23	M_Kaduna	46.25	81.86	8007	70	2	20813	60	Kaduna	18	Kaduna North/Old (WTW)	45.2	80.0	90,000	15.59	27.59
				8007	71	2	20813	60	Kaduna	18	Kaduna North/New (WTW)	45.2	80.0	150,000	25.98	45.99
				8007	72	2	20813	60	Kaduna	18	Kaduna South (WTW)	45.2	80.0	27,000	4.68	8.28
24	M_Chiromawa	0.42	2.94	8008	76	8	808075	193	Kano	19	Chiromawa (P-WTW)	45.2	80.0	2,400	0.42	0.74
				8008	1035	8	808075	193	Kano	19	Chiromawa Regional (WTW)	0.0	80.0	7,200	0.00	2.21
25	M_Joda	1.66	32.74	8009	78	8	808073	187	Kano	19	Joda (P?-WTW)	45.2	80.0	9,600	1.66	2.94
				8009	1036	8	808073	187	Kano	19	Joda Phase-1 (WTW)	0.0	80.0	7,200	0.00	2.21
				8009	1037	8	808073	187	Kano	19	Joda Phase-2 (WTW)	0.0	80.0	90,000	0.00	27.59
26	M_KanoC	34.65	61.32	8010	85	8	8080741	188	Kano	19	G. Kano/Challawa1 (WTW)	45.2	80.0	20,000	3.46	6.13
				8010	86	8	8080741	188	Kano	19	G. Kano/Challawa2 (WTW)	45.2	80.0	90,000	15.59	27.59
				8010	87	8	8080741	188	Kano	19	G. Kano/Challawa3 (WTW)	45.2	80.0	90,000	15.59	27.59
27	M_Tamburawa	3.46	107.31	8011	88	8	808073	187	Kano	19	G. Kano/Tamburawa Old (WTW)	45.2	80.0	20,000	3.46	6.13
				8011	506	8	808073	187	Kano	19	G. Kano/Tamburawa New (WTW)	0.0	80.0	150,000	0.00	45.99
				8011	1041	8	808073	187	Kano	19	G. Kano/Tamburawa New (WTW)	0.0	80.0	180,000	0.00	55.19
28	M_Wudil	3.46	33.73	8012	94	8	808073	187	Kano	19	Wudil (WTW)	45.2	80.0	20,000	3.46	6.13
				8012	1047	8	808073	187	Kano	19	Wudil (WTW)	0.0	80.0	90,000	0.00	27.59
29	M_Kebbi	11.95	21.16	8013	103	1	10605	10	Kebbi	21	Argungu (WTW)	45.2	80.0	8,000	1.39	2.45
				8013	104	1	10605	10	Kebbi	21	Birnin-Kebbi/Duku (WTW)	45.2	80.0	61,000	10.57	18.70
30	M_Yelwa	2.18	3.86	8014	105	1	103	3	Kebbi	21	Yauri/Yelwa (WTW)	45.2	80.0	12,600	2.18	3.86
31	M_Lokoja	2.94	19.01	8015	110	5	50403	125	Kogi	22	Idah (WTW)	45.2	80.0	13,500	2.34	4.14
				8015	508	5	50403	125	Kogi	22	Greater Lokoja (WTW)	0.0	80.0	45,000	0.00	13.80
				8015	111	5	50403	125	Kogi	22	Lokoja Old (WTW)	45.2	80.0	3,500	0.61	1.07
32	M_Lagos	90.56	344.20	8016	123	6	60401	133	Lagos	24	Adiyan (WTW)	45.2	80.0	318,220	55.12	97.57
				8016	124	6	60401	133	Lagos	24	Iju (WTW)	45.2	80.0	204,570	35.44	62.72
				8016	1055	6	60401	133	Lagos	24	Adiyan-2 (WTW)	0.0	75.4	318,220	0.00	91.96
				8016	1056	6	60401	133	Lagos	24	Adiyan-3 (WTW)	0.0	75.4	318,220	0.00	91.96
33	M_Abeokuta	16.80	29.74	8017	142	6	60401	133	Ogun	27	Abeokuta Old (WTW)	45.2	80.0	15,000	2.60	4.60
				8017	143	6	60401	133	Ogun	27	Abeokuta New (WTW)	45.2	80.0	82,000	14.20	25.14
34	M_Apoje	3.20	32.58	8018	150	6	608	142	Ogun	27	Ijebu-Igbo/Apoje (WTW)	45.2	80.0	18,500	3.20	5.67
				8018	1073	6	608	142	Ogun	27	Apoje Regional-1 (WTW)	0.0	35.1	200,000	0.00	26.90
				8018	1074	6	608	142	Ogun	27	Apoje Regional-2 (WTW)	0.0	0.0	200,000	0.00	0.00
35	M_Sokoto	31.96	56.57	8020	230	1	106091	30	Sokoto	33	Sokoto Old (WTW)	45.2	80.0	54,000	9.35	16.56
				8020	231	1	106091	30	Sokoto	33	Sokoto New (WTW)	45.2	80.0	103,500	17.93	31.73
				8020	232	1	106091	30	Sokoto	33	Sokoto/Biwater (WTW)	45.2	80.0	27,000	4.68	8.28
36	M_Ibi	3.20	6.41	8021	234	4	411	120	Taraba	34	Ibi/Wukari (WTW)	45.2	80.0	20,900	3.62	6.41
37	M_Onitsha	0.00	73.58	8022	1011	5	50401	123	Anambra	4	Greater Onitsha (WTW)	0.0	80.0	240,000	0.00	73.58
38	M_Ebonyi	0.00	25.14	8023	1024	7	70403	155	Ebonyi	11	Oferekpe (WTW)	0.0	65.6	100,000	0.00	25.14
39	M_Odomola	0.00	151.07	8024	1052	6	608	142	Lagos	24	Odomola Phase-1 (WTW)	0.0	75.5	113,650	0.00	32.84
				8024	1053	6	608	142	Lagos	24	Odomola Phase-2 (WTW)	0.0	75.5	409,140	0.00	118.23
				8024	1054	6	608	142	Lagos	24	Odomola Phase-3 (WTW)	0.0	0.0	431,870	0.00	0.00
40	M_Gurara	0.00	0.92	8025	1064	2	20203	38	Niger	26	Gurara (P-WTW)	0.0	80.0	3,000	0.00	0.92
41	M_Zungeru	0.00	1.38	8026	1068	2	20805	53	Niger	26	Zungeru/Wushishi (WTW)	0.0	80.0	4,500	0.00	1.38
42	M_Mokoloki	0.00	76.65	8027	1075	6	60401	133	Ogun	27	Mokoloki Regional Phase-1 (WTW)	0.0	80.0	250,000	0.00	76.65
				8027	1076	6	60401	133	Ogun	27	Mokoloki Regional Phase-2 (WTW)	0.0	0.0	250,000	0.00	0.00
				8027	1077	6	60401	133	Ogun	27	Mokoloki Regional Phase-3 (WTW)	0.0	0.0	200,000	0.00	0.00
43	M_Challawa	0.00	24.43	8028	1040	8	8080743	191	Kano	19	Challawa River	0.0	80.0	67,667	0.00	20.75
				8028	1043	8	8080743	191	Kano	19	Madobi (Sub-Surface)	0.0	80.0	12,000	0.00	3.68

Annex-T SR3-5 Water Users Directly Considered in MODSIM-DSS Model Network (2/2)

No	Name of Node in MODSIM-DSS	Irrigation Area (ha)		SN	HA	SHA	SN-SHA	Project Name	Name of Source	SN of Source	Status	Irrigation Area (ha)			
		2010	2030									Planned Area	Evaluated	2010	2030
1	I_Jibiya	3,000	2,300	1	1	1060861_i2	23	Jibiya	Jibiya	6	E	3,500	2,300	3,000	2,300
2	I_Zobe	60	2,000	2	1	1060881	27	Zobe	Zobe	14	E	8,200	2,000	60	2,000
3	I_Bakolori	23,000	23,000	3	1	106091	30	Bakolori	Bakolori	2	E	23,000	23,000	23,000	23,000
4	I_Goronyo	1,188	5,000	4	1	106083	18	Middle Rima Valley	Goronyo	4	E	5,000	5,000	1,188	5,000
5	I_Kainji	350	700	9	1	101	1	Wara	Kainji	7	E	2,000	2,000	200	200
				12	1	101	1	Gafara	Kainji	7	E	500	500	150	500
6	I_Auna	250	2,000	13	2	218	73	Kontagora	Kontagora (Auna)	1014	E	2,000	2,000	250	2,000
7	I_Omi	1,000	4,000	17	2	20401	44	Kampe/Omi	Omi	29	E	4,000	4,000	1,000	4,000
8	I_Kangimi	1,200	1,600	30	2	20813	60	Kangimi	Kangimi	27	E	1,600	1,600	1,200	1,600
9	I_DadinKowa	250	6,660	43	3	31405	96	Dadin Kowa	DadinKowa	43	E	6,660	6,660	250	6,660
10	I_Kiri	7,000	12,200	53	3	311	90	Savannah Sugar	Kiri	45	E	12,200	12,200	7,000	12,200
11	I_Erinle	500	500	98	6	608	142	New Erinle	Erinle	65	E	500	500	500	500
12	I_Tiga	16,000	22,000	114	8	808075	193	Kano River Phase I	Tiga	99	E	22,000	22,000	16,000	22,000
13	I_Gari	2,260	300	124	8	8080721_i	185	Gari	Gari	88	E	4,100	300	2,200	300
				130	8	8080723	186	Dembo	Gari	88	E	700	0	60	0
14	I_Watari	273	0	127	8	80807421	189	Baguwai (Watari)	Watari	103	E	872	0	273	0
15	I_10605	200	200		1	10605	10	*Others*	Rima R.		E	200	200	200	200
16	I_106081	1,000	2,300	8	1	106081_i	14	Wurno	Rima R.		E	1,500	1,500	700	1,500
				10	1	106081_i	14	Kware	Rima R.		E	800	800	300	800
17	I_106083	120	120		1	106083	18	*Others*	Rima R.		E	120	120	120	120
18	I_1060881	100	100		1	1060881	27	*Others*	Rima R.		E	100	100	100	100
19	I_20201	400	400	21	2	20201	38	Gerinyan	Gurura R.		E	2,000	2,000	400	400
20	I_20401	570	570	16	2	20401	44	Kpada	Kampe R.		E	1,500	1,500	150	150
				18	2	20401	44	Ikale	Kampe R.		E	2,700	2,700	420	420
21	I_207	90	90	24	2	207	48	Duro-Gakpan	Niger R.		E	500	500	90	90
22	I_20801	425	425		2	20801	49	*Others*	Kaduna R.		E	450	450	450	450
23	I_20805	300	0	37	2	20805	53	Manta	Kaduna R.		E	500	0	300	0
24	I_20814	240	795	36	2	20814	61	Galma	Galma R.		E	610	610	55	610
					2	20814	61	*Others*	Galma R.		E	185	185	185	185
25	I_209	6,165	13,230	15	2	209	63	Tada Shonga	Niger R.		E	4,100	4,100	435	4,100
				28	2	209	63	Rabba	Niger R.		E	2,000	2,000	110	110
				40	2	209	63	Bacita	Niger R.		E	9,000	9,000	5,600	9,000
					2	209	63	*Others*	Niger R.		E	20	20	20	20
26	I_30203	60	60		3	30203_i	78	*Others*	Donga R.		E	60	60	60	60
27	I_30601	30	3,000	44	3	30601	82	Lower Taraba (Gassol)	Taraba R.		E	3,000	3,000	30	3,000
28	I_31405	359	4,250	45	3	31405	96	Kushimaga	Gongola R.		E	500	500	200	200
				49	3	31405	96	Gora	Gongola R.		E	2,000	2,000	50	50
				54	3	31405	96	Savannah Integrated Farm	Gongola R.		E	4,000	4,000	109	4,000
29	I_31407	300	300	46	3	31407	97	Gari Abdullahi	Gongola R.		E	750	750	0	0
					3	31407	97	*Others*	Gongola R.		E	300	300	300	300
30	I_405	200	1,000	60	4	405	113	Makurdi	Benue R.		E	1,000	1,000	200	1,000
31	I_406	254	3,034	59	4	406_i	115	Katsina-Ala	Katsina-Ala R.		E	2,000	2,000	200	2,000
				65	4	406_i	115	Jato-Aka	Katsina-Ala R.		E	1,000	1,000	20	1,000
				69	4	406_i	115	Adi	Katsina-Ala R.		E	1,000	1,000	24	24
					4	406_i	115	*Others*	Katsina-Ala R.		E	10	10	10	10
32	I_407	500	500	55	4	407	116	Obagaji	Benue R.		E	1,000	500	500	500
33	I_500	772	4,240	71	5	500	121	Ewu	Niger R.		E	1,500	1,500	100	100
				74	5	500	121	Isampou Rice	Niger R.		E	1,280	1,280	110	1,280
				75	5	500	121	Peremabiri Rice	Niger R.		E	1,280	1,280	348	1,280
				76	5	500	121	Kolo Rice	Niger R.		E	1,300	1,300	140	1,300
					5	500	121	*Others*	Niger R.		E	280	280	74	280
34	I_50403	3,100	5,100	73	5	50403	125	Ilush-Ega	Niger R.		E	5,000	5,000	3,000	5,000
				79	5	50403	125	Illahi Ebuh	Niger R.		E	3,000	3,000	100	100
35	I_60401	500	12,000	86	6	60401	133	Lower Ogun (Mokoloki)	Ogun R.		E	12,000	12,000	500	12,000
36	I_60403	750	12,000	84	6	60403	137	Middle Ogun (I.G)	Ogun R.		E	12,000	12,000	750	12,000
37	I_608	630	630	94	6	608	142	Igbonla	Osun R.		E	1,500	130	130	130
38	I_70401	400	800	103	7	70401	153	Itu	Cross R.		E	1,265	1,265	100	100
				113	7	70401	153	Mbiabet	Cross R.		E	500	500	100	500
					7	70401	153	*Others*	Cross R.		E	200	200	200	200
39	I_70403	315	315		7	70403	155	*Others*	Cross R.		E	315	315	315	315
40	I_808073	5,758	27,800	115	8	808073	187	Kano River Phase II	Hadejia R.		E	40,000	15,000	203	15,000
				116	8	808073	187	Hadejia Valley	Hadejia R.		E	12,500	12,500	5,255	12,500
				135	8	808073	187	Aguja	Hadejia R.		E	700	120	120	120
				139	8	808073	187	Jahun	Hadejia R.		E	700	100	100	100
					8	808073	187	*Others*	Hadejia R.		E	80	80	80	80
41	I_Mayo Belwa	0	18,000	2004	3	312	91	Mayo Belwa	Mayo Belwa	2091	P			0	18,000
42	I_Shemankar	0	16,000	2006	4	410	119	Shemankar	Shemankar	2124	P			0	16,000
43	I_Muleng	0	10,000	2016	3	318	103	Muleng	Muleng	3012	P			0	10,000
44	I_TA_Int1	0	5,000	2018	3	30603_i	85	Taraba_Int-1	Taraba R.		P			0	5,000
45	I_TA_Int2	0	15,000	2019	3	30601	82	Taraba_Int-2	Taraba R.		P			0	15,000
46	I_TA_Int3	0	25,000	2020	3	305	81	Taraba_Int-3	Benue R.		P			0	25,000
47	I_DS_Int	0	35,000	2021	3	30201	75	Donga-Suntai_Int	Donga R.		P			0	35,000
48	I_NA_Int1	0	4,000	2022	4	402	110	Nasarawa_Int-1	Akini R.		P			0	4,000
49	I_NA_Int2	0	15,000	2023	4	403	111	Nasarawa_Int-2	Benue R.		P			0	15,000

Annex-T SR3-6 List of Checking Points of Water Balance inside SHA
for Municipal Water Supply

No	Scheme/City	Demand (MCM/year)		SN of Source	Name of Source	SN-WTP	HA	SHA	SN-SHA	State	SN-State	Name	Operation Rate (%)		Install Capacity (m3/day)	Demand (MCM/year)	
		2010	2030										2010	2030		2010	2030
1	Ajiwa	7.01	7.01	1	Ajiwa	95	1	106082_i2	17	Katsina	20	Katsina/Ajiwa (WTW)	36.6	36.6	50,000	7.01	7.01
2	Gusau	7.80	13.80	5	Gusau	238	1	106093	31	Zamfara	36	Gusau (WTW)	45.2	80.0	45,000	7.80	13.80
3	Mairuwa	3.20	5.67	9	Mariura+Gwaigwaye	99	1	106093	31	Katsina	20	Funtua/Mairua Old (WTW)	45.2	80.0	5,000	0.87	1.53
				9	Mariura+Gwaigwaye	100	1	106093	31	Katsina	20	Funtua/Mairua New (WTW)	45.2	80.0	13,500	2.34	4.14
4	Agba/Ilorin	2.34	4.14	16	Agba	116	2	212	65	Kwara	23	Ilorin/Agba Old (WTW)	45.2	80.0	4,500	0.78	1.38
				16	Agba	117	2	212	65	Kwara	23	Ilorin/Agba New (WTW)	45.2	80.0	9,000	1.56	2.76
5	Asa/Ilorin	19.88	35.18	17	Asa	120	2	212	65	Kwara	23	Ilorin/Asa (WTW)	45.2	80.0	114,750	19.88	35.18
6	Ero	18.10	32.04	21	Ero	58	2	209	63	Ekiti	13	Ero (WTW)	45.2	80.0	104,500	18.10	32.04
7	Oyun	3.51	6.21	31	Oyun	121	2	212	65	Kwara	23	Offa/Oyun (Old, WTW)	45.2	80.0	4,500	0.78	1.38
				31	Oyun	122	2	212	65	Kwara	23	Offa/Oyun (New, WTW)	45.2	80.0	15,750	2.73	4.83
8	Suleja	8.66	15.33	35	Suleja	141	2	202021	39	Niger	26	Suleja (WTW)	45.2	80.0	50,000	8.66	15.33
9	Tagwai/Minna	13.73	24.30	36	Tagwai	134	2	206	47	Niger	26	Chanchaga Old (WTW)	45.2	80.0	2,250	0.39	0.69
				36	Tagwai	135	2	206	47	Niger	26	Chanchaga (WTW)	45.2	80.0	77,000	13.34	23.61
10	Balanga	0.00	11.65	40	Balanga	1031	3	31405	95	Gombe	15	Balanga (WTW)	0.0	80.0	38,000	0.00	11.65
11	Biu	0.00	3.68	41	Biu	1013	3	31405	95	Borno	8	Biu (WTW)	0.0	80.0	12,000	0.00	3.68
12	Gubi/Bauchi	8.66	15.33	44	Gubi	18	3	31409	99	Bauchi	5	Bauchi/Gubi (WTW)	45.2	80.0	40,000	6.93	12.26
				44	Gubi	19	3	31409	99	Bauchi	5	Bauchi/Gubi (P-WTW)	45.2	80.0	10,000	1.73	3.07
13	Yakubu Gowon/Jos	14.28	14.28	47	Yakubu Gowon	226	3	31409	99	Plateau	31	Bukuku/Yakubu-Gowon (WTW)	41.4	41.4	90,000	14.28	14.28
14	Doma/Lafia	1.56	11.65	50	Doma	127	4	404	112	Nasarawa	25	Doma (WTW)	45.2	80.0	9,000	1.56	2.76
				50	Doma	1060	4	404	112	Nasarawa	25	Doma (WTW)	0.0	80.0	29,000	0.00	8.89
15	Langtang	3.12	5.52	52	Langtang	227	3	304	80	Plateau	31	Langtang (WTW)	45.2	80.0	18,000	3.12	5.52
16	Egbe	11.43	20.24	63	Egbe	55	6	614	147	Ekiti	13	Egbe/Little-Osse (WTW)	45.2	80.0	66,000	11.43	20.24
17	Eko-Ende	2.08	3.68	64	Eko-Ende	191	6	608	142	Osun	29	Eko-Ende (WTW)	45.2	80.0	12,000	2.08	3.68
18	Itapaji	0.87	3.07	71	Itapaji	57	2	20403	45	Ekiti	13	Itapaji (WTW)	45.2	80.0	5,000	0.87	1.53
				71	Itapaji	1028	2	20403	45	Ekiti	13	Itapaji (WTW)	0.0	80.0	5,000	0.00	1.53
19	Guzuguzu	1.25	1.90	89	Guzuguzu	1039	8	8080743	191	Kano	19	Guzu-Guzu (WTW)	0.0	0.0	20,000	0.00	0.00
				89	Guzuguzu	82	8	8080743	191	Kano	19	Guzu-Guzu (Disinfection)	45.2	68.7	7,200	1.25	1.90
20	Karaye	1.22	1.22	92	Karaye	84	8	8080743	191	Kano	19	Kusalla (WTW)	21.2	21.2	15,000	1.22	1.22
21	Laminga/Jos	3.12	5.52	93	Laminga	225	8	808063	182	Plateau	31	Jos/Lamiga (WTW)	45.2	80.0	18,000	3.12	5.52
22	Moh.Ayuba	1.73	1.75	96	Moh.Ayuba	65	8	8080721_i	185	Jigawa	17	Kazaure (WTW?)	45.2	45.2	10,000	1.73	1.73
23	Eleyele	4.72	8.35	115	Eleyele	213	6	606	140	Oyo	30	Ibadan/Eleyele (WTW)	45.2	80.0	27,240	4.72	8.35
24	Lafia	1.05	1.05	131	Lafia	128	4	404	112	Nasarawa	25	Lafia (WTW)	20.3	20.3	13,500	1.05	1.05
25	Nassarawa	0.39	4.83	132	Nassarawa	129	4	402	110	Nasarawa	25	Nasarawa (WTW)	45.2	80.0	2,250	0.39	0.69
				132	Nassarawa	1061	4	402	110	Nasarawa	25	Nasarawa (WTW)	0.0	80.0	13,500	0.00	4.14
26	Ikpoba/Benin	2.60	4.60	134	Ikpoba	53	6	616	148	Edo	12	Benin/Ikpoba (WTW)	45.2	80.0	15,000	2.60	4.60
27	Ureje	1.73	2.68	144	Ureje	54	6	614	147	Ekiti	13	Ado/Ureje (WTW)	45.2	70.0	10,000	1.73	2.68
28	Lokpanta/Okigwe	7.80	13.80	149	Lokpanta	62	7	702	151	Imo	16	Okigwe (M-WTW)	45.2	80.0	45,000	7.80	13.80
29	Ife	0.00	9.20	1002	Ile-Ife	1084	6	610	144	Osun	29	Ife (WTW)	0.0	80.0	30,000	0.00	9.20
30	Ilesha	0.00	18.40	1003	Ilesha	1083	6	608	142	Osun	29	Ilesha (WTW)	0.0	80.0	60,000	0.00	18.40
31	Owena	4.34	26.08	1005	Owena & Owena Multi	159	6	612	146	Ondo	28	Owena/Ondo-Road (WTW)	45.2	80.0	19,600	3.40	6.01
				1005	Owena & Owena Multi	160	6	612	146	Ondo	28	Owena/Igbara-Oke (WTW)	45.2	80.0	5,450	0.94	1.67
				1005	Owena & Owena Multi	1080	6	612	146	Ondo	28	Owena Dam (WTW)	0.0	80.0	60,000	0.00	18.40
32	Otukpo	0.94	6.25	1022	Otukpo	35	7	704043	158	Benue	7	Otobi Old (WTW)	45.2	80.0	5,400	0.94	1.66
				1022	Otukpo	503	7	704043	158	Benue	7	Otobi New (WTW)	0.0	80.0	15,000	0.00	4.60
33	Mangu	0.00	3.07	1026	Mangu	228	4	31409	99	Plateau	31	Mangu (WTW)	0.0	80.0	10,000	0.00	3.07
34	Aba	9.18	16.25	5001	Aba R.	1	7	702	151	Abia	1	Aba (WTW?)	45.2	80.0	53,000	9.18	16.25
35	Mudi	2.08	3.68	5002	Yedseram R.	9	8	80403_i	169	Adamawa	2	Mubi (WTW)	45.2	80.0	12,000	2.08	3.68
36	Akamkpa	1.73	3.07	5005	Calabar R.	43	7	705	161	Cross River	9	Akamkpa (WTW)	45.2	80.0	10,000	1.73	3.07
37	Calabar	13.86	24.53	5006	Great Kwa R.	44	7	705	161	Cross River	9	Calabar (WTW)	45.2	80.0	80,000	13.86	24.53
38	Ogoja	0.00	5.36	5007	Abe R.	48	7	704042	157	Cross River	9	Ogoja (Old, WTW)	0.0	0.0	450	0.00	0.00
				5007	Abe R.	49	7	704042	157	Cross River	9	Ogoja (New, WTW)	0.0	0.0	3,450	0.00	0.00
				5007	Abe R.	1021	7	704042	157	Cross River	9	Ogoja Phase-1 (WTW)	0.0	80.0	8,144	0.00	2.50
				5007	Abe R.	1022	7	704042	157	Cross River	9	Ogoja Phase-2 (WTW)	0.0	80.0	9,336	0.00	2.86
39	Ishielu/Ezzilo	4.40	7.78	5008	Aya R.	50	7	70402	154	Ebonyi	11	Ishielu/Ezzilo WTW	45.2	80.0	25,380	4.40	7.78
40	Ajalli	13.34	23.61	5012	Ajalli R.	59	5	50402	124	Enugu	14	Ajalli (WTW)	45.2	80.0	77,000	13.34	23.61
41	Owerri/Otamiri	10.39	18.40	5013	Otamiri R.	63	7	702	151	Imo	16	Owerri/Otamiri (WTW)	45.2	80.0	60,000	10.39	18.40
42	Kwoi	2.13	3.77	5014	Gurara R.	68	2	20205	42	Kaduna	18	Kwoi (WTW)	45.2	80.0	12,300	2.13	3.77
43	Kafanchan	2.29	4.05	5015	River/Steam(Unknown)	69	4	404	112	Kaduna	18	Kafanchan (WTW)	45.2	80.0	13,200	2.29	4.05
44	Keffi/Mada	7.80	13.80	5023	Mada R.	126	4	404	112	Nasarawa	25	Keffi/Mada (WTW)	45.2	80.0	45,000	7.80	13.80
45	Bida	4.68	9.20	5026	Gbako R.	132	2	206	47	Niger	26	Bida (WTW)	45.2	80.0	27,000	4.68	8.28
				5026	Gbako R.	1063	2	206	47	Niger	26	Bida (P-WTW)	0.0	80.0	3,000	0.00	0.92
46	Ota	1.59	5.64	5030	River/Steam(Unknown)	144	6	603	132	Ogun	27	Ota Old (WTW)	45.2	80.0	2,450	0.42	0.75
				5030	River/Steam(Unknown)	145	6	603	132	Ogun	27	Ota New (WTW)	45.2	80.0	6,750	1.17	2.07
				5030	River/Steam(Unknown)	1069	6	603	132	Ogun	27	Ota Old (WTW)	0.0	80.0	2,450	0.00	0.75
				5030	River/Steam(Unknown)	1070	6	603	132	Ogun	27	Ota New (WTW)	0.0	80.0	6,750	0.00	2.07
47	Ifo Akinsede /Papalanto	2.08	3.68	5031	River/Steam(Unknown)	148	6	60401	133	Ogun	27	Ifo Akinsede/Papalanto(WTW)	45.2	80.0	12,000	2.08	3.68
48	Ijebu-Ode/Yemoji	3.12	5.52	5032	River/Steam(Unknown)	151	6	606	140	Ogun	27	Ijebu-Ode/Yemoji (WTW)	45.2	80.0	18,000	3.12	5.52
49	Ogere & Shagamu	2.29	4.05	5033	River/Steam(Unknown)	152	6	606	140	Ogun	27	Ogere (WTW)	45.2	80.0	6,700	1.16	2.05
				5033	River/Steam(Unknown)	157	6	606	140	Ogun	27	Shagamu (WTW)	45.2	80.0	6,500	1.13	1.99
50	Greater Awka	0.00	30.66	5045	Mamu(Ezu) R.	1008	5	50502	124	Anambra	4	Greater Awka (WTW)	0.0	80.0	100,000	0.00	30.66
51	Ihiala Regional	0.00	13.18	5046	Ntamili R.	1009	5	506	126	Anambra	4	Ihiala Regional (WTW)	0.0	80.0	43,000	0.00	13.18
52	Nnewi Regional	0.00	25.14	5047	Ubor R.	1010	5	506	126	Anambra	4	Nnewi Regional (WTW)	0.0	80.0	82,000	0.00	25.14
53	Ohafia-Ukawu	0.00	25.14	1012	Unknown(Ivo)	1025	7	70402	154	Ebonyi	11	Ohafia-Ukawu (WTW)	0.0	65.6	100,000	0.00	25.14
54	Kachia	0.00	3.37	5051	Unknown	1033	2	20205	42	Kaduna	18	Kachia (WTW)	0.0	80.0	11,000	0.00	3.37
55	Otta Ikosi	0.00	5.58	5053	Aye R.	1051	6	606	140	Lagos	24	Otta Ikosi (WTW)	0.0	80.0	18,184	0.00	5.58
56	Yewa Regional	0.00	0.00	5056	Yewa R.	1071	6	602_i	131	Ogun	27	Yewa Regional-1 (WTW)	0.0	0.0	100,000	0.00	0.00
				5056	Yewa R.	1072	6	602_i	131	Ogun	27	Yewa Regional-2 (WTW)	0.0	0.0	100,000	0.00	0.00
57	Waya/Bauchi	0.00	6.13	46	Waya	1012	3	31409	99	Bauchi	5	Bauchi/Waya(WTW)	0.0	80.0	20,000	0.00	6.13
58	Barakin/Jos	0.00	13.41	6001	Barakin	1102	3	31409	99	Plateau	31	Jos/Barakin (WTW)	0.0	80.0	43,750	0.00	13.41

Annex-T SR3-7 Water Balance Study for Municipal Water Supply inside SHA (without Proposed Dams)

No	Scheme/City	Demand (MCM/year)		SN of Source	Name of Source	Status of Source	HA	SHA	SN-SHA	State	SN-State	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Share Ratio of Dam Catchment (-)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Supply Capacity with 90% Year Dependability (MCM/y)
		2010	2030																				
1	Ajiwa	7.01	7.01	1	Ajiwa	E	1	106082_i2	17	Katsina	20	1,782	1,732	18.2	18.3	32	1.000	22.0	17.2	6.3	1,661	0.00	7.01
2	Gusau	7.80	13.80	5	Gusau	E	1	106093	31	Zamfara	36	2,570	2,332	187.5	180.0	482	1.000	3.0	2.5	3.2	1,654	0.00	3.21
3	Mairuwa	3.20	5.67	9	Mariura+Gwaigwaye	E	1	106093	31	Katsina	20	238	238	233.2	233.2	56	1.000	10.7	8.4	3.6	1,531	0.00	9.65
4	Agba/Ilorin	2.34	4.14	16	Agba	E	2	212	65	Kwara	23	715	536	146.3	146.3	105	1.000	2.7	2.1	0.6	1,630	0.00	4.32
5	Asa/Ilorin	19.88	35.18	17	Asa	E	2	212	65	Kwara	23	905	905	136.0	136.0	123	1.000	43.0	34.4	9.3	1,643	0.00	40.97
6	Ero	18.10	32.04	21	Ero	E	2	209	63	Ekiti	13	466	466	193.3	193.3	90	1.000	20.0	18.5	4.9	1,478	0.01	36.09
7	Oyun	3.51	6.21	31	Oyun	E	2	212	65	Kwara	23	109	109	159.1	159.1	17	1.000	2.1	1.6	1.2	1,573	0.00	2.29
8	Suleja	8.66	15.33	35	Suleja	E	2	202021	39	Niger	26	139	139	374.0	374.0	52	1.000	52.0	48.5	5.3	1,579	0.10	35.28
9	Tagwai/Minna	13.73	24.30	36	Tagwai	E	2	206	47	Niger	26	1,171	1,171	237.6	237.6	278	0.144	28.3	26.4	4.7	1,742	0.06	50.87
10	Balanga	0.00	11.65	40	Balanga	E	3	31405	95	Gombe	15	313	313	244.9	244.9	77	1.000	73.0	63.0	7.8	1,633	0.00	33.07
11	Biu	0.00	3.68	41	Biu	E	3	31405	95	Borno	8	153	153	87.6	87.6	13	1.000	11.1	9.6	1.5	1,448	0.00	5.16
12	Gubi/Bauchi	8.66	15.33	44	Gubi	E	3	31409	99	Bauchi	5	181	181	133.0	133.0	24	1.000	38.4	35.2	7.9	1,571	0.01	16.48
13	Yakubu Gowon/Jos	14.28	14.28	47	Yakubu Gowon	E	3	31409	99	Plateau	31	82	82	235.9	235.9	19	1.000	30.0	22.0	4.8	1,296	0.01	14.27
14	Doma/Lafia	1.56	11.65	50	Doma	E	4	404	112	Nasarawa	25	250	250	300.0	300.0	75	1.000	37.5	28.5	9.3	1,743	0.18	45.87
15	Langtang	3.12	5.52	52	Langtang	E	3	304	80	Plateau	31	52	52	251.9	251.9	13	1.000	4.6	3.5	0.6	1,689	0.00	6.09
16	Egbe	11.43	20.24	63	Egbe	E	6	614	147	Ekiti	13	298	298	244.9	244.9	73	1.000	23.0	21.8	4.3	1,499	0.12	35.28
17	Eko-Ende	2.08	3.68	64	Eko-Ende	E	6	608	142	Osun	29	537	537	232.3	232.3	125	1.000	5.5	5.3	0.9	1,583	0.01	14.64
18	Itapaji	0.87	3.07	71	Itapaji	E	2	20403	45	Ekiti	13	338	338	221.6	221.6	75	1.000	1.5	1.2	1.0	1,497	0.01	3.58
19	Guzuguzu	1.25	1.90	89	Guzuguzu	E	8	8080743	191	Kano	19	100	100	72.6	72.6	7	1.000	24.6	21.5	4.3	1,602	0.00	1.90
20	Karaye	1.22	1.22	92	Karaye	E	8	8080743	191	Kano	19	83	83	39.0	39.0	3	1.000	17.2	16.6	2.3	1,596	0.00	1.22
21	Laminga/Jos	3.12	5.52	93	Laminga	E	8	808063	182	Plateau	31	30	30	251.3	251.3	8	1.000	20.0	15.0	1.5	1,279	0.00	5.70
22	Moh.Ayuba	1.73	1.73	96	Moh.Ayuba	E	8	8080721_i	185	Jigawa	17	383	383	14.9	14.9	6	1.000	5.5	4.3	0.7	1,685	0.00	1.74
23	Eleyele	4.72	8.35	115	Eleyele	E	6	606	140	Oyo	30	321	321	233.4	233.4	75	1.000	7.0	5.5	2.1	1,640	0.01	10.83
24	Lafia	1.05	1.05	131	Lafia	E	4	404	112	Nasarawa	25	103	103	314.2	314.2	32	1.000	0.2	0.1	0.1	1,749	0.08	1.05
25	Nassarawa	0.39	4.83	132	Nassarawa	E	4	402	110	Nasarawa	25	3,363	3,363	391.5	391.5	1,317	1.000	0.6	0.4	0.1	1,700	2.73	8.74
26	Ikpoba/Benin	2.60	4.60	134	Ikpoba	E	6	616	148	Edo	12	734	734	517.0	517.0	379	1.000	1.5	1.2	0.4	1,590	1.02	6.53
27	Ureje	1.73	2.68	144	Ureje	E	6	614	147	Ekiti	13	30	30	264.3	264.3	8	1.000	1.3	1.0	0.2	1,505	0.01	2.69
28	Lokpanta/Okigwe	7.80	13.80	149	Lokpanta	E	7	702	151	Imo	16	538	538	829.4	829.4	446	1.000	0.1	0.1	0.1	1,649	2.28	1.00
29	Ilesha	0.00	9.20	1002	Ile-Ife	U	6	610	144	Osun	29	170	170	225.2	225.2	38	1.000	14.0	10.9	1.7	1,608	0.00	14.22
30	Ife	0.00	18.40	1003	Ilesha	U	6	608	142	Osun	29	285	285	249.9	249.9	71	1.000	25.0	19.5	3.1	1,601	0.01	24.73
31	Owena	4.34	26.08	1005	Owena & Owena Multi	U	6	612	146	Ondo	28	695	695	266.5	266.5	185	1.000	36.0	28.1	4.4	1,551	0.14	65.62
32	Otukpo	0.94	6.25	1022	Otukpo	U	7	704043	158	Benue	7	1,108	1,108	627.6	627.6	695	1.000	30.0	23.4	2.4	1,683	0.19	93.78
33	Mangu	0.00	3.07	1026	Mangu	U	4	31409	99	Plateau	31	*Not Available*											
34	Aba	9.18	16.25	5001	Aba R.		7	702	151	Abia	1	210	210	981.0	981.0	206	1.000	0.0	0.0	0.0	0	1.05	1.20
35	Mudi	2.08	3.68	5002	Yedseram R.		8	80403_i	169	Adamawa	2	143	143	74.0	74.0	11	1.000	0.0	0.0	0.0	0	0.00	0.00
36	Akamkpa	1.73	3.07	5005	Calabar R.		7	705	161	Cross River	9	489	489	1,103.0	1,103.0	539	1.000	0.0	0.0	0.0	0	3.12	12.00
37	Calabar	13.86	24.53	5006	Great Kwa R.		7	705	161	Cross River	9	1,204	1,204	1,225.0	1,225.0	1,475	1.000	0.0	0.0	0.0	0	8.52	32.40
38	Ogoja	0.00	5.36	5007	Abe R.		7	704042	157	Cross River	9	1,368	1,346	967.7	968.0	1,324	1.000	0.0	0.0	0.0	0	0.48	0.00
39	Ishielu/Ezzilo	4.40	7.78	5008	Aya R.		7	70402	154	Ebonyi	11	1,244	1,244	550.0	550.0	684	1.000	0.0	0.0	0.0	0	0.42	0.00
40	Ajalli	13.34	23.61	5012	Ajalli R.		5	50402	124	Enugu	14	84	84	576.5	576.5	48	1.000	0.0	0.0	0.0	0	0.11	0.00
41	Owerri/Otamiri	10.39	18.40	5013	Otamiri R.		7	702	151	Imo	16	160	160	993.0	993.0	159	1.000	0.0	0.0	0.0	0	0.81	0.03
42	Kwoi	2.13	3.77	5014	Gurara R.		2	20205	42	Kaduna	18	613	613	509.1	509.1	312	1.000	0.0	0.0	0.0	0	0.66	0.00
43	Kafanchan	2.29	4.05	5015	River/Steam(Unknown)		4	404	112	Kaduna	18	190	190	561.3	561.3	107	1.000	0.0	0.0	0.0	0	0.26	0.17
44	Keffi/Mada	7.80	13.80	5023	Mada R.		4	404	112	Nasarawa	25	4,452	4,014	501.6	491.8	2,233	1.000	0.0	0.0	0.0	0	4.84	1.00
45	Bida	4.68	9.20	5026	Gbako R.		2	206	47	Niger	26	6,057	4,708	184.0	182.2	1,114	1.000	0.0	0.0	0.0	0	0.18	0.00
46	Ota	1.59	5.64	5030	River/Steam(Unknown)		6	603	132	Ogun	27	279	279	184.8	184.8	52	1.000	0.0	0.0	0.0	0	0.00	0.00
47	Ifo	2.08	3.68	5031	River/Steam(Unknown)		6	60401	133	Ogun	27	168	168	87.6	87.6	15	1.000	30.0	23.4	3.8	1,687	0.00	9.11
48	Ijebu-Ode/Yemoji	3.12	5.52	5032	River/Steam(Unknown)		6	606	140	Ogun	27	3,152	2,831	205.8	202.5	649	1.000	0.0	0.0	0.0	0	0.05	0.00
49	Ogere & Shagamu	2.29	4.05	5033	River/Steam(Unknown)		6	605	139	Ogun	27	552	552	188.0	226.9	104	1.000	0.0	0.0	0.0	0	0.01	0.00
50	Greater Awka	0.00	30.66	5045	Mamu(Ezu) R.		5	50402	124	Anambra	2	948	948	576.3	576.3	546	1.000	0.0	0.0	0.0	0	1.19	0.00
51	Ihiala Regional	0.00	13.18	5046	Ntamili R.		5	506	126	Anambra	2	677	677	698.7	698.7	473	1.000	0.0	0.0	0.0	0	1.40	0.24
52	Nnewi Regional	0.00	25.14	5047	Ubor R.		5	506	126	Anambra	2	136	136	590.0	590.0	80	1.000	0.0	0.0	0.0	0	0.24	0.04
53	Ohafia-Ukawu	0.00	25.14	1012	Unknown(Ivo)	U	7	70402	154	Ebonyi	11	2,873	2,580	706.2	707.8	2,029	0.102	20.0	15.6	3.4	1,716	1.13	104.66
54	Kachia	0.00	3.37	5051	Unknown		2	20205	42	Kaduna	18	571	571	435.7	435.7	249	1.000	0.0	0.0	0.0	0	0.52	0.00
55	Otta Ikosi	0.00	5.58	5053	Aye R.		6	605	139	Lagos	24	1,007	455	219.1	264.1	221	1.000	0.0	0.0	0.0	0	0.01	0.00
56	Yewa Regional	0.00	0.00	5056	Yewa R.		6	602_i	131	Ogun	27	3,088	2,910	89.6	88.2	277	1.000	0.0	0.0	0.0	0	0.00	0.00

Status of Source: E=Exsiting, U=Under Construction

Annex-T SR3-8 Water Balance Study for Municipal Water Supply inside SHA (with Proposed Dams)

No	Scheme/City	Demand (MCM/year)		SN of Source	Name of Source	SN-Proposed Additional Source	Status of Source	HA	SHA	SN-SHA	State	SN-State	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Share Ratio of Dam Catchment (-)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Supply Capacity with 90% Year Dependability (MCM/y)
		2010	2030																					
1	Ajiwa	7.01	7.01	1	Ajiwa		E	1	106082_i2	17	Katsina	20	1,782	1,732	18.2	18.3	32	1.000	22.0	17.2	6.3	1,661	0.00	7.01
2	Gusau	7.80	13.80	5	Gusau	4008	P	1	106093	31	Zamfara	36	2,570	2,332	187.5	180.0	482	0.966	29.7	23.2	5.6	1,642	0.00	35.28
3	Mairuwa	3.20	5.67	9	Mariura+Gwaigwaye		E	1	106093	31	Katsina	20	238	238	233.2	233.2	56	1.000	10.7	8.4	3.6	1,531	0.00	9.65
4	Agba/Ilorin	2.34	4.14	16	Agba		E	2	212	65	Kwara	23	715	715	146.3	146.3	105	1.000	2.7	2.1	0.6	1,630	0.00	4.65
5	Asa/Ilorin	19.88	35.18	17	Asa		E	2	212	65	Kwara	23	905	905	136.0	136.0	123	1.000	43.0	34.4	9.3	1,643	0.00	40.97
6	Ero	18.10	32.04	21	Ero		E	2	209	63	Ekiti	13	466	466	193.3	193.3	90	1.000	20.0	18.5	4.9	1,478	0.01	36.09
7	Oyun	3.51	6.21	31	Oyun	2023	P	2	212	65	Kwara	23	109	109	159.1	159.1	17	0.853	18.9	14.8	3.5	1,573	0.00	8.74
8	Suleja	8.66	15.33	35	Suleja		E	2	202021	39	Niger	26	139	139	374.0	374.0	52	1.000	52.0	48.5	5.3	1,579	0.10	35.28
9	Tagwai/Minna	13.73	24.30	36	Tagwai		E	2	206	47	Niger	26	1,171	1,171	237.6	237.6	278	0.144	28.3	26.4	4.7	1,742	0.06	50.87
10	Balanga	0.00	11.65	40	Balanga		E	3	31405	95	Gombe	15	313	313	244.9	244.9	77	1.000	73.0	63.0	7.8	1,633	0.00	33.07
11	Biu	0.00	3.68	41	Biu		E	3	31405	95	Borno	8	153	153	87.6	87.6	13	1.000	11.1	9.6	1.5	1,448	0.00	5.16
12	Gubi/Bauchi	8.66	15.33	44	Gubi		E	3	31409	99	Bauchi	5	181	181	133.0	133.0	24	1.000	38.4	35.2	7.9	1,571	0.01	16.48
13	Yakubu Gowon/Jos	14.28	14.28	47	Yakubu Gowon		E	3	31409	99	Plateau	31	82	82	235.9	235.9	19	1.000	30.0	22.0	4.5	1,296	0.01	14.28
14	Doma/Lafia	1.56	11.65	50	Doma		E	4	404	112	Nasarawa	25	250	250	300.0	300.0	75	1.000	37.5	28.5	9.3	1,743	0.18	45.87
15	Langtang	3.12	5.52	52	Langtang		E	3	304	80	Plateau	31	52	52	251.9	251.9	13	1.000	4.6	3.5	0.6	1,689	0.00	6.01
16	Egbe	11.43	20.24	63	Egbe		E	6	614	147	Ekiti	13	298	298	244.9	244.9	73	1.000	23.0	21.8	4.3	1,499	0.12	35.28
17	Eko-Ende	2.08	3.68	64	Eko-Ende		E	6	608	142	Osun	29	537	537	232.3	232.3	125	1.000	5.5	5.3	0.9	1,583	0.01	14.64
18	Itapaji	0.87	3.07	71	Itapaji		E	2	20403	45	Ekiti	13	338	338	221.6	221.6	75	1.000	1.5	1.2	1.0	1,497	0.01	3.58
19	Guzuguzu	1.25	1.90	89	Guzuguzu		E	8	8080743	191	Kano	19	100	100	72.6	72.6	7	1.000	24.6	21.5	4.3	1,602	0.00	1.90
20	Karaye	1.22	1.22	92	Karaye		E	8	8080743	191	Kano	19	83	83	39.0	39.0	3	1.000	17.2	16.6	2.3	1,596	0.00	1.22
21	Laminga/Jos	3.12	5.52	93	Laminga		E	8	808063	182	Plateau	31	30	30	251.3	251.3	8	1.000	20.0	15.0	1.5	1,279	0.00	5.70
22	Moh.Ayuba	1.73	1.73	96	Moh.Ayuba		E	8	8080721_i	185	Jigawa	17	383	383	14.9	14.9	6	1.000	5.5	4.3	0.7	1,685	0.00	1.75
23	Eleyele	4.72	8.35	115	Eleyele		E	6	606	140	Oyo	30	321	321	233.4	233.4	75	1.000	7.0	5.5	2.1	1,640	0.01	10.83
24	Lafia	1.05	1.05	131	Lafia		E	4	404	112	Nasarawa	25	103	103	314.2	314.2	32	1.000	0.2	0.1	0.1	1,749	0.08	1.18
25	Nassarawa	0.39	4.83	132	Nassarawa		E	4	402	110	Nasarawa	25	3,363	3,363	391.5	391.5	1,317	1.000	0.6	0.4	0.1	1,700	2.73	8.74
26	Ikpoba/Benin	2.60	4.60	134	Ikpoba		E	6	616	148	Edo	12	734	734	517.0	517.0	379	1.000	1.5	1.2	0.4	1,590	1.02	6.53
27	Ureje	1.73	2.68	144	Ureje		E	6	614	147	Ekiti	13	30	30	264.3	264.3	8	1.000	1.3	1.0	0.2	1,505	0.01	2.69
28	Lokpanta/Okigwe	7.80	13.80	149	Lokpanta	4015	P	7	702	151	Imo	16	538	538	829.4	829.4	446	0.268	9.3	7.2	4.3	1,647	2.28	63.07
29	Ilesha	0.00	9.20	1002	Ile-Ife		U	6	610	144	Osun	29	170	170	225.2	225.2	38	1.000	14.0	10.9	1.7	1,608	0.00	14.22
30	Ife	0.00	18.40	1003	Ilesha		U	6	608	142	Osun	29	285	285	249.9	249.9	71	1.000	25.0	19.5	3.1	1,601	0.01	24.73
31	Owena	4.34	26.08	1005	Owena & Owena Multi		U	6	612	146	Ondo	28	695	695	266.5	266.5	185	1.000	36.0	28.1	4.4	1,551	0.14	65.62
32	Otukpo	0.94	6.25	1022	Otukpo		U	7	704043	158	Benue	7	1,108	1,108	627.6	627.6	695	1.000	30.0	23.4	2.4	1,683	0.19	92.25
33	Mangu	0.00	3.07	1026	Mangu		U	4	31409	99	Plateau	31	*Not Available*											
34	Aba	9.18	16.25	5001	Aba R.	4012	P	7	702	151	Abia	1	210	210	981.0	981.0	206	0.752	3.4	2.7	0.7	1,617	1.05	25.98
35	Mudi	2.08	3.68	5002	Yedseram R.	4013	P	8	80403_i	169	Adamawa	2	164	164	74.0	74.0	12	0.884	6.0	4.7	0.9	1,510	0.00	3.76
36	Akamkpa	1.73	3.07	5005	Calabar R.			7	705	161	Cross River	9	489	489	1,103.0	1,103.0	539	1.000	0.0	0.0	0.0	0	3.12	12.00
37	Calabar	13.86	24.53	5006	Great Kwa R.			7	705	161	Cross River	9	2,714	2,225	1,164.0	1,164.0	3,159	1.000	0.0	0.0	0.0	0	8.52	57.60
38	Ogoja	0.00	5.36	5007	Abe R.	2245	P	7	704042	157	Cross River	9	1,368	1,346	967.7	968.0	1,324	0.121	5.4	4.2	3.1	1,683	0.48	26.36
39	Ishielu/Ezzilo	4.40	7.78	5008	Aya R.	4016	P	7	70402	154	Ebonyi	11	1,244	1,244	550.0	550.0	684	0.005	2.3	1.8	0.5	1,714	0.42	15.11
40	Ajalli	13.34	23.61	5012	Ajalli R.	2185	P	5	50402	124	Enugu	14	219	219	576.5	622.0	622	1.000	16.9	13.2	2.6	1,629	0.11	35.28
41	Owerri/Otamiri	10.39	18.40	5013	Otamiri R.	4002	P	7	702	151	Imo	16	230	230	961.5	961.5	221	1.000	3.9	3.0	1.2	1,605	0.81	28.63
42	Kwoi	2.13	3.77	5014	Gurara R.	4017	P	2	20205	42	Kaduna	18	613	613	509.1	509.1	312	0.134	2.5	2.0	1.1	1,440	0.66	16.42
43	Kafanchan	2.29	4.05	5015	River/Steam(Unknown)	4003	P	4	404	112	Kaduna	18	190	190	561.3	561.3	107	0.953	3.1	2.4	1.3	1,440	0.26	13.22
44	Keffi/Mada	7.80	13.80	5023	Mada R.	4005	P	4	404	112	Nasarawa	25	4,452	4,014	501.6	491.8	2,233	0.399	3.4	2.7	1.0	1,603	4.84	34.10
45	Bida	4.68	9.20	5026	Gbako R.	2067	P	2	206	47	Niger	26	6,057	4,708	184.0	182.2	1,114	0.007	3.2	2.5	1.0	1,809	0.18	13.16
46	Ota	1.59	5.64	5030	River/Steam(Unknown)	4014	P	6	603	132	Ogun	27	279	279	184.8	184.8	52	0.204	6.4	5.0	1.5	1,660	0.00	7.63
47	Ifo	2.08	3.68	5031	River/Steam(Unknown)			6	60401	133	Ogun	27	168	168	87.6	87.6	15	1.000	30.0	23.4	3.8	1,687	0.00	9.11
48	Ijebu-Ode/Yemoji	3.12	5.52	5032	River/Steam(Unknown)	4018	P	6	606	140	Ogun	27	3,152	2,831	205.8	202.5	649	0.592	3.3	2.6	1.5	1,703	0.05	7.85
49	Ogere & Shagamu	2.29	4.05	5033	River/Steam(Unknown)	2205	P	6	605	139	Ogun	27	552	552	188.0	226.9	104	1.000	20.6	16.1	4.6	1,673	0.01	29.59
50	Greater Awka	0.00	30.66	5045	Mamu(Ezu) R.	4009	P	5	50402	124	Anambra	2	948	948	576.3	576.3	546	0.139	9.5	7.4	3.4	1,683	1.19	45.60
51	Ihiala Regional	0.00	13.18	5046	Ntamili R.	4010	P	5	506	126	Anambra	2	677	677	698.7	698.7	473	1.000	3.4	2.7	1.4	1,673	1.40	29.05
52	Nnewi Regional	0.00	25.14	5047	Ubor R.	4011	P	5	506	126	Anambra	2	136	136	590.0	590.0	80	1.000	24.0	18.8	3.6	1,653	0.24	43.98
53	Ohafia-Ukawu	0.00	25.14	1012	Unknown(Ivo)		U	7	70402	154	Ebonyi	11	2,873	2,580	706.2	707.8	2,029	0.102	20.0	15.6	3.4	1,716	1.13	104.66
54	Kachia	0.00	3.37	5051	Unknown	4004	P	2	20205	42	Kaduna	18	570	570	435.7	435.7	248	0.972	3.5	2.7	1.5	1,463	0.52	19.68
55	Otta Ikosi	0.00	5.58	5053	Aye R.	2205	P	6	605	139	Lagos	24	*Jointly evaluated with 49:Ogere & Shagamu*											
56	Yewa Regional	0.00	0.00	5056	Yewa R.			6	602_i	131	Ogun	27	3,088	2,910	89.6	88.2	277	1.000	0.0	0.0	0.0	0	0.00	0.00
57	Waya/Bauchi	0.00	6.13	46	Waya	46	E	3	31409	99	Bauchi	5	128	128	128.5	128.5	16	1.000	50.0	35.0	4.5	1,584	0.01	12.86
58	Barakin/Jos	0.00	13.41	6001	Barakin	4007	P	3	31409	99	Plateau	31	126	126	249.4	249.4	31	1.000	20.0	15.6	2.8	1,259	0.01	20.59

Status of Source: E=Exsiting, U=Under Construction, P=Proposed

Annex-T SR3-9 Water Balance Study for Irrigation Water Supply inside SHA (1/2)

No	SN-Irr	Name of Irrigation Scheme	Planned Irrigation Area (ha)	Irrigation Area (ha) 2010	Irrigation Area (ha) 2030	SN-Source	Name of Source	Status of Source	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Share Ratio of Dam Catchment (-)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Municipal Water Demand (MCM/year)	Irrigable Area with 80% Year Dependability (ha)
1	5	Swashi Valley	2,900	200	2,900	8	Kubil&Swashi	E	1	101	1	643	643	127.3	127.3	82	1.000	70.0	57.0	9.4	1,712	0.00	0.00	5,534
2	6	Sabke	1,200	540	130	148	Sabke	E	1	106082_i2	17	1,352	1,288	9.5	9.5	13	1.000	31.6	24.7	5.2	1,698	0.00	2.15	130
3	7	Ajiwa	1,900	500	0	1	Ajiwa	E	1	106082_i2	17	1,782	1,732	18.2	18.3	32	1.000	22.0	17.2	6.4	1,661	0.00	7.01	0
4	14	Omu-Aran	1,300	400	0	126	Omu-Aran	E	2	209	63	1	1	205.9	205.9	0	1.000	0.1	0.1	0.0	1,473	0.00	0.00	0
5	19	Oke Oyi	500	100	60	9999	NF		2	209	63	942	942	156.4	156.4	147	1.000	0.0	0.0	0.0	0	0.02	0.00	60
6	20	Oloru	500	20	0	9999	NF		2	212	65	2,996	425	140.1	135.8	420	1.000	0.0	0.0	0.0	0	0.00	0.00	0
7	22	Oro-Ago	500	80	10	9999	NF		2	209	63	177	177	169.4	169.4	30	1.000	0.0	0.0	0.0	0	0.00	0.00	10
8	23	Tungan Kowa	800	800	800	37	Tungan Kowa	E	2	20805	53	160	160	208.0	208.0	33	1.000	22.0	21.0	4.1	1,831	0.00	0.00	2,326
9	25	Agaie/ Lapai	1,000	20	1,000	2028	Agaie	P	2	206	47	270	270	167.9	167.9	45	1.000	44.0	34.4	9.5	1,793	0.01	0.00	2,609
10	26	Adorun	500	80	80	9999	NF		2	20401	44							*Not Available*						
11	27	Duku-Lade	2,000	200	1,200	2043	Lade	P	2	209	45	162	162	117.1	117.1	19	1.000	29.5	23.1	4.2	1,769	0.00	0.00	1,208
12	29	Guzan	1,500	400	0	9999	NF		2	20801	49	346	346	170.0	170.0	59	1.000	0.0	0.0	0.0	0	0.00	0.00	0
13	31	E.Lapai	2,000	100	2,000	155	Bakajeba	E	2	206	47	1,020	1,020	193.7	193.7	198	1.000	34.0	26.6	9.0	1,742	0.04	0.00	4,636
14	32	Bakogi	2,000	100	2,000	2069		P	2	206	47	839	236	155.9	146.2	131	1.000	48.7	38.1	10.4	1,810	0.01	0.00	2,097
15	33	Bagoma	500	50	500	19	Bagoma	E	2	20804	52	1,358	1,358	287.5	287.5	390	0.468	5.5	5.0	1.8	1,635	0.03	0.80	1,400
16	34	Zara	500	50	0	9999	NF		2	20804	52	1,358	448	290.0	268.6	394	1.000	0.0	0.0	0.0	0	0.01	0.00	0
17	35	Tubo	620	100	600	145	Kerawa	E	2	20812	59	279	279	135.4	135.4	38	1.000	3.5	2.8	0.7	1,527	0.01	0.00	600
18	38	Badeggi	830	830	830	2066	Mussa	P	2	206	47	120	120	148.3	148.3	18	1.000	13.2	10.3	3.1	1,812	0.00	0.00	925
19	39	Otibe	1,000	3	3	9999	NF		2	201	37							*Not Available*						
20	42	Ngalda	500	200	500	9999	NF		3	31409	99	19,152	16,208	128.2	115.2	2,455	1.000	0.0	0.0	0.0	0	0.68	0.00	884
21	47	Wase	500	100	90	9999	Gongola R.	E	3	304	80	3,347	3,347	233.9	233.9	783	1.000	0.0	0.0	0.0	0	0.16	0.00	90
22	50	Bagal	5,700	10	760	46	Waya	E	3	31409	99	128	128	128.5	128.5	16	1.000	50.0	35.0	4.5	1,584	0.01	5.84	762
23	51	Balanga	4,400	500	3,800	40	Balanga	E	3	31405	96	313	313	244.9	244.9	77	1.000	73.0	63.0	6.0	1,633	0.00	11.65	3,800
24	52	Kaititingo	2,300	0	0	9999	NF		3	31405	96	97	97	133.3	133.3	13	1.000	0.0	0.0	0.0	0	0.00	0.00	0
25	56	Shendam(1)	1,000	500	1,000	54	Shendam	E	4	410	119	265	265	272.7	272.7	72	1.000	6.3	4.9	1.5	1,770	0.02	0.00	1,154
26	57	Longkat	2,000	800	1,100	53	Pankisin	E	4	410	119	587	587	398.0	398.0	234	0.017	4.5	2.8	0.7	1,259	0.06	1.38	1,100
27	58	Dep	2,000	300	2,000	9999	NF		4	408	117	6,075	4,848	466.2	443.3	2,832	1.000	0.0	0.0	0.0	0	0.86	0.00	3,066
28	61	Doma	2,037	1,600	2,037	50	Doma	E	4	404	112	250	250	300.0	300.0	75	1.000	37.5	28.5	9.3	1,743	0.18	13.22	3,350
29	62	Awe	500	0	80	9999	NF		4	407	116	698	698	267.7	267.7	187	1.000	0.0	0.0	0.0	0	0.05	0.00	80
30	63	Umogidi	1,500	0	580	133	Umogodi	E	4	405	113	115	115	365.4	365.4	42	1.000	2.5	1.8	1.0	1,610	0.05	0.00	588
31	64	Oguma	1,000	100	1,000	9999	NF		4	401	109	1,403	1,403	255.9	255.9	359	1.000	0.0	0.0	0.0	0	0.22	0.00	1,179
32	66	Bokkos	1,000	18	360	49	Bokkos(2)	E	4	408	117	7	7	452.8	452.8	3	1.000	5.0	3.6	0.1	1,202	0.00	0.00	361
33	67	Wuse	1,000	50	1,000	9999	NF		4	408	117	9,525	3,450	397.1	272.1	3,782	1.000	0.0	0.0	0.0	0	0.37	0.00	1,350
34	68	Kiroki	1,000	15	15	9999	NF		4	405	113							*Not Available*						
35	70	Lower Anambra	5,000	3,850	5,000	9999	NF		5	50402	124	8,281	5,859	285.8	274.4	2,367	1.000	0.0	0.0	0.0	0	3.51	0.00	8,420
36	72	Adoru	500	100	500	9999	NF		5	50402	124	664	664	407.5	407.5	271	1.000	0.0	0.0	0.0	0	0.59	0.00	1,437
37	77	Ejule Ojebe	2,000	25	1,100	9999	NF		5	50402	124	762	762	259.2	259.2	198	1.000	0.0	0.0	0.0	0	0.43	0.00	1,100
38	78	Ofarachi	1,000	10	520	9999	NF		5	50402	124	1,132	370	252.8	231.3	286	1.000	0.0	0.0	0.0	0	0.19	0.00	520
39	80	Ada-Rice	5,000	1,000	1,000	9999	NF		5	50402	124	446	446	346.3	346.3	154	1.000	0.0	0.0	0.0	0	0.34	0.00	1,000
40	81	Uzo Uwani	1,000	315	50	9999	NF		5	50402	124	30	30	267.5	267.5	8	1.000	0.0	0.0	0.0	0	0.02	0.00	50

Status of Source: E =Existing, U = Under Construction, P = Proposed

Annex-T SR3-9 Water Balance Study for Irrigation Water Supply inside SHA (2/2)

No	SN-Irr	Name of Irrigation Scheme	Planned Irrigation Area (ha)	Irrigation Area (ha)		SN-Source	Name of Source	Status of Source	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Share Ratio of Dam Catchment (-)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Municipal Water Demand (MCM/year)	Irrigable Area with 80% Year Dependability (ha)
				2010	2030																			
41	82	Upper Ogun	2,000	10	600	1033	Igbojaye	E	6	604023_i	136	233	233	124.4	124.4	29	1.000	5.6	5.2	0.7	1,657	0.00	0.00	658
42	83	Ofiki(A)	2,000	24	60	74	Ofiki(A)	E	6	604023_i	136	11	11	131.3	131.3	1	1.000	1.3	1.2	0.5	1,620	0.00	0.00	64
43	85	Sepeteri(A)	2,000	24	30	82	Sepeteri(A)	E	6	60405	138	3	3	106.0	106.0	0	1.000	2.6	2.4	0.1	1,592	0.00	0.00	33
44	87	Iwo	1,000			9999	NF		6	608	142	71	71	211.2	211.2	15	1.000	0.0	0.0	0.0	0	0.00	0.00	0
45	88	Ilero	2,000			168	Okeho	E	6	604023_i	136	21	21	169.7	169.7	4	1.000	0.8	0.6	0.2	1,638	0.00	0.00	77
46	89	Otta	1,000			9999	NF		6	603	132	35	35	229.9	229.9	8	1.000	0.0	0.0	0.0	0	0.00	0.00	0
47	90	Eyinwa	1,000			9999	NF		6	606	140	3,244	92	211.2	289.7	685	1.000	0.0	0.0	0.0	0	0.00	0.00	10
48	91	Oke-Odan	600			77	Oke-Odan	E	6	602_i	131	71	71	129.7	129.7	9	1.000	5.5	4.3	0.2	1,710	0.00	0.00	400
49	92	Asa	500			73	Oba	E	6	608	142	341	341	181.1	181.1	62	1.000	4.6	4.1	1.4	1,612	0.01	0.00	761
50	93	Okuku	600			78	Okuku	E	6	608	142	3	3	211.3	211.3	1	1.000	0.7	0.5	0.2	1,573	0.00	0.00	36
51	95	Owena	500	500	500	1005	Owena Multipurpose	E	6	612	146	695	695	266.5	266.5	185	1.000	36.0	28.1	4.4	1,551	0.14	26.08	3,388
52	96	Oye	500	100	0	9999	NF		6	614	147	24	24	224.6	224.6	5	1.000	0.0	0.0	0.0	0	0.01	0.00	0
53	97	Esa Odo Dam	800	800	800	67	Esa-Odo	E	6	608	142	1,193	1,193	298.4	298.4	356	1.000	8.2	6.4	0.1	1,563	0.04	1.53	1,452
54	99	Nkari	2,080	0	600	1027	Nkari	U	7	70401	153	21	21	1,015.0	1,015.0	21	1.000	3.5	2.7	0.7	1,635	0.09	0.00	619
55	100	Ijegu Yala	2,000	80	80	9999	NF		7	704042	157	852	852	809.4	809.4	690	1.000	0.0	0.0	0.0	0	0.20	0.00	913
56	101	Abakaliki/ Iwa	1,000	1,000	1,000	9999	NF		7	70403	155	971	971	581.0	581.0	564	1.000	0.0	0.0	0.0	0	0.39	0.00	1,657
57	102	Imo (Igwu and Ibu)	1,200	80	0	149	Lokpanta	E	7	702	151	538	538	829.4	829.4	446	1.000	0.1	0.1	0.1	1,649	2.28	13.80	0
58	104	Bausara	2,000	0	2,000	9999	NF		7	704042	157	7,640	4,572	811.7	733.3	6,201	1.000	0.0	0.0	0.0	0	0.97	0.00	4,718
59	105	Isi-Uzo	500	71	290	9999	NF		7	70402	154	303	303	661.1	661.1	200	1.000	0.0	0.0	0.0	0	0.11	0.00	368
60	106	Itogodi	500	0	0	9999	NF		7	705	161	*Not Available*												
61	107	Igbere	1,300	250	440	9999	NF		7	70401	153	120	120	757.2	757.2	91	1.000	0.0	0.0	0.0	0	0.37	0.00	440
62	108	Ekoi	500	80	500	9999	NF		7	70401	153	572	572	881.0	881.0	504	1.000	0.0	0.0	0.0	0	2.08	0.00	2,243
63	109	Adim Rice	1,000	545	340	9999	NF		7	70401	153	104	104	780.3	780.3	81	1.000	0.0	0.0	0.0	0	0.33	0.00	340
64	110	Idomi	1,000	100	470	9999	NF		7	70401	153	145	145	823.1	823.1	119	1.000	0.0	**0.0**	0.0	0	0.49	0.00	539
65	111	Ukum	1,000	0	1,000	9999	NF		7	704042	157	2,215	2,194	972.3	1,029.5	2,154	1.000	0.0	0.0	0.0	0	0.65	0.00	2,830
66	112	Ofodun	800	0	800	9999	NF		7	70403	155	777	777	894.0	894.0	695	1.000	0.0	0.0	0.0	0	0.47	0.00	2,029
67	120	Jere Bowl Rice	1,300	0	0	9999	NF		8	806	170	9,317	5,367	28.5	22.8	266	1.000	0.0	0.0	0.0	0	0.00	0.00	0
68	122	Michika	500	200	0	9999	NF		8	80403_i	169	155	12	73.8	72.4	11	1.000	0.0	0.0	0.0	0	0.00	0.00	0
69	125	Tomas	1,100	400	1,000	100	Tomas	E	8	8080721_i	185	696	696	44.8	44.8	31	1.000	60.3	56.6	12.5	1,680	0.00	0.74	1,000
70	126	Jakara	2,000	820	430	90	Jakara	E	8	8080721_i	185	563	563	48.6	48.6	27	1.000	65.3	54.4	22.2	1,684	0.00	0.00	438
71	131	Guzuguzu	530	530	0	89	Guzugzu	E	8	8080743	191	100	100	72.6	72.6	7	1.000	24.6	21.5	4.3	1,602	0.00	2.21	0
72	132	Magaga	600	300	70	94	Magaga	E	8	8080743	191	119	119	57.8	57.8	7	1.000	19.7	17.2	3.5	1,600	0.00	1.47	70
73	133	Bagauda	610	300	410	85	Bagauda	E	8	808075	193	200	200	48.7	48.7	10	1.000	22.1	20.9	2.9	1,625	0.00	0.00	414
74	134	Kafin Chiri	600	0	200	91	Kafin Chiri	E	8	808073	187	222	222	52.1	52.1	12	1.000	31.1	24.6	4.8	1,647	0.00	1.47	205
75	140	Gwarzo	600	0	0	97	Pada	E	8	8080745	191	64	64	91.1	91.1	6	1.000	12.0	10.5	2.4	1,569	0.00	1.96	0

Status of Source: E =Existing, U = Under Construction, P = Proposed

Annex-T SR3-10 Water Balance Study for Potential Dam Sites (1/6)

SN-Dam	Code	Name	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Inflow for Cheking Exsiting Water Use Point (MCM/y)	Existing Downstream Irrigation Area (ha)	Existing Municipal Water Supply (MCM/y)	Available Municipal Water Supply with 90% Year Dependability (MCM/y)*	Irrigable Area with 80% Year Dependability (ha)*
2001	1101	Karaduwa	1	1060883	28	1,025	1,025	78.6	78.6	81	123.0	96.1	28.5	1,615	0.00	203.27	0	0.00	NA	NA
2002	1102	Kaya	1	106089	29	6,662	6,472	52.1	51.7	347	137.9	107.7	23.9	1,757	0.00	805.00	0	0.00	NA	NA
2003	1201	Ka	1	10602	7	9,012	9,012	120.0	120.0	1,081	121.9	95.2	25.2	1,801	0.39	1155.97	0	0.00	135.13	18,112
2004	1202	K.Sakachi	1	105	5	57	57	112.5	112.5	6	22.8	17.8	5.2	1,761	0.00	307.53	0	0.00	1.80	215
2005	1203	Kotsu	1	104	4	230	230	111.0	111.0	26	13.9	10.9	3.8	1,747	0.00	348.30	0	0.00	6.18	792
2006	1204	Danzaki	1	104	4	2,640	2,410	119.3	120.1	315	56.0	43.7	11.5	1,745	0.00	348.30	0	0.00	42.54	5,186
2007	1205	Wasa	1	103	3	147	147	124.8	124.8	18	30.6	23.9	5.8	1,724	0.00	401.81	0	0.00	7.76	895
2008	1206	Bakin Turu	1	103	3	32	32	127.1	127.1	4	13.0	10.2	2.7	1,709	0.00	401.81	0	0.00	1.32	160
2009	1207	Kasanu	1	103	3	409	409	132.7	132.7	54	21.0	16.4	5.2	1,704	0.00	401.81	0	0.00	13.84	1,597
2010	1208	Bambiri	1	103	3	150	150	152.5	152.5	23	15.5	12.1	5.2	1,696	0.00	401.81	0	0.00	6.22	767
2011	1209	Wata	1	101	1	695	695	169.4	169.4	118	55.1	43.0	13.3	1,723	0.00	1045.29	0	0.00	40.13	4,584
2012	1210	Utula	1	101	1	307	307	88.9	88.9	27	15.2	11.8	4.2	1,725	0.00	1045.29	0	0.00	9.05	1,075
2013	1211	Shafaci	1	101	1	278	278	88.8	88.8	25	46.1	36.0	8.9	1,732	0.00	1045.29	0	0.00	11.37	1,302
2014	2101	Jokoro	2	212	65	71	71	174.5	174.5	12	12.8	10.0	2.1	1,600	0.00	924.11	0	0.00	5.10	598
2015	2102	Ajelanwa	2	212	65	673	384	137.9	147.7	93	86.5	67.6	14.1	1,643	0.00	924.11	0	0.00	25.72	3,238
2016	2103	Yanku	2	212	65	289	218	124.7	125.5	36	48.8	38.1	8.3	1,634	0.00	924.11	0	0.00	13.48	1,671
2017	2104	Ala	2	212	65	290	290	129.7	129.7	38	51.0	39.8	8.5	1,644	0.00	924.11	0	0.00	15.75	2,032
2018	2105	Shao	2	212	65	132	132	150.1	150.1	20	25.8	20.1	4.0	1,675	0.00	420.00	0	0.00	9.05	1,049
2019	2106	Oloye	2	212	65	71	71	119.9	119.9	9	14.4	11.2	3.0	1,621	0.00	924	0	0.00	3.79	502
2020	2107	Mogaji	2	212	65	268	268	134.2	134.2	36	52.1	40.7	9.2	1,624	0.00	105.00	0	2.62	14.33	1,922
2021	2108	Okanle	2	212	65	270	161	149.7	144.6	40	16.1	12.6	3.0	1,601	0.00	924.11	0	0.00	8.70	1,049
2022	2111	Okeoyi	2	212	65	69	69	137.9	137.9	10	12.7	10.0	2.0	1,649	0.00	420.00	0	0.00	4.46	524
2023	2112	Faloku	2	212	65	93	93	162.4	162.4	15	18.9	14.7	3.5	1,573	0.00	17.00	0	5.91	NA	NA
2024	2114	Galma(2)	2	20814	61	398	398	154.2	154.2	61	83.0	64.8	16.7	1,523	0.00	1107.62	610	0.00	29.28	3,511
2025	2115	Galma(3)	2	20814	61	983	983	181.8	181.8	179	49.7	38.8	11.7	1,515	0.00	1107.62	0	0.00	44.13	3,988
2026	2116	Essan	2	206	47	208	208	239.3	239.3	50	39.0	30.4	6.5	1,703	0.01	278.00	0	23.14	20.67	2,591
2027	2117	Eniko	2	206	47	160	160	142.4	142.4	23	21.4	16.7	5.0	1,819	0.00	1115.00	0	7.89	10.09	1,272
2028	2118	Agaie	2	206	47	270	270	167.9	167.9	45	44.0	34.4	9.5	1,793	0.01	91.00	0	0.00	21.07	2,609
2029	2119	Tungawain	2	206	47	223	223	199.6	199.6	45	25.3	19.8	5.5	1,787	0.01	1115.00	0	7.89	15.73	2,008
2030	2120	Sanakpan	2	20805	53	227	227	169.9	169.9	39	25.8	20.2	7.9	1,835	0.00	1055.27	0	0.00	13.48	1,694
2031	2121	Jariga	2	206	47	90	90	271.1	271.1	24	5.6	4.4	0.5	1,624	0.01	198.00	2,000	0.00	5.89	519
2032	2122	Yankpako	2	206	47	2,285	1,529	218.0	207.6	498	143.6	112.1	20.7	1,821	0.07	1115.00	0	7.89	119.02	12,941
2033	2124	Nabi	2	206	47	247	247	259.2	259.2	64	27.9	21.8	4.6	1,690	0.01	278.00	0	23.14	21.11	2,324
2034	2125	Faka	2	206	47	253	253	192.0	192.0	49	40.9	31.9	15.8	1,718	0.01	198.00	2,000	0.00	15.75	2,068
2035	2201	Igporin	2	209	63	1,064	122	153.9	134.8	164	38.3	29.9	6.4	1,689	0.00	1896.11	0	0.00	10.16	1,070
2036	2202	Elebu	2	209	63	141	141	134.2	134.2	19	27.3	21.3	3.8	1,703	0.00	1896.11	0	0.00	10.47	1,150
2037	2203	Lasaki	2	209	63	67	67	127.8	127.8	9	13.2	10.3	2.3	1,722	0.00	1896.11	0	0.00	4.51	524
2038	2204	Okunrun	2	209	63	36	36	178.8	178.8	6	10.6	8.3	2.2	1,467	0.00	90.00	0	30.51	2.57	300
2039	2205	Ukusu	2	20804	52	784	784	246.8	246.8	193	11.5	8.9	3.5	1,730	0.01	4097.35	0	0.00	16.40	1,446
2040	2206	K. Chaaruma	2	20804	52	160	160	259.5	259.5	42	6.9	5.4	2.1	1,718	0.00	4097.35	0	0.00	7.60	663
2041	2207	Kombou	2	20804	52	108	108	326.5	326.5	35	15.0	11.7	3.8	1,750	0.00	4097.35	0	0.00	13.62	1,142
2042	2208	Kaduna	2	20801	49	63,052								*No evaluation*						
2043	2209	Lade	2	209	63	162	162	117.1	117.1	19	29.5	23.1	4.2	1,769	0.00	21.00	0	0.00	10.47	1,208
2044	2210	Auge	2	209	63	114	114	112.1	112.1	13	31.1	24.3	4.1	1,777	0.00	1896.11	0	0.00	8.14	868
2045	2211	Pategi	2	209	63	88	88	100.8	100.8	9	18.1	14.1	2.8	1,766	0.00	1896.11	0	0.00	5.25	584
2046	2212	Sunawa	2	203	43	84	84	232.2	232.2	20	14.0	10.9	2.9	1,745	0.02	861.11	0	0.00	9.16	982
2047	2213	Kakanda	2	201	37	54	54	281.5	281.5	15	7.3	5.7	0.6	1,554	0.01	600.50	0	0.00	6.38	649
2048	2214	M. dutse	2	20812	59	146	146	117.1	117.1	17	35.0	27.4	6.8	1,525	0.01	874.79	0	0.00	9.77	1,057
2049	2215	Jusawo	2	20812	59	91	91	124.5	124.5	11	19.5	15.2	4.2	1,523	0.00	874.79	0	0.00	6.27	689

Remarks: * 1) Safety factor (0.8) is multiplied.
2) When total inflow at exsiting downstream dam is less than the total storage volume of the exsiting downstream dam and the potential dam, the evaluation is not conducted.

Annex-T SR3-10 Water Balance Study for Potential Dam Sites (2/6)

SN-Dam	Code	Name	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Inflow for Cheking Exsiting Water Use Point (MCM/y)	Existing Downstream Irrigation Area (ha)	Existing Municipal Water Supply (MCM/y)	Available Municipal Water Supply with 90% Year Dependability (MCM/y)*	Irrigable Area with 80% Year Dependability (ha)*
2050	2216	Kalegi	2	20812	59	152	152	130.1	130.1	20	35.1	27.4	7.2	1,516	0.01	874.79	0	0.00	11.23	1,221
2051	2217	Gazare	2	20812	59	167	167	131.9	131.9	22	25.2	19.7	5.1	1,526	0.01	874.79	0	0.00	11.37	1,214
2052	2218	Maraku	2	20812	59	117	117	129.4	129.4	15	24.9	19.5	6.0	1,522	0.01	874.79	0	0.00	8.30	901
2053	2219	Karami	2	20815	62	58	58	222.3	222.3	13	13.1	10.2	3.0	1,509	0.00	3292.56	0	0.00	7.14	752
2054	2220	Bishiwa	2	20815	62	108	108	296.0	296.0	32	13.5	10.5	2.1	1,452	0.00	110.00	0	1.02	14.10	1,157
2055	2221	Gambo	2	20815	62	171	171	366.1	366.1	63	17.9	14.0	2.7	1,447	0.01	110.00	0	1.02	21.42	1,735
2056	2222	Gora	2	20815	62	86	86	276.5	276.5	24	18.0	14.1	4.3	1,466	0.00	3292.56	0	0.00	13.13	1,314
2057	2223	Gurza	2	20815	62	122	122	308.6	308.6	38	41.5	32.4	7.5	1,456	0.01	3292.56	0	0.00	21.64	2,306
2058	2224	Bakin kogi	2	20815	62	1,334	930	392.7	410.1	524	67.1	52.4	13.3	1,458	0.05	3292.56	0	0.00	88.78	7,295
2059	2225	Zonzon	2	20815	62	76	76	391.2	391.2	30	9.3	7.3	1.9	1,435	0.00	3292.56	0	0.00	10.65	867
2060	2226	Atom	2	20815	62	31	31	394.3	394.3	12	12.0	9.4	1.8	1,439	0.00	3292.56	0	0.00	7.13	756
2061	2227	Gadoko	2	206	47	49	25	217.9	217.9	11	7.2	5.6	1.5	1,725	0.00	1115.00	0	7.89	2.80	339
2062	2228	Maidna	2	206	47	82	82	214.4	214.4	18	11.0	8.6	2.6	1,761	0.00	1115.00	0	7.89	6.74	822
2063	2229	Edndnade	2	206	47	80	45	222.7	222.7	18	10.7	8.3	2.5	1,721	0.00	1115.00	0	7.89	4.92	592
2064	2230	Kondi	2	206	47	70	70	147.5	147.5	10	13.2	10.3	3.3	1,824	0.00	1115.00	0	7.89	5.09	604
2065	2231	Noayma	2	206	47	218	138	215.6	212.1	47	11.8	9.3	2.0	1,740	0.01	1290.39	0	0.00	10.60	1,093
2066	2233	Mussa	2	206	47	120	120	148.3	148.3	18	13.2	10.3	3.1	1,812	0.00	22.00	0	0.00	6.85	925
2067	2234	Emiziko	2	206	47	35	35	142.2	142.2	5	3.2	2.5	1.0	1,809	0.00	1290.39	0	0.00	1.73	229
2068	2235	Esama	2	206	47	34	34	154.9	154.9	5	11.3	8.8	2.5	1,800	0.00	133.00	0	0.00	2.67	292
2069	2236	Bakoji	2	206	47	839	236	155.9	146.2	131	48.7	38.1	10.4	1,810	0.01	133.00	0	0.00	17.75	2,097
2070	2237	Yewar	2	206	47	98	98	159.0	159.0	16	14.1	11.0	3.3	1,785	0.00	26.00	0	0.95	6.78	829
2071	2238	Anbero	2	205	46	88	88	149.4	149.4	13	14.7	11.5	2.9	1,801	0.00	36.00	0	0.33	6.01	655
2072	2239	Kateha	2	203	43	201	201	156.1	156.1	31	24.6	19.2	4.7	1,789	0.03	861.11	0	0.00	15.39	1,673
2073	2240	Kanko	2	20803	51	76	76	167.6	167.6	13	23.5	18.4	5.0	1,830	0.00	111.88	0	0.00	6.67	752
2074	2241	Ebbo	2	203	43	70	70	235.0	235.0	16	21.0	16.4	3.1	1,757	0.02	861.11	0	0.00	8.99	1,022
2075	2242	Ossen Seni	2	201	37	79	79	205.2	205.2	16	13.9	10.9	1.9	1,658	0.01	600.50	0	0.00	8.42	859
2076	2243	Koten karifi	2	201	37	137	137	235.2	235.2	32	35.1	27.4	3.9	1,677	0.02	600.50	0	0.00	16.85	1,938
2077	2244	Baro	2	203	43	1,167	1,155	221.3	221.2	258	275.9	215.5	33.6	1,774	0.25	861.11	0	0.00	143.08	15,676
2078	2245	Nugmagi	2	203	43	63	63	228.2	228.2	14	23.3	18.2	4.3	1,755	0.01	861.11	0	0.00	7.44	875
2079	2246	Takara	2	20203	41	190	190	533.3	533.3	101	35.3	27.6	5.9	1,501	0.19	1710.65	0	0.00	40.13	3,985
2080	2247	Kuda	2	20205	42	137	137	474.7	474.7	65	27.3	21.4	6.1	1,453	0.14	1253.18	0	300.00	22.14	2,264
2081	2248	Marasa	2	20205	42	98	98	507.1	507.1	50	26.8	20.9	6.9	1,444	0.10	312.00	0	3.59	24.03	2,468
2082	2249	Chori	2	20205	42	132	132	506.2	506.2	67	39.3	30.7	7.5	1,453	0.14	312.00	0	3.59	34.22	3,613
2083	3101	Hona gombi	3	318	103	935	708	148.7	148.7	139	64.0	50.0	11.4	1,611	0.01	595.48	0	0.00	31.91	4,563
2084	3102	Mubi	3	318	103	63	63	153.8	153.8	10	14.9	11.7	1.9	1,538	0.00	595.48	0	0.00	4.55	579
2085	3103	Dumne Song	3	318	103	192	192	130.5	130.5	25	14.7	11.5	2.6	1,608	0.00	595.48	0	0.00	8.09	1,057
2086	3104	Dumne	3	318	103	84	84	142.7	142.7	12	0.9	0.7	0.4	1,619	0.00	595.48	0	0.00	1.07	109
2087	3105	Kiri Ganye	3	316	101	85	85	151.0	151.0	13	12.0	9.4	2.2	1,724	0.00	1291.63	0	0.00	7.01	746
2088	3106	Mukan	3	316	101	333	333	391.5	391.5	130	33.4	26.1	4.0	1,649	0.04	1291.63	0	0.00	41.83	3,605
2089	3107	Mayo Ine	3	316	101	4,658	2,679	258.9	227.9	1,206	72.6	56.7	17.1	1,740	0.19	1291.63	0	0.00	100.40	8,800
2090	3109	Askira Uba	3	31404	95	205	205	125.7	125.7	26	12.4	9.7	3.3	1,554	0.00	1109.50	0	0.00	5.46	646
2091	3110	Mayo Belwa	3	312	91	2,257	2,165	174.3	167.3	393	240.0	187.4	29.6	1,754	0.06	436.37	0	0.00	168.31	17,520
2092	3111	Monkin Zin	3	312	91	87	87	295.7	295.7	26	23.9	18.7	3.4	1,557	0.00	436.37	0	0.00	13.68	1,401
2093	3112	Bali	3	311	90	494	494	308.3	308.3	152	72.2	56.4	10.4	1,728	0.03	1706.28	0	0.00	64.67	5,866
2094	3113	Mutumbu	3	311	90	250	250	151.0	151.0	38	52.9	41.3	8.3	1,740	0.01	1706.28	0	0.00	22.87	2,405
2095	3114	Tella	3	30601	82	21,313								*No evaluation*						
2096	3115	Sardauna	3	30602	83	3,558	3,558	339.8	339.8	1,209	74.2	58.0	17.2	1,720	0.03	1642.03	0	0.00	111.61	9,681
2097	3116	Suntai	3	30202	83	3,995	3,995	602.6	602.6	2,407	47.3	36.9	15.4	1,721	0.05	1642.03	0	0.00	86.75	8,028
2098	3201	Nguli	3	318	103	55	55	132.7	132.7	7	6.7	5.2	1.2	1,581	0.00	595.48	0	0.00	2.71	355
2099	3202	Nbumngo	3	318	103	109	109	148.7	148.7	16	18.6	14.6	3.5	1,609	0.00	595.48	0	0.00	5.99	819
2100	3203	Sensen	3	318	103	142	142	142.6	142.6	20	20.2	15.8	2.2	1,557	0.00	595.48	0	0.00	8.54	1,082

Remarks: * 1) Safety factor (0.8) is multiplied.

2) When total inflow at exsiting downstream dam is less than the total storage volume of the exsiting downstream dam and the potential dam, the evaluation is not conducted.

Annex-T SR3-10 Water Balance Study for Potential Dam Sites (3/6)

SN-Dam	Code	Name	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Inflow for Cheking Exsiting Water Use Point (MCM/y)	Existing Downstream Irrigation Area (ha)	Existing Municipal Water Supply (MCM/y)	Available Municipal Water Supply with 90% Year Dependability (MCM/y)*	Irrigable Area with 80% Year Dependability (ha)*
2101	3204	Song	3	318	103	272	272	128.1	128.1	35	3.1	2.4	0.8	1,642	0.00	595.48	0	0.00	3.55	382
2102	3205	Baunra	3	315	100	131	131	94.6	94.6	12	14.9	11.7	3.0	1,730	0.00	115.53	0	0.00	5.05	635
2103	3206	M. Jamba	3	31404	95	201	201	138.0	138.0	28	15.5	12.1	3.1	1,582	0.00	1109.50	0	0.00	6.36	771
2104	3207	M. Gerewa	3	31404	95	120	120	153.1	153.1	18	32.8	25.6	4.4	1,512	0.00	1109.50	0	0.00	7.64	990
2105	3208	M. Zangula	3	31404	95	214	214	126.7	126.7	27	23.1	18.0	4.2	1,568	0.00	1109.50	0	0.00	7.10	990
2106	3209	M. Faa	3	31404	95	232	232	132.3	132.3	31	64.1	50.1	11.8	1,568	0.00	1109.50	0	0.00	10.75	1,440
2107	3210	Hawal D.D	3	31404	95	9,635	8,833	97.3	94.4	937	117.7	91.9	12.9	1,630	0.00	1109.50	0	0.00	99.05	8,906
2108	3211	M. Leningo	3	31404	95	214	95	145.9	133.8	31	9.0	7.0	1.4	1,574	0.00	1109.50	0	0.00	3.38	430
2109	3212	Zurhu	3	312	91	183	183	122.9	122.9	22	31.5	24.6	5.6	1,743	0.00	436.37	0	0.00	12.44	1,354
2110	3213	Danwoiba	3	311	90	104	104	188.0	188.0	20	8.7	6.8	0.9	1,631	0.00	1706.28	0	0.00	8.26	739
2111	3214	Kunini	3	311	90	281	281	253.4	253.4	71	2.8	2.2	0.5	1,617	0.01	1706.28	0	0.00	4.68	449
2112	3215	Bado	3	304	80	510	510	172.2	172.2	88	28.6	22.3	10.1	1,752	0.02	1079.92	0	0.00	25.77	2,293
2113	3216	Loyerima	3	307	86	54	54	155.4	155.4	8	13.6	10.6	2.2	1,750	0.00	780.55	0	0.00	4.96	545
2114	3217	Dankuturu	3	307	86	225	225	147.4	147.4	33	35.7	27.9	6.6	1,746	0.00	780.55	0	0.00	17.34	1,942
2115	3218	Adashange	3	30203_i	78	74	74	378.4	378.4	28	19.6	15.3	4.2	1,700	0.04	7364.72	0	0.00	17.06	1,692
2116	3219	Mboosa	3	30203_i	78	60	60	416.6	416.6	25	16.5	12.9	3.2	1,676	0.03	7364.72	0	0.00	15.14	1,473
2117	3220	Goragh	3	30203_i	78	81	81	443.2	443.2	36	22.4	17.5	4.6	1,672	0.05	7364.72	0	0.00	21.23	2,024
2118	3221	Adu	3	30203_i	78	331	331	487.0	487.0	161	70.9	55.3	11.0	1,701	0.21	7364.72	0	0.00	87.82	7,342
2119	3222	Tati	3	30203_i	78	159	159	659.8	659.8	105	11.0	8.6	2.9	1,675	0.14	7364.72	0	0.00	22.66	1,776
2120	3223	Mala	3	30203_i	78	283	283	683.4	683.4	193	38.5	30.1	6.3	1,672	0.25	7364.72	0	0.00	64.18	5,218
2121	4101	Shendam	4	410	119	308	308	252.5	252.5	78	32.6	25.5	7.1	1,757	0.02	1256.52	0	0.00	31.91	3,085
2122	4102	Dansak	4	408	117	522	515	440.1	440.1	230	5.9	4.6	1.1	1,696	0.09	2149.00	2,000	0.00	14.31	1,484
2123	4103	Baushe	4	410	119	257	257	206.6	206.6	53	53.0	41.4	10.5	1,762	0.01	1256.52	0	0.00	29.18	3,551
2124	4104	Shemankar	4	410	119	2,918	1,919	314.2	306.7	917	138.5	108.2	25.4	1,774	0.14	1256.52	0	0.00	168.31	15,833
2125	4201	Ujany	4	409	118	37	37	258.3	258.3	10	15.5	12.1	3.4	1,683	0.00	413.21	0	0.00	5.63	687
2126	4202	Riti	4	409	118	111	111	276.7	276.7	31	30.4	23.7	5.9	1,677	0.01	413.21	0	0.00	15.59	1,909
2127	4203	Uweyande	4	407	116	52	52	263.2	263.2	14	15.1	11.8	3.1	1,717	0.00	958.15	0	0.00	7.47	911
2128	4204	Fofi	4	407	116	41	41	255.6	255.6	10	14.5	11.3	2.1	1,695	0.00	958.15	0	0.00	6.60	797
2129	4205	Ajiba	4	406_i	115	65	65	282.2	282.2	18	15.7	12.3	4.1	1,684	0.01	12042.64	0	0.00	12.00	1,386
2130	4206	Karma(1)	4	408	117	162	162	553.8	553.8	90	18.4	14.4	2.1	1,656	0.04	2149.00	2,000	0.00	25.41	2,318
2131	4207	Karma(2)	4	408	117	211	48	555.2	561.9	117	13.9	10.8	1.7	1,701	0.01	2149.00	2,000	0.00	14.29	1,346
2132	4208	gudi	4	408	117	122	122	564.3	564.3	69	22.7	17.7	3.9	1,637	0.03	678.00	0	0.41	26.44	2,449
2133	4209	Ukon	4	408	117	56	56	552.4	552.4	31	13.7	10.7	2.1	1,724	0.01	2149.00	2,000	0.00	14.60	1,352
2134	4210	Feteruwa	4	408	117	163	163	423.9	423.9	69	27.5	21.5	5.8	1,764	0.03	2149.00	2,000	0.00	29.18	2,702
2135	4211	Ganye	4	404	112	76	76	372.7	372.7	28	20.9	16.3	3.9	1,771	0.07	3846.10	0	0.00	15.82	1,873
2136	4212	Katari	4	404	112	122	122	344.7	344.7	42	17.2	13.5	3.8	1,771	0.10	3846.10	0	0.00	19.79	1,907
2137	4213	Tsorom	4	408	117	408	408	333.1	333.1	136	17.6	13.7	6.6	1,777	0.05	939.00	1,000	0.00	23.64	2,181
2138	4214	Ovena	4	407	116	42	42	294.5	294.5	12	12.3	9.6	2.8	1,716	0.00	958.15	0	0.00	6.43	766
2139	4215	Aneri	4	407	116	505	505	277.6	277.6	140	14.2	11.1	4.7	1,726	0.04	958.15	0	0.00	22.13	1,887
2140	4216	Tsemngo	4	406_i	115	50	50	259.5	259.5	13	11.2	8.8	2.9	1,706	0.01	12042.64	0	0.00	8.51	982
2141	4217	Vakugu	4	406_i	115	48	48	275.4	275.4	13	13.7	10.7	2.6	1,685	0.01	12042.64	0	0.00	9.26	1,092
2142	4218	Kereke	4	405	113	550	550	290.5	290.5	160	16.7	13.0	7.4	1,718	0.20	3183.33	0	0.00	27.00	2,431
2143	4219	Baa	4	405	113	42	42	301.6	301.6	13	3.0	2.3	3.0	1,727	0.02	3183.33	0	0.00	2.42	221
2144	4220	Ube	4	405	113	51	51	297.4	297.4	15	11.9	9.3	3.3	1,717	0.02	3183.33	0	0.00	7.02	867
2145	4221	Afiae	4	407	116	162	162	272.6	272.6	44	20.6	16.1	5.4	1,689	0.01	958.15	0	0.00	17.09	1,843
2146	4222	Agbunko	4	406_i	115	49	49	988.9	988.9	48	12.3	9.6	2.3	1,666	0.03	12042.64	0	0.00	18.75	1,533
2147	4223	Mnyande	4	406_i	115	53	53	1034.5	1034.5	55	9.6	7.5	2.6	1,666	0.04	12042.64	0	0.00	15.75	1,232
2148	4224	Dula	4	406_i	115	154	154	1150.0	1150.0	177	19.9	15.6	4.6	1,657	0.12	12042.64	0	0.00	38.91	2,980
2149	4225	Mishe	4	406_i	115	121	121	965.6	965.6	117	22.9	17.9	4.3	1,685	0.08	12042.64	0	0.00	37.78	2,977
2150	4226	Uchi Mbako	4	405	113	48	48	245.2	245.2	12	12.2	9.5	2.6	1,700	0.01	3183.33	0	0.00	6.39	766

Remarks: * 1) Safety factor (0.8) is multiplied.

2) When total inflow at exsiting downstream dam is less than the total storage volume of the exsiting downstream dam and the potential dam, the evaluation is not conducted.

Annex-T SR3-10 Water Balance Study for Potential Dam Sites (4/6)

SN-Dam	Code	Name	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Inflow for Cheking Exsiting Water Use Point (MCM/y)	Existing Downstream Irrigation Area (ha)	Existing Municipal Water Supply (MCM/y)	Available Municipal Water Supply with 90% Year Dependability (MCM/y)*	Irrigable Area with 80% Year Dependability (ha)*
2151	4227	Dzer	4	406_i	115	43	43	280.4	280.4	12	10.3	8.1	2.6	1,710	0.01	12042.64	0	0.00	7.94	909
2152	4228	Yelen(1)	4	406_i	115	60	48	311.2	311.2	19	10.0	7.8	2.2	1,693	0.01	12042.64	0	0.00	9.61	1,014
2153	4229	Yelen(2)	4	406_i	115	89	89	323.0	323.0	29	30.7	24.0	5.0	1,697	0.02	12042.64	0	0.00	20.28	2,446
2154	4230	Amber	4	406_i	115	61	61	883.8	883.8	54	14.9	11.6	2.5	1,668	0.04	12042.64	0	0.00	22.47	1,819
2155	4231	Ambighir	4	406_i	115	222	222	941.4	941.4	209	46.8	36.6	7.4	1,672	0.14	12042.64	0	0.00	74.30	6,077
2156	4232	Ukwye	4	406_i	115	35	35	851.0	851.0	30	11.5	9.0	2.1	1,674	0.02	12042.64	0	0.00	15.75	1,340
2157	4233	Daudu	4	406_i	115	40	40	868.1	868.1	35	10.6	8.3	2.3	1,685	0.02	12042.64	0	0.00	15.14	1,252
2158	4234	Kamken	4	405	113	72	72	294.6	294.6	21	13.8	10.8	3.0	1,692	0.03	3183.33	0	0.00	9.50	1,146
2159	4235	Safuga	4	405	113	55	55	323.6	323.6	18	9.8	7.7	2.4	1,681	0.02	3183.33	0	0.00	7.39	880
2160	4236	Kpawaju	4	405	113	193	193	275.7	275.7	53	8.1	6.3	3.7	1,704	0.06	3183.33	0	0.00	11.64	1,016
2161	4237	Ogari(1)	4	405	113	297	297	370.3	370.3	110	15.9	12.4	5.1	1,650	0.13	3183.33	0	0.00	25.61	2,167
2162	4238	Ogari(2)	4	405	113	378	116	357.2	315.4	135	21.3	16.6	5.8	1,673	0.04	3183.33	0	0.00	15.11	1,887
2163	4239	Takwa	4	402	110	51	51	348.1	348.1	18	15.4	12.0	3.0	1,654	0.04	3173.82	0	0.00	9.32	1,208
2164	4240	G. Shehu	4	404	112	66	66	348.0	348.0	23	13.7	10.7	2.4	1,744	0.06	3846.10	0	0.00	12.43	1,335
2165	4241	Leizi	4	404	112	237	237	433.8	433.8	103	24.0	18.7	4.2	1,768	0.25	3846.10	0	0.00	36.03	3,369
2166	4243	Kyereku(1)	4	404	112	212	212	306.9	306.9	65	15.4	12.0	3.5	1,740	0.16	3846.10	0	0.00	22.42	2,099
2167	4244	Kyereku(2)	4	404	112	169	169	292.7	292.7	49	21.5	16.8	4.7	1,740	0.12	3846.10	0	0.00	24.11	2,332
2168	4245	Ushongu	4	405	113	100	100	313.2	313.2	31	17.1	13.3	3.4	1,713	0.04	3183.33	0	0.00	13.26	1,603
2169	4246	Kwagiri	4	404	112	138	138	501.9	501.9	69	43.5	34.0	8.7	1,576	0.17	2233.10	0	13.14	37.83	4,157
2170	4247	Dongwa	4	404	112	78	78	533.6	533.6	42	23.2	18.1	3.1	1,573	0.10	2233.10	0	13.14	22.78	2,427
2171	4248	Kormi	4	404	112	118	118	464.8	464.8	55	16.7	13.0	4.9	1,561	0.13	2233.10	0	13.14	21.87	2,037
2172	4249	Sanga	4	404	112	693	445	458.0	451.5	317	34.6	27.0	6.7	1,575	0.49	2233.10	0	13.14	58.69	5,507
2173	5101	Ghagede	5	50403	125	46	46	248.9	248.9	11	13.6	10.6	1.4	1,716	0.02	3072.10	0	0.00	5.36	768
2174	5102	Onado	5	50403	125	153	153	230.3	230.3	35	33.5	26.2	4.6	1,661	0.06	3072.10	0	0.00	14.80	2,133
2175	5103	Obe	5	50403	125	298	298	241.9	241.9	72	52.4	41.0	5.4	1,673	0.11	3072.10	0	0.00	28.96	4,001
2176	5104	Urhobo	5	50403	125	193	193	376.6	376.6	73	23.0	18.0	3.4	1,679	0.12	3072.10	0	0.00	27.09	2,325
2177	5105	Okupo	5	50402	124	101	101	285.4	285.4	29	17.7	13.8	2.4	1,673	0.06	39.00	1,000	0.00	11.87	1,248
2178	5106	Nibo	5	50402	124	153	153	408.8	408.8	63	57.7	45.1	5.9	1,615	0.14	160.00	1,000	0.00	33.38	3,932
2179	5107	Oforochi	5	50402	124	1,071	309	255.5	246.7	274	20.1	15.7	2.9	1,695	0.17	286.00	550	0.00	25.95	2,374
2180	5108	Atapo	5	50401	123	93	93	565.2	565.2	53	22.9	17.9	2.5	1,670	0.16	1041.31	0	0.00	27.91	2,460
2181	5110	Umuleri	5	50402	124	51	51	536.5	536.5	27	10.1	7.9	2.4	1,705	0.06	4932.34	0	0.00	10.85	1,016
2182	5111	Ukwa, Abwa	5	50402	124	161	110	529.9	527.3	85	22.2	17.3	6.3	1,705	0.13	4932.34	0	0.00	22.86	2,136
2183	5112	Obibia	5	50402	124	21	21	546.1	546.1	11	10.4	8.1	1.3	1,690	0.03	4932.34	0	0.00	6.27	729
2184	5113	Ugbio	5	50402	124	33	33	622.0	622.0	21	10.4	8.2	1.6	1,655	0.04	4932.34	0	0.00	9.77	965
2185	5114	Oji	5	50402	124	266	266	623.8	623.8	166	16.9	13.2	2.6	1,629	0.36	4932.34	0	0.00	31.91	2,925
2186	6101	Igangan	6	604023_i	136	140	140	129.8	129.8	18	16.8	13.2	3.7	1,702	0.00	1241.00	500	28.33	5.36	609
2187	6102	Ilora	6	60403	137	89	89	150.9	150.9	13	16.5	12.9	3.5	1,648	0.00	890.64	0	0.00	4.68	571
2188	6103	Ose	6	60403	137	311	311	180.1	180.1	56	30.2	23.6	4.5	1,646	0.00	890.64	0	0.00	15.56	1,660
2189	6104	Omi	6	606	140	235	235	181.2	181.2	43	23.3	18.2	4.4	1,658	0.00	733.87	1,000	0.00	12.79	1,394
2190	6201	Adeniji	6	604023_i	136	164	164	122.5	122.5	20	32.4	25.3	5.6	1,678	0.00	1241.00	500	28.33	8.01	867
2191	6202	Egbebi	6	604023_i	136	176	176	146.6	146.6	26	15.4	12.0	3.1	1,664	0.00	1241.00	500	28.33	6.67	697
2192	6203	Washinmi	6	60403	137	88	88	142.8	142.8	13	25.8	20.1	4.0	1,685	0.00	76.70	0	0.96	5.57	638
2193	6204	Oko	6	60403	137	60	60	122.0	122.0	7	27.9	21.8	3.9	1,699	0.00	76.70	0	0.96	4.03	435
2194	6205	Ohu	6	60403	137	457	369	132.2	129.8	60	42.7	33.4	9.3	1,704	0.00	76.70	0	0.96	14.33	1,710
2195	6206	Eketa	6	60403	137	50	50	144.1	144.1	7	23.6	18.5	4.4	1,640	0.00	890.64	0	0.00	3.58	393
2196	6207	Agida	6	60403	137	32	32	154.4	154.4	5	13.8	10.8	2.3	1,625	0.00	890.64	0	0.00	2.42	281
2197	6208	Akinmorin	6	60403	137	50	50	175.0	175.0	9	14.8	11.6	3.1	1,588	0.00	890.64	0	0.00	3.55	426
2198	6209	Aba	6	60403	137	257	257	143.8	143.8	37	24.1	18.8	4.1	1,674	0.00	890.64	0	0.00	10.95	1,187
2199	6210	Alapa	6	60403	137	28	28	134.0	134.0	4	11.2	8.7	1.9	1,681	0.00	890.64	0	0.00	1.88	209
2200	6211	Are Ago	6	60403	137	33	33	128.8	128.8	4	12.3	9.6	2.8	1,677	0.00	890.64	0	0.00	1.88	218

Remarks: * 1) Safety factor (0.8) is multiplied.

2) When total inflow at exsiting downstream dam is less than the total storage volume of the exsiting downstream dam and the potential dam, the evaluation is not conducted.

Annex-T SR3-10 Water Balance Study for Potential Dam Sites (5/6)

SN-Dam	Code	Name	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Inflow for Cheking Exsiting Water Use Point (MCM/y)	Existing Downstream Irrigation Area (ha)	Existing Municipal Water Supply (MCM/y)	Available Municipal Water Supply with 90% Year Dependability (MCM/y)*	Irrigable Area with 80% Year Dependability (ha)*
2201	6212	Elesin	6	60403	137	99	99	138.6	138.6	14	11.8	9.2	2.3	1,700	0.00	890.64	0	0.00	4.31	495
2202	6213	Oyebode	6	60403	137	54	54	134.7	134.7	7	36.6	28.6	5.4	1,704	0.00	890.64	0	0.00	4.06	431
2203	6214	Atopa	6	60403	137	61	61	190.1	190.1	12	14.5	11.3	2.4	1,698	0.00	890.64	0	0.00	4.46	513
2204	6215	Cuta	6	60401	133	52	52	90.4	90.4	5	23.9	18.7	4.3	1,693	0.00	309.55	0	0.00	2.33	260
2205	6216	Ibu	6	605	139	260	260	143.4	143.4	37	20.6	16.1	4.6	1,673	0.00	104.00	0	4.23	12.56	1,296
2206	6217	Olobi	6	606	140	67	67	173.4	173.4	12	14.7	11.5	3.0	1,676	0.00	733.87	1,000	0.00	4.79	524
2207	6218	Ojo	6	606	140	43	43	232.1	232.1	10	15.2	11.9	2.7	1,688	0.00	733.87	1,000	0.00	4.53	465
2208	6219	Bale	6	606	140	36	36	200.9	200.9	7	13.6	10.6	2.6	1,692	0.00	733.87	1,000	0.00	3.38	360
2209	6220	Opebi	6	606	140	64	64	191.5	191.5	12	21.5	16.8	3.0	1,672	0.00	733.87	1,000	0.00	6.00	633
2210	6221	Mobi	6	608	142	62	62	255.1	255.1	16	14.9	11.6	2.8	1,610	0.00	1712.00	0	54.31	6.70	676
2211	6222	Otamakun	6	608	142	112	112	270.6	270.6	30	36.6	28.6	5.4	1,597	0.00	1712.00	0	54.31	13.98	1,435
2212	6223	Ajekale	6	608	142	50	50	216.6	216.6	11	27.5	21.5	3.2	1,613	0.00	1712.00	0	54.31	6.51	717
2213	6224	Ifeodan	6	608	142	202	202	203.1	203.1	41	26.4	20.6	4.7	1,606	0.00	1712.00	0	54.31	14.39	1,573
2214	6225	Ijimoba	6	608	142	46	46	214.0	214.0	10	11.6	9.1	2.4	1,595	0.00	1712.00	0	54.31	4.48	470
2215	6226	Llobu	6	608	142	132	132	224.3	224.3	30	21.1	16.5	3.7	1,586	0.00	1712.00	0	54.31	10.85	1,168
2216	6227	Isaki Igbc	6	608	142	91	91	223.7	223.7	20	22.6	17.6	3.8	1,600	0.00	309.00	0	55.19	7.62	808
2217	6228	Edagun	6	608	142	31	31	184.9	184.9	6	12.5	9.8	3.4	1,651	0.00	1712.00	0	54.31	2.61	297
2218	6229	Adokanra	6	608	142	22	22	219.8	219.8	5	12.6	9.9	3.4	1,641	0.00	2688.00	0	5.26	2.42	275
2219	6231	Oni	6	610	144	270	270	244.2	244.2	66	28.9	22.6	6.1	1,597	0.01	357.00	0	0.83	18.53	1,922
2220	6232	Oke Awo	6	610	144	57	57	300.9	300.9	17	12.6	9.9	2.7	1,589	0.00	357.00	0	0.83	6.06	641
2221	6234	Bolorunduro	6	614	147	52	52	299.3	299.3	16	12.2	9.5	3.1	1,518	0.03	4149.25	0	0.00	7.43	774
2222	6235	Ofosun	6	612	146	122	122	332.7	332.7	41	17.2	13.4	3.3	1,546	0.03	2399.03	0	0.00	16.21	1,566
2223	6236	Ala	6	614	147	278	278	282.3	282.3	78	16.5	12.9	2.5	1,546	0.13	4149.25	0	0.00	22.57	2,222
2224	6237	Okhuo	6	614	147	189	189	529.3	529.3	100	9.6	7.5	1.6	1,602	0.16	4149.25	0	0.00	19.38	1,783
2225	7101	Okete	7	704043	158	64	64	616.3	616.3	39	14.4	11.2	2.3	1,637	0.01	295.00	0	0.00	18.52	1,393
2226	7102	Ajide-Eko	7	70402	154	194	136	528.1	545.3	102	43.1	33.7	11.6	1,708	0.05	4559.39	0	0.00	38.34	3,507
2227	7103	Emezu	7	70402	154	532	532	561.0	561.0	298	8.0	6.3	3.6	1,685	0.18	331.00	0	7.41	22.83	2,016
2228	7201	Panbele	7	704043	158	72	72	607.7	607.7	44	8.9	7.0	2.7	1,689	0.01	5158.68	0	0.00	13.09	947
2229	7202	Ombi	7	704043	158	217	217	624.3	624.3	135	24.1	18.8	5.9	1,694	0.04	5158.68	0	0.00	38.14	2,704
2230	7203	Ugboba	7	704043	158	50	50	674.8	674.8	34	9.9	7.8	3.2	1,699	0.01	5158.68	0	0.00	12.79	960
2231	7204	Ogege	7	704043	158	198	198	704.0	704.0	139	12.6	9.9	3.9	1,726	0.04	5158.68	0	0.00	24.54	1,695
2232	7205	Adam East	7	704043	158	27	27	715.7	715.7	19	16.1	12.6	4.2	1,705	0.01	5158.68	0	0.00	11.61	1,226
2233	7206	Ieheri	7	704043	158	40	40	808.2	808.2	32	12.2	9.6	3.0	1,724	0.01	5158.68	0	0.00	14.57	1,121
2234	7207	Ogwuawu	7	70403	155	28	28	583.8	583.8	16	8.7	6.8	2.8	1,714	0.01	564.00	1,000	0.00	8.91	728
2235	7208	Ogbogbo(1)	7	70403	155	58	58	546.6	546.6	32	13.2	10.3	4.1	1,724	0.02	564.00	1,000	0.00	15.81	1,192
2236	7209	Ogbogbo(2)	7	70403	155	53	53	553.1	553.1	29	14.3	11.2	4.5	1,740	0.02	564.00	1,000	0.00	15.89	1,228
2237	7210	Abe	7	704043	158	72	72	844.5	844.5	61	13.0	10.2	4.2	1,737	0.02	5158.68	0	0.00	18.57	1,296
2238	7211	Gbumacha	7	704042	157	108	108	613.9	613.9	66	11.8	9.2	3.7	1,686	0.02	6256.03	0	0.00	18.62	1,301
2239	7212	Uwebende	7	704042	157	133	133	616.9	616.9	82	47.2	36.8	10.2	1,690	0.03	6256.03	0	0.00	49.08	4,026
2240	7213	Konshisha	7	704042	157	226	226	628.5	628.5	142	16.0	12.5	5.4	1,685	0.05	6256.03	0	0.00	30.26	2,018
2241	7214	Ukyoha	7	704042	157	152	152	687.5	687.5	105	12.8	10.0	3.7	1,677	0.04	6256.03	0	0.00	23.67	1,599
2242	7215	Kaakya	7	704042	157	58	58	676.8	676.8	39	10.2	8.0	2.7	1,674	0.01	6256.03	0	0.00	14.57	1,058
2243	7216	Adum	7	704042	157	31	31	750.8	750.8	23	10.9	8.5	3.0	1,700	0.01	6256.03	0	0.00	12.74	954
2244	7217	Moi	7	704042	157	106	106	1073.6	1073.6	114	2.8	2.2	0.9	1,698	0.04	2154.00	1,000	0.00	7.77	653
2245	7218	Monaya	7	704042	157	163	163	900.5	900.5	147	5.4	4.3	3.1	1,683	0.05	1324.00	0	1.14	12.49	1,022
2246	7219	Akpoga	7	70402	154	98	98	519.2	519.2	51	12.8	10.0	2.4	1,627	0.03	200.00	390	0.00	18.28	1,351
2247	7220	Ikem	7	70402	154	138	138	535.8	535.8	74	14.5	11.3	2.5	1,627	0.05	200.00	390	0.00	23.30	1,657
2248	7221	Agala	7	70402	154	58	58	506.7	506.7	29	19.3	15.1	6.7	1,691	0.02	4559.39	0	0.00	15.10	1,464
2249	7222	Okpoto	7	70402	154	50	50	615.2	615.2	31	11.3	8.9	3.1	1,720	0.02	4559.39	0	0.00	13.48	1,049
2250	7223	Ndeaboh	7	70402	154	185	185	692.8	692.8	128	14.6	11.4	6.7	1,703	0.08	200.00	0	0.00	25.86	1,827
2251	7224	Eneagu	7	70402	154	32	32	678.2	742.3	22	8.8	6.9	2.8	1,716	0.01	4559.39	0	0.00	10.23	791
2252	7225	Ubei	7	70401	153	148	146	742.3	742.3	110	49.0	38.3	11.3	1,729	0.45	5721.99	0	0.00	52.66	4,739

Remarks: * 1) Safety factor (0.8) is multiplied.

2) When total inflow at exsiting downstream dam is less than the total storage volume of the exsiting downstream dam and the potential dam, the evaluation is not conducted.

Annex-T SR3-10 Water Balance Study for Potential Dam Sites (6/6)

SN-Dam	Name	HA	SHA	SN-SHA	Total Drainage Area (TDA) (km2)	Drainage Area excluding upstream dam catchment (DA) (km2)	Runoff for TDA (mm/year)	Runoff for DA (mm/year)	Total Inflow (MCM/ year)	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Minimum Stream Flow Requirement (m3/s)	Inflow for Cheking Exsiting Water Use Point (MCM/y)	Existing Downstream Irrigation Area (ha)	Existing Municipal Water Supply (MCM/y)	Available Municipal Water Supply with 90% Year Dependability (MCM/y)*	Irrigable Area with 80% Year Dependability (ha)*
3001	Baudeu	3	30603_i	85	9,872	9,872	552.0	552.0	5,449	240.0	187.5	22.0	1,360	0.57	6,939	0	0.00	446.7	39,686
3002	Gashaka	3	30603_i	85	555	555	696.0	696.0	386	380.0	296.9	21.0	1,296	0.04	6,939	0	0.00	285.7	29,842
3003	Kila	3	30603_i	85	1,925	1,925	633.0	633.0	1,219	1,200.0	937.6	79.0	1,311	0.13	6,939	0	0.00	896.2	90,833
3004	Kogin Baba	3	30603_i	85	1,771	1,771	438.0	438.0	776	443.0	346.1	32.4	1,309	0.08	6,939	0	0.00	464.3	38,376
3005	Kwossa	3	30202	76	1,615	1,615	724.0	724.0	1,169	1,150.0	898.5	36.0	1,351	0.14	2,833	0	0.00	870.9	88,723
3006	Okwaregi	4	404	112	4,617	4,617	502.0	502.0	2,318	547.0	427.4	19.3	1,343	5.68	3,846	0	0.00	869.5	92,957
3007	Wana	4	408	117	1,264	1,264	546.0	546.0	690	223.0	174.2	12.1	1,376	0.28	3,953	0	0.00	282.7	26,299
3008	Bejagira	2	20804	52	7,197	7,197	237.0	237.0	1,706	188.9	147.6	8.9	1,348	0.12	4,097	0	0.00	276.4	6,717
3009	Mamam	3	30603_i	85	405	405	535.0	535.0	217	210.0	164.1	19.4	1,290	0.02	6,939	0	0.00	156.7	15,833
3010	Nyasikasi	3	30603_i	85	2,173	2,173	563.0	563.0	1,223	1,200.0	937.6	69.5	1,336	0.13	6,939	0	0.00	901.2	91,169
3011	Ragwa	4	402	110	6,869	6,869	381.9	381.9	2,623	115.0	89.9	12.5	1,369	5.45	3,174	0	0.00	345.3	49,001
3012	Muleng	3	318	103	2,425	2,425	139.4	139.4	338	112.8	88.2	8.5	1,365	0.03	595	0	0.00	79.8	10,429
3013	Bad Es Sem	2	214_i	68	8,538	8,538	142.7	142.7	1,218	139.6	109.1	10.4	1,367	0.09	1,363	0	0.00	186.5	17,409
3501	Odedele	6	608	142	8,116	413	232.5	232.5	1,887	142.7	111.5	22.9	1,675	0.20	2,365	130	3.20	46.7	5,238
3502	Aiyete	6	604023_i	136	4,103	3,210	134.4	134.4	551	424.2	331.5	50.7	1,716	0.00	1,229	0	0.00	153.2	17,243
3503	Oba	6	608	142	2,076	1,239	204.3	204.3	424	153.9	120.3	32.0	1,629	0.05	2,365	130	38.00	86.6	9,347
3504	Ijesha	6	608	142	1,111	1,111	301.0	301.0	334	193.5	151.2	30.8	1,550	0.04	2,365	130	38.00	116.8	12,583
3505	Ona	6	606	140	1,974	1,481	200.6	200.6	396	232.4	181.5	31.1	1,703	0.03	942	0	0.00	117.0	11,469
4001	Obulo Eziama	7	702	151	93	93	862.0	862.0	80	18.3	14.3	3.3	1,624	0.41	9,216	0	0.00	31.6	NE
4002	Owerri	7	702	151	230	230	961.5	961.5	221	3.9	3.0	1.2	1,605	1.13	9,216	0	0.00	22.8	NE
4003	Kafanchan	4	404	112	181	181	561.3	561.3	102	3.1	2.4	1.3	1,440	0.25	3,846	0	0.00	10.5	NE
4004	Kacha	2	20205	42	554	554	435.9	435.9	241	3.5	2.7	1.5	1,463	0.51	1,253	0	0.00	15.5	NE
4005	Kumpa	4	404	112	201	201	508.5	508.5	102	3.1	2.4	1.0	1,603	0.25	3,846	0	0.00	10.5	NE
4006	Bale	6	602_i	131	833	833	93.9	93.9	78	82.6	64.5	12.7	1,719	0.00	313	0	0.00	28.1	NE
4007	Barakin	3	31409	99	126	126	249.4	249.4	31	20.1	15.7	2.8	1,258	0.01	2,458	0	0.00	16.7	NE
4008	Sakin Noma	1	106093	31	2,252	2,252	181.7	181.7	409	29.7	23.2	5.6	1,642	0.00	706	0	0.00	27.3	NE
4009	Umuseke	5	50402	124	132	132	579.2	579.2	76	9.5	7.4	3.4	1,682	0.17	4,932	0	0.00	15.7	NE
4010	Ihiala	5	506	126	677	677	698.7	698.7	473	3.4	2.7	1.3	1,675	1.40	3,091	0	0.00	23.2	NE
4011	Nnewi	5	506	126	136	136	591.0	591.0	80	24.2	18.9	3.6	1,656	0.24	3,091	0	0.00	35.3	NE
4012	Aba	7	702	151	158	158	977.2	977.2	154	3.4	2.7	0.7	1,617	0.79	9,216	0	0.00	18.3	NE
4013	Mubi	8	80403_i	169	145	145	74.0	74.0	11	6.0	4.7	0.9	1,511	0.00	232	0	0.00	2.4	NE
4014	Ota	6	603	132	57	57	166.8	166.8	10	6.4	5.0	1.5	1,660	0.00	443	0	0.00	3.0	NE
4015	Okigwe	7	702	151	222	222	852.2	852.2	189	9.2	7.2	4.3	1,649	0.97	9,216	0	0.00	30.8	NE
4016	Ezillo	7	70402	154	6	6	546.9	546.9	3	2.3	1.8	0.5	1,714	0.00	4,559	0	0.00	1.8	NE
4017	Kwoi	2	20205	42	82	82	529.0	529.0	43	2.5	2.0	1.1	1,440	0.09	1,253	0	0.00	6.4	NE
4018	Araromi Ake	6	606	140	1,997	1,997	201.0	201.0	401	3.3	2.6	1.5	1,709	0.04	734	0	0.00	6.6	NE

Remarks: * 1) Safety factor (0.8) is multiplied.
2) When total inflow at exsiting downstream dam is less than the total storage volume of the exsiting downstream dam and the potential dam, the evaluation is not conducted.
3) NE=Not evaluated.

Annex-T SR3-11 Evaluation of Water Sources for Municipal Water Supply (1/2)

No	SN-S	Name of Source	Scheme/City	SD	HA	SHA	SN-SHA	State	SN-State	Water Demand 2010 (MCM/y)	Before Adjustment & without Proposed dams			Proposed Measures	After Adjustment & with Proposed dams		
											Water Demand 2030 (original plan) (MCM/y)	Supply Cap with 90% Year Dependability (MCM/y)	Deficit (MCM/y)	Water Source Works	Water Demand 2030 (MCM/y)	Supply Cap with 90% Year Dependability (MCM/y)	Deficit (MCM/y)
34	5001	Aba R.	Aba	1	7	702	151	Abia	1	9.18	16.25	1.20	-15.05	New Dam: 4012	25.98	0.00	9.73
35	5002	Yedseram R.	Mudi	1	8	80403_i	169	Adamawa	2	2.08	3.68	0.00	-3.68	New Dam: 4013	3.76	0.00	0.08
62	8001	Benue R.	Numan	8	3	313	92	Adamawa	2	2.08	3.68	3.68	0.00		3.68	0.00	0.00
63	8002	Benue R.	Yola	8	3	317	102	Adamawa	2	9.01	38.57	38.57	0.00		38.57	0.00	0.00
96	45	Kiri	Kiri	9	3	31403	94	Adamawa	2	0.00	1.53	1.53	0.00		1.53	0.00	0.00
50	5045	Mamu(Ezu) R.	Greater Awka	1	5	50402	124	Anambra	4	0.00	30.66	0.00	-30.66	New Dam:4009	45.60	0.00	14.94
51	5046	Ntamili R.	Ihiala Regional	1	5	506	126	Anambra	4	0.00	13.18	0.24	-12.95	New Dam:4010	29.05	0.00	15.87
52	5047	Ubor R.	Nnewi Regional	1	5	506	126	Anambra	4	0.00	25.14	0.04	-25.11	New Dam:4011	43.98	0.00	18.84
82	8022	Niger R.	Onitsha	8	5	50401	123	Anambra	4	0.00	73.58	73.58	0.00		73.58	0.00	0.00
12	44	Gubi	Gubi/Bauchi	1	3	31409	99	Bauchi	5	8.66	15.33	16.48	0.00	46 Waya dam	16.48	0.00	1.15
57	46	Waya	Bauchi/Waya	1	3	31409	99	Bauchi	5	0.00	0.00	0.00	0.00		12.86	0.00	6.73
32	1022	Otukpo	Otukpo	1	7	704043	158	Benue	7	0.94	6.25	93.78	0.00		93.78	0.00	87.53
64	8003	Katsina-Ala R.	Katsina-Ala	8	4	406_i	115	Benue	7	0.94	6.25	6.25	0.00		6.25	0.00	0.00
65	8004	Benue R.	Makarudi	8	4	405	113	Benue	7	3.12	36.18	36.18	0.00		36.18	0.00	0.00
11	41	Biu	Biu	1	3	31405	95	Borno	8	0.00	3.68	5.16	0.00		5.16	0.00	1.48
102	117	Alau	Alau/Maiduguri	9	8	806	170	Borno	8	11.61	23.30	16.80	-6.50	Diversion from Yedseram R.	23.30	0.00	0.00
36	5005	Calabar R.	Akamkpa	1	7	705	161	Cross River	9	1.73	3.07	12.00	0.00		12.00	0.00	8.93
37	5006	Great Kwa R.	Calabar	1	7	705	161	Cross River	9	13.86	24.53	32.40	0.00	Intake from Calabar R.	57.60	0.00	33.07
38	5007	Abe R.	Ogoja	1	7	704042	157	Cross River	9	0.00	5.36	0.00	-5.36	2245	27.49	0.00	22.13
66	8005	Cross R.	Ugep/Itigidi/Obubra	8	7	70403	155	Cross River	9	8.31	16.56	16.56	0.00		16.56	0.00	0.00
67	8006	Cross R.	Ikom	8	7	70405_i	160	Cross River	9	0.00	7.62	7.62	0.00		7.62	0.00	0.00
39	5008	Aya R.	Ishielu/Ezzilo	1	7	70402	154	Ebonyi	11	4.40	7.78	0.00	-7.78	New Dam: 4016	14.43	0.00	6.65
53	1012	Unknown(Ivo)	Ohafia-Ukawu	1	7	70402	154	Ebonyi	11	0.00	30.66	104.66	0.00		104.66	0.00	79.52
83	8023	Cross R.	CrossR./Ebonyi	8	7	70403	155	Ebonyi	11	0.00	30.66	30.66	0.00		25.14	0.00	0.00
26	134	Ikpoba	Ikpoba/Benin	1	6	616	148	Edo	12	2.60	4.60	6.53	0.00		6.53	0.00	1.93
6	21	Ero	Ero	1	2	209	63	Ekiti	13	18.10	32.04	36.09	0.00		36.09	0.00	4.05
16	63	Egbe	Egbe	1	6	614	147	Ekiti	13	11.43	20.24	35.28	0.00		35.28	0.00	15.05
18	71	Itapaji	Itapaji	1	2	20403	45	Ekiti	13	0.87	3.07	3.58	0.00		3.58	0.00	0.51
27	144	Ureje	Ureje	1	6	614	147	Ekiti	13	1.73	3.07	2.69	-0.38	(1016)	2.69	0.00	0.01
40	5012	Ajalli R.	Ajali	1	5	50402	124	Enugu	14	13.34	23.61	0.00	-23.61	2185	35.28	0.00	11.67
10	40	Balanga	Balanga	1	3	31405	95	Gombe	15	0.00	11.65	33.07	0.00		33.07	0.00	21.42
95	43	Dadin Kowa	Dadin Kowa	9	3	31407	97	Gombe	15	8.66	23.00	23.00	0.00		23.00	0.00	0.00
28	149	Lokpanta	Lokpanta/Okigwe	1	7	702	151	Imo	16	7.80	13.80	1.00	-12.80	New Dam: 4015	63.07	0.00	49.28
41	5013	Otamiri R.	Owerri/Otamiri	1	7	702	151	Imo	16	10.39	18.40	0.03	-18.37	New Dam: 4002	28.63	0.00	10.23
22	96	Moh.Ayuba	Moh/Ayuba	1	8	8080721_i	185	Jigawa	17	1.73	3.07	1.74	-1.33	(GW)	1.75	0.00	0.02
42	5014	Gurara R.	Kwoi	1	2	20205	42	Kaduna	18	2.13	3.77	0.00	-3.77	New Dam: 4017	16.42	0.00	12.65
43	5015	River/Steam(Unknown)	Kafanchan	1	4	404	112	Kaduna	18	2.29	4.05	0.17	-3.88	New Dam: 4003	13.22	0.00	9.17
54	5051	Unknown	Kachia	1	2	20205	42	Kaduna	18	0.00	3.37	0.00	-3.37	New Dam: 4004	19.68	0.00	16.31
68	8007	Kaduna R.	Kaduna	8	2	20813	60	Kaduna	18	46.25	81.86	81.86	0.00		81.86	0.00	0.00
94	39	Zaria	Zaria	9	2	20814	61	Kaduna	18	10.39	64.39	64.39	0.00		64.39	0.00	0.00
19	89	Guzugzu	Guzugzu	1	8	8080743	191	Kano	19	1.25	8.34	1.90	-6.44		1.90	0.00	0.00
20	92	Karaye	Karaye	1	8	8080743	191	Kano	19	1.22	4.60	1.22	-3.38	(8080743)	1.22	0.00	0.00
69	8008	Kano R.	Chiromawa/Kano	8	8	808075	193	Kano	19	0.42	2.94	2.94	0.00		2.94	0.00	0.00
70	8009	Hadejia R.	Joda	8	8	808073	187	Kano	19	1.66	32.74	32.74	0.00		32.74	0.00	0.00
71	8010	Challawa R.	Kano/Challawa	8	8	8080741	188	Kano	19	34.65	61.32	61.32	0.00		61.32	0.00	0.00
72	8011	Hadejia R.	Kano/Tamburawa	8	8	808073	187	Kano	19	3.46	107.31	107.31	0.00		107.31	0.00	0.00
73	8012	Hadejia R.	Wudil	8	8	808073	187	Kano	19	3.46	33.73	33.73	0.00		33.73	0.00	0.00
88	8028	Challawa R.	Madobi	8	8	8080743	191	Kano	19	0.00	24.43	24.12	-0.31		24.43	0.00	0.00
99	88	Gari	Gari	9	8	8080723	186	Kano	19	0.83	2.58	2.58	0.00		2.58	0.00	0.00
100	99	Tiga	Tiga	9	8	808077	194	Kano	19	1.66	6.01	6.01	0.00		6.01	0.00	0.00
101	103	Watari	Watari	9	8	80807423	190	Kano	19	0.00	23.00	12.07	-10.93	(8080743)	12.07	0.00	0.00

Annex-T SR3-11 Evaluation of Water Sources for Municipal Water Supply (2/2)

No	SN-S	Name of Source	Scheme/City	SD	HA	SHA	SN-SHA	State	SN-State	Water Demand 2010 (MCM/y)	Before Adjustment & without Proposed dams			Proposed Measures	After Adjustment & with Proposed dams		
											Water Demand 2030 (original plan) (MCM/y)	Supply Cap with 90% Year Dependability (MCM/y)	Deficit (MCM/y)	Water Source Works	Water Demand 2030 (MCM/y)	Supply Cap with 90% Year Dependability (MCM/y)	Deficit (MCM/y)
1	1	Ajiwa	Ajiwa	1	1	106082_i2	17	Katsina	20	7.01	15.33	7.01	-8.32	(Zobe)	7.01	0.00	0.00
3	9	Mariura+Gwaigwaye	Mairuwa	1	1	106093	31	Katsina	20	3.20	5.67	9.65	0.00		9.65	0.00	3.97
90	6	Jibiya	Jibiya	9	1	1060863	24	Katsina	20	1.04	1.84	1.84	0.00		1.84	0.00	0.00
92	14	Zobe	Zobe	9	1	1060883	28	Katsina	20	13.86	32.96	32.96	0.00		32.96	0.00	0.00
74	8013	Sokoto R.	Kebbi	8	1	10605	10	Kebbi	21	11.95	21.16	21.16	0.00		21.16	0.00	0.00
75	8014	Niger R.	Yelwa	8	1	103	3	Kebbi	21	2.18	3.86	3.86	0.00		3.86	0.00	0.00
76	8015	Niger R.	Lokoja	8	5	50403	125	Kogi	22	2.94	19.01	19.01	0.00		19.01	0.00	0.00
4	16	Agba	Agba/Ilorin	1	2	212	65	Kwara	23	2.34	4.14	4.32	0.00		4.65	0.00	0.51
5	17	Asa	Asa/Ilorin	1	2	212	65	Kwara	23	19.88	35.18	40.97	0.00		40.97	0.00	5.78
7	31	Oyun	Oyun	1	2	212	65	Kwara	23	3.51	6.21	2.29	-3.92	2023	8.74	0.00	2.53
55	5053	Aye R.	Otta Ikosi	1	6	606	139	Lagos	24	0.00	5.58	0.00	-5.58	2205	35.28	0.00	29.71
77	8016	Ogun R.	OgunR./Lagos	8	6	60401	133	Lagos	24	90.56	344.52	344.52	0.00		344.20	0.00	0.00
84	8024	Osun R.	Odomola/Lagos	8	6	608	142	Lagos	24	0.00	151.33	151.33	0.00		151.07	0.00	0.00
14	50	Doma	Doma/Lafia	1	4	404	112	Nasarawa	25	1.56	11.65	45.87	0.00		45.87	0.00	34.22
24	131	Lafia	Lafia	1	4	404	112	Nasarawa	25	1.05	4.14	1.05	-3.09	50: Doma dam	1.18	0.00	0.13
25	132	Nassarawa	Nassarawa	1	4	402	110	Nasarawa	25	0.39	4.83	8.74	0.00		8.74	0.00	3.91
44	5023	Mada R.	Keffi/Mada	1	4	404	112	Nasarawa	25	7.80	13.80	1.00	-12.80	New Dam: 4005	34.10	0.00	20.30
8	35	Suleja	Suleja	1	2	202021	39	Niger	26	8.66	15.33	35.28	0.00		35.28	0.00	19.95
9	36	Tagwai	Tagwai/Minna	1	2	206	47	Niger	26	13.73	24.30	50.87	0.00		50.87	0.00	26.57
45	5026	Gbako R.	Bida	1	2	206	47	Niger	26	4.68	9.20	0.00	-9.20	2067	13.16	0.00	3.97
85	8025	Gurara R.	Gurara/Niger	8	2	20203	38	Niger	26	0.00	0.92	0.92	0.00		0.92	0.00	0.00
86	8026	Kaduna R.	Zungeru/Wushishi	8	2	20805	53	Niger	26	0.00	1.38	1.38	0.00		1.38	0.00	0.00
91	7	Kainji	Kainji	9	1	101	1	Niger	26	1.73	3.07	3.07	0.00		3.07	0.00	0.00
46	5030	River/Steam(Unknown)	Ota	1	6	603	132	Ogun	27	1.59	5.64	0.00	-5.64	New Dam: 4014	7.63	0.00	1.99
47	5031	River/Steam(Owiwi)	Ifo Akinsede/Papalanto	1	6	60401	133	Ogun	27	2.08	3.68	9.11	0.00		9.11	0.00	5.43
48	5032	River/Steam(Unknown)	Ijebu-Ode/Yemoji	1	6	606	140	Ogun	27	3.12	5.52	0.00	-5.52	New Dam: 4018	26.43	0.00	20.92
49	5033	River/Steam(Unknown)	Ogere & Shagamu	1	6	606	139	Ogun	27	2.29	4.05	0.00	-4.05	2205	30.02	0.00	25.97
56	5056	Yewa R.	Yewa Regional	1	6	602_i	131	Ogun	27	0.00	0.00	0.00	0.00		0.00	0.00	0.00
78	8017	Ogun R.	Abeokuta	8	6	60401	133	Ogun	27	16.80	29.74	29.74	0.00		29.74	0.00	0.00
79	8018	Osun R.	Apoje	8	6	608	142	Ogun	27	3.20	26.49	26.49	0.00		32.58	0.00	0.00
87	8027	Ogun R.	Mokoloki Regional	8	6	60401	133	Ogun	27	0.00	76.65	76.65	0.00		76.65	0.00	0.00
31	1005	Owena & Owena Multi	Owena	1	6	612	146	Ondo	28	4.34	26.08	65.62	0.00		65.62	0.00	39.54
17	64	Eko-Ende	Eko-Ende	1	6	608	142	Osun	29	2.08	3.68	14.64	0.00		14.64	0.00	10.96
29	1002	Ilesha	Ilesha	1	6	608	142	Osun	29	0.00	9.20	14.22	0.00		14.22	0.00	5.02
30	1003	Ile-Ife	Ife	1	6	610	144	Osun	29	0.00	18.40	24.73	0.00		24.73	0.00	6.33
98	66	Erinle(EDE)	Erinle(EDE)	9	6	608	142	Osun	29	32.74	57.95	57.95	0.00		57.95	0.00	0.00
23	115	Eleyele	Eleyle	1	6	606	140	Oyo	30	4.72	8.35	10.92	0.00		10.92	0.00	2.57
97	59	Asejire	Asejire	9	6	608	142	Oyo	30	34.63	66.21	66.21	0.00		66.21	0.00	0.00
104	3501	Odedele	Ibadan/Odedele	9	6	608	142	Oyo	30	0.00	109.92	0.00	-109.92		109.92	0.00	0.00
13	47	Yakubu Gowon	Yakubu Gowon/Jos	1	3	31409	99	Plateau	31	14.28	27.59	14.27	-13.33	New Dam: 4007	14.28	0.00	0.00
15	52	Langtang	Langtang	1	3	304	80	Plateau	31	3.12	5.52	6.09	0.00		6.09	0.00	0.57
21	93	Laminga	Laminga/Jos	1	8	808063	182	Plateau	31	3.12	5.52	5.70	0.00		5.70	0.00	0.18
33	1026	Mangu	Mangu	1	4	31409	99	Plateau	31	0.00	3.07	3.07	0.00		3.07	0.00	0.00
58	6001	Barakin	Jos/Barakin	1	3	31409	99	Plateau	31	0.00	0.00	0.00	0.00		20.59	0.00	7.18
80	8020	Sokoto R.	Sokoto	8	1	106091	30	Sokoto	33	31.96	56.57	56.57	0.00		56.57	0.00	0.00
81	8021	Benue R.	Ibi	8	4	411	120	Taraba	34	3.62	6.41	6.41	0.00		6.41	0.00	0.00
103	1006	Kashimvilla	Kashimvilla	9	4	406_i	115	Taraba	34	0.00	18.40	18.40	0.00		18.40	0.00	0.00
2	5	Gusau	Gusau	1	1	106093	31	Zamfara	36	7.80	13.80	3.21	-10.59	New Dam: 4008	35.28	0.00	21.48
89	2	Bakolori	Bakolori	9	1	106093	31	Zamfara	36	0.35	14.42	14.42	0.00		14.42	0.00	0.00
93	38	Usuma	Usuma	9	2	202023	40	FCT Abuja	37	41.57	222.29	222.29	0.00		222.29	0.00	0.00

Annex-T SR3-12 Summary of Water Balance at Representative Points (1/4)

HA-1

1101: D.S.of Sokoto in Sokoto R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1101	56.8	85.9	5.3	0.3	0.008

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1101	2010	1,823	11.25	33.4	-41
	2030	1,864	17.63	28.2	-50

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1101	2010	0.01	0.88	0.00	0.00	0.00	Jun	0.89	0.89	0.89	0.01	12.18	0.64	13.06
	2030	0.01	1.50	0.00	0.00	0.00	Jun	1.51	1.51	1.51	0.01	6.85	0.64	8.35

Note: "Others" includes release for groundwater recharge for Fadama.

HA-2

1202:U.S.of Kaduna in Kaduna R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1202	162	263	57	8	1.59

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1202	2010	115	0.77	158.1	-2
	2030	305	3.24	155.5	-4

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1202	2010	1.59	0.00	1.48	0.00	0.00	Jan	3.07	3.07	3.07	2.05	8.71	14.86	12.44
	2030	1.59	0.00	2.60	0.00	0.00	Jan	4.19	4.19	4.19	2.05	13.25	14.86	13.25

Note: "Others" includes release for groundwater recharge for Fadama.

Annex-T SR3-12 Summary of Water Balance at Representative Points (2/4)

HA-3

1302:D.S.of Kiri Dam in Gongola R.; 1303: Taraba Gauging St. in Taraba R.; 1304: Donga Gauging St. in Donga R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1302	161.00	281.50	43.50	7.70	1.04
1303	292.10	638.10	95.20	10.40	0.94
1304	396.70	819.40	219.70	49.80	13.98

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1302	2010	3,618	1.56	145.0	-10
	2030	3,638	8.14	138.3	-14
1303	2010	0	0.04	286.7	-2
	2030	530	1.53	284.0	-3
1304	2010	0	0.13	388.1	-2
	2030	400	0.22	387.7	-2

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1302	2010	1.04	0.05	0.00	0.00	0.00	Jan	1.10	1.10	1.10	1.00	87.58	10.60	87.58
	2030	1.04	0.09	0.00	0.00	0.00	Jan	1.13	1.13	1.13	1.00	72.40	10.60	72.40
1303	2010	0.94	0.11	0.00	0.00	0.01	Jan	1.05	1.05	1.06	0.88	0.93	13.58	13.14
	2030	0.94	0.19	0.00	5.35	10.41	Jan	1.13	6.48	11.54	0.88	1.28	13.58	27.45
1304	2010	13.98	0.04	0.00	0.00	0.00	Jan	14.02	14.02	14.02	14.66	14.69	57.05	59.86
	2030	13.98	0.06	0.00	10.40	20.24	Jan	14.04	24.44	34.28	14.66	19.38	57.05	81.26

Note: “Others” includes release for groundwater recharge for Fadama.

HA-4

1401:Makurdi Gauging St. in Benue R.; 1402: Katsina-Ala Gauging St. in Katsina-Ala R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1401	2,959.00	6,050.80	1,478.30	330.20	98.35
1402	718.90	1,352.80	572.40	110.00	24.14

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1401	2010	2,303	6.48	2,904.8	-2
	2030	4,016	65.18	2,849.4	-4
1402	2010	0	0.05	713.7	-1
	2030	521	1.21	711.8	-1

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1401	2010	98.35	0.00	0.10	0.00	0.00	Jan	98.45	98.45	98.45	116.43	189.50	385.77	449.69
	2030	98.35	0.00	1.15	0.00	0.00	Jan	99.50	99.50	99.50	116.43	217.31	385.77	408.93
1402	2010	24.14	0.00	0.03	0.03	0.08	Jan	24.17	24.20	24.25	23.09	22.88	91.37	90.18
	2030	24.14	0.00	0.20	0.80	1.91	Jan	24.34	25.14	26.25	23.09	83.91	91.37	86.41

Note: “Others” includes release for groundwater recharge for Fadama.

Annex-T SR3-12 Summary of Water Balance at Representative Points (3/4)

HA-5

1502: U.S. of Onitsa in Niger R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1502	5,668	10,811	3,288	1,133	312.94

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1502	2010	33,131	32.60	5,455.2	-4
	2030	36,225	139.14	5,359.1	-5

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1502	2010	312.94	0.00	0.00	0.00	0.00	Jan	312.94	312.94	312.94	363.38	1,334.00	1,916.53	1,954.94
	2030	312.94	0.00	2.33	0.00	0.00	Jan	315.27	315.27	315.27	363.38	1,341.60	1,916.53	1,856.80

Note: "Others" includes release for groundwater recharge for Fadama.

HA-6

1601:U.S. of Akute Intake in Ogun R.; 1602: U.S. of Intake for Odomola WTW in Oshun R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1601	102	139	32	3	0.043
1602	75	104	29	4	0.257

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1601	2010	983	0.95	98.3	-4
	2030	1,019	12.42	87.8	-14
1602	2010	154	2.61	70.9	-6
	2030	154	5.71	60.3	-20

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1601	2010	0.04	0.00	2.87	0.00	0.00	Jan	2.91	2.91	2.91	0.17	30.27	1.76	30.27
	2030	0.04	0.00	10.91	0.00	0.00	Jan	10.95	10.95	10.95	0.17	22.37	1.76	22.37
1602	2010	0.26	0.00	0.00	0.04	0.10	Jan	0.26	0.30	0.36	0.22	7.23	3.69	7.26
	2030	0.26	0.00	4.79	0.04	0.10	Jan	5.05	5.09	5.15	0.22	8.09	3.69	8.19

Note: "Others" includes release for groundwater recharge for Fadama.

Annex-T SR3-12 Summary of Water Balance at Representative Points (4/4)

HA-7

1702: Obubra Gauging St. in Cross R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1702	1,429	2,693	1,148	231	58.71

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1702	2010	3	0.18	1,411.5	-1
	2030	104	2.75	1,408.9	-1

3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1702	2010	58.71	0.03	0.27	0.02	0.05	Jan	59.01	59.03	59.06	64.62	63.90	197.59	193.95
	2030	58.71	0.05	1.32	0.08	0.29	Jan	60.08	60.16	60.37	64.62	62.46	197.59	187.01

Note: "Others" includes release for groundwater recharge for Fadama.

HA-8

1801: Wudil Gauging St. in Hadejia R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1801	60.1	95.6	7.5	0.5	0.002

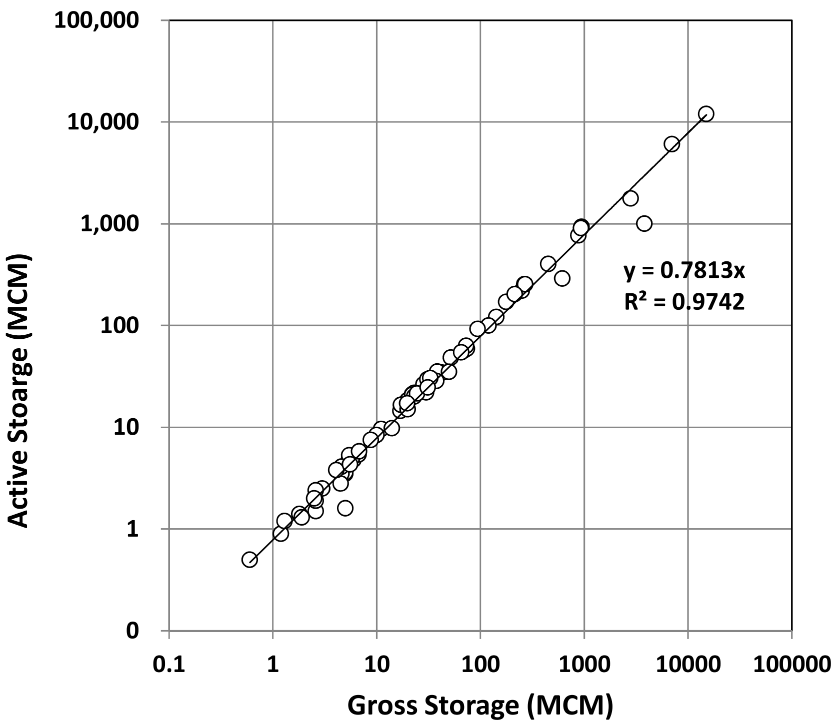
2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1801	2010	2,775	8.63	40.7	-32
	2030	2,805	17.71	32.9	-45

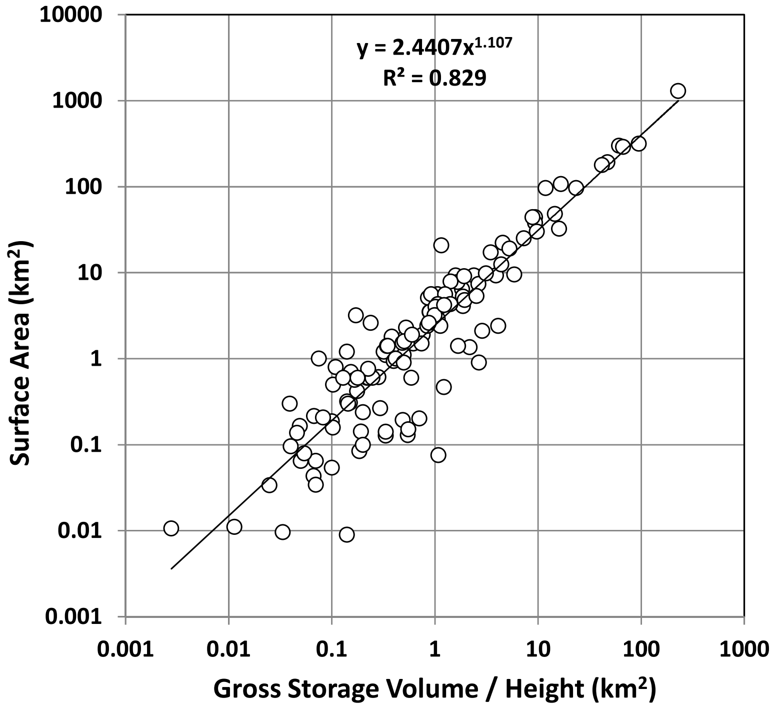
3. Water Demand and Supply Capacty

Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	demand	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1801	2010	0.00	3.97	0.16	2.02	6.55	Jun	4.13	6.15	10.68	0.00	21.19	4.84	27.68
	2030	0.00	4.81	2.11	10.92	30.89	Jun	6.92	17.84	37.81	0.00	7.45	4.84	37.81

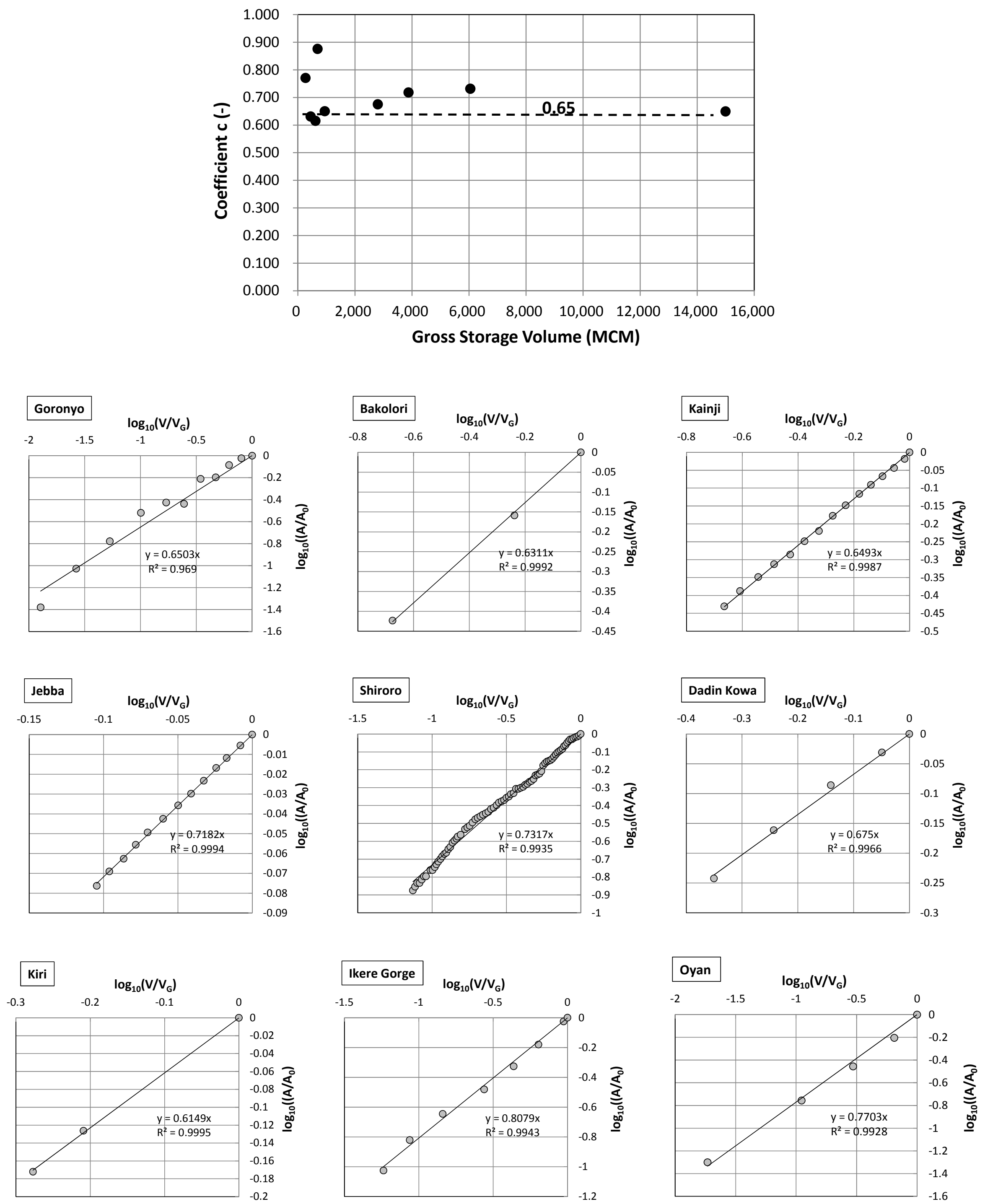
Note: "Others" includes release for groundwater recharge for Fadama and conservation flow for wetland area.



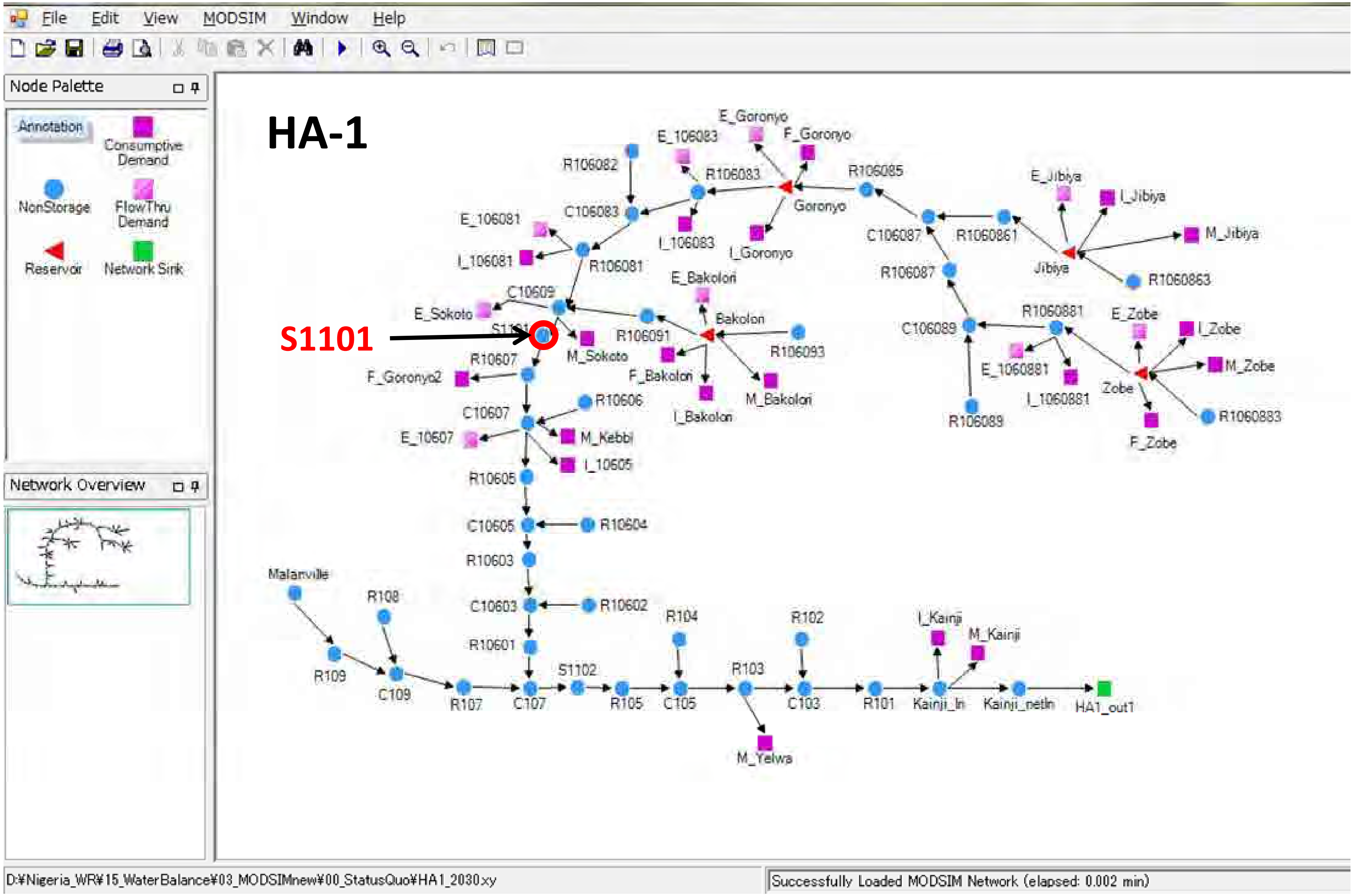
Annex-F SR3-1 Relationship between Gross Storage Volume and Active Storage Volume



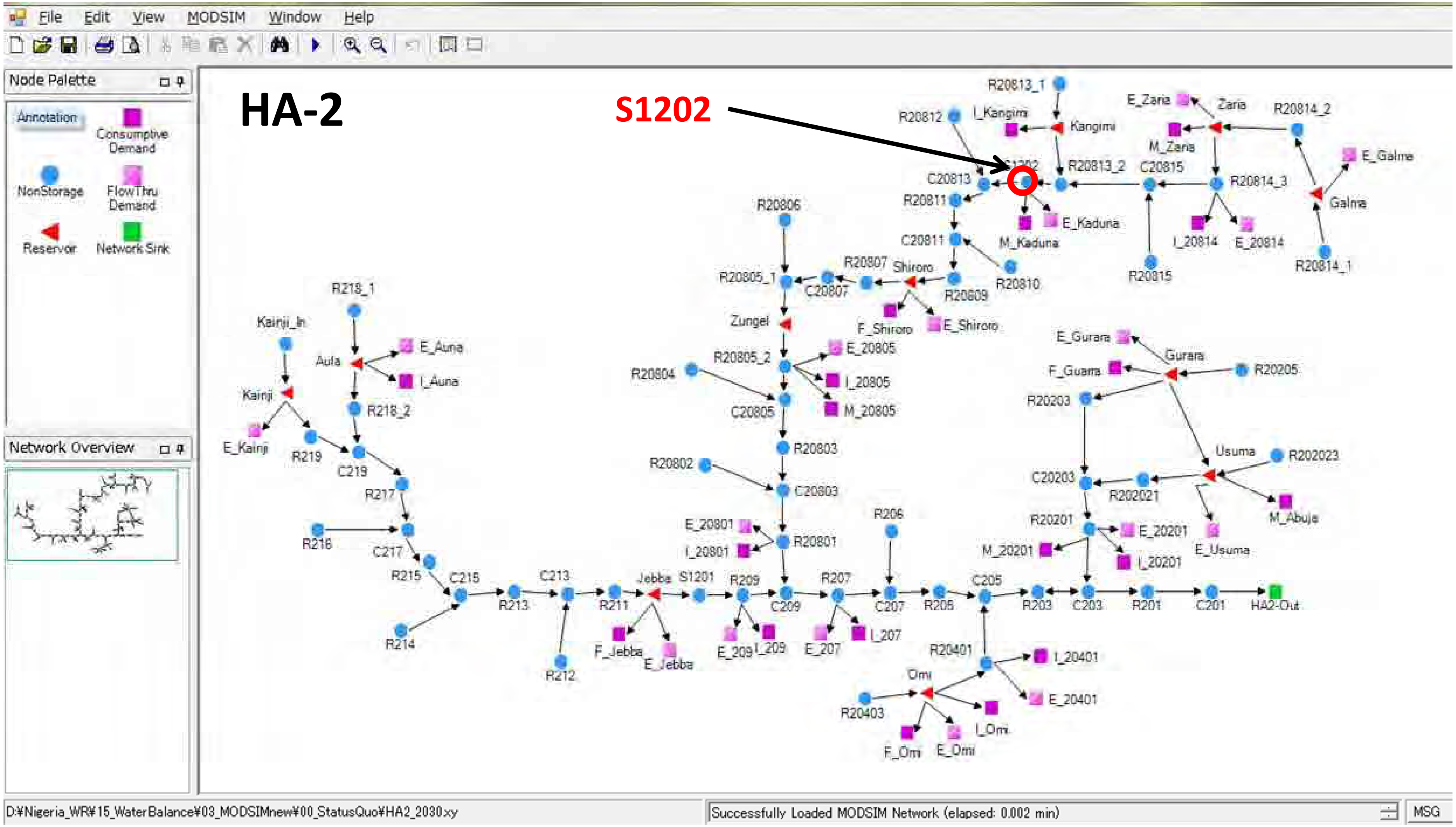
Annex-F SR3-2 Relationship among Gross Storage Volume Height of Dam and Active Storage Volume



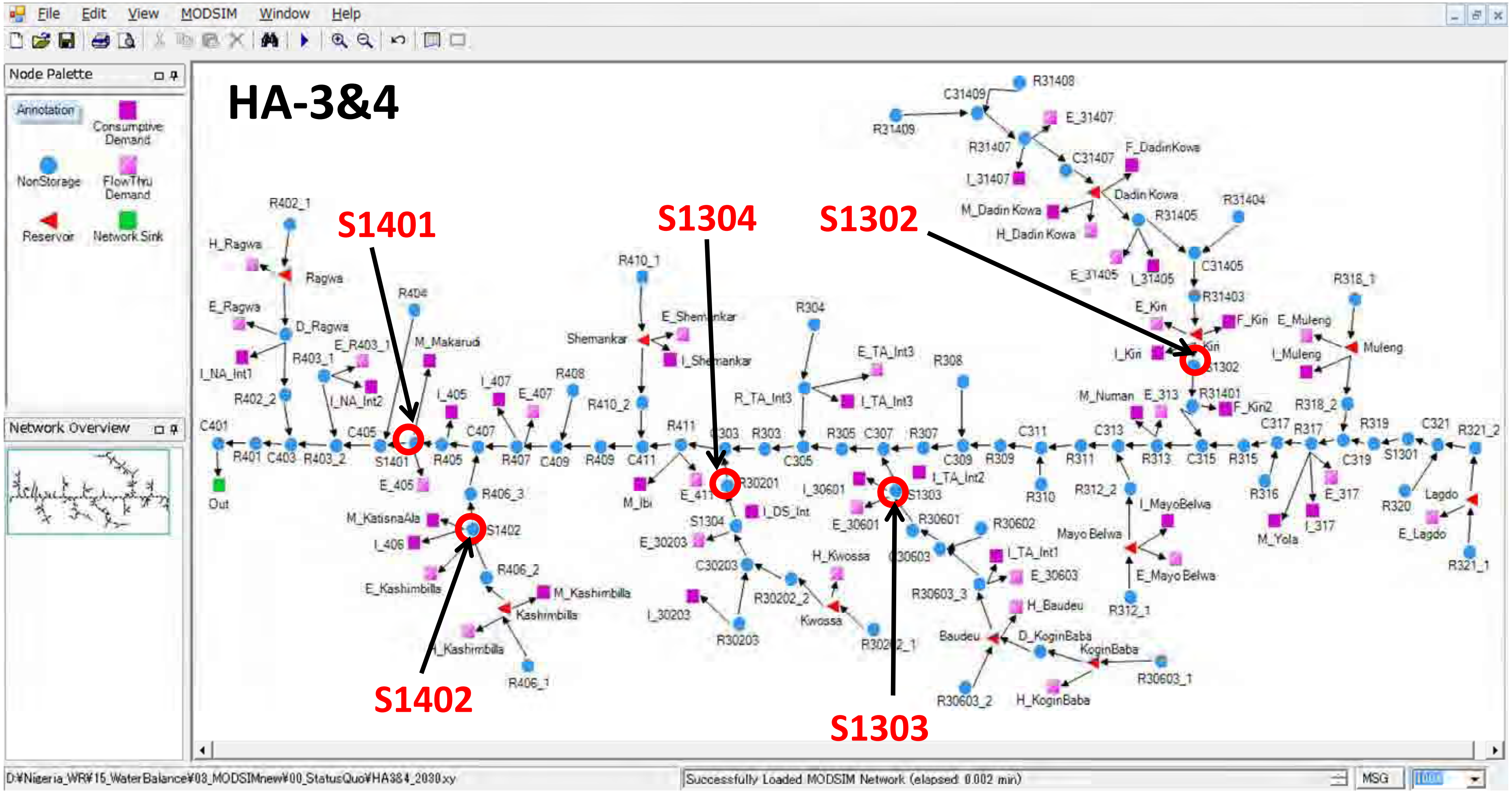
Annex-F SR3-3 Relationship between Storage Volume and Surface Area



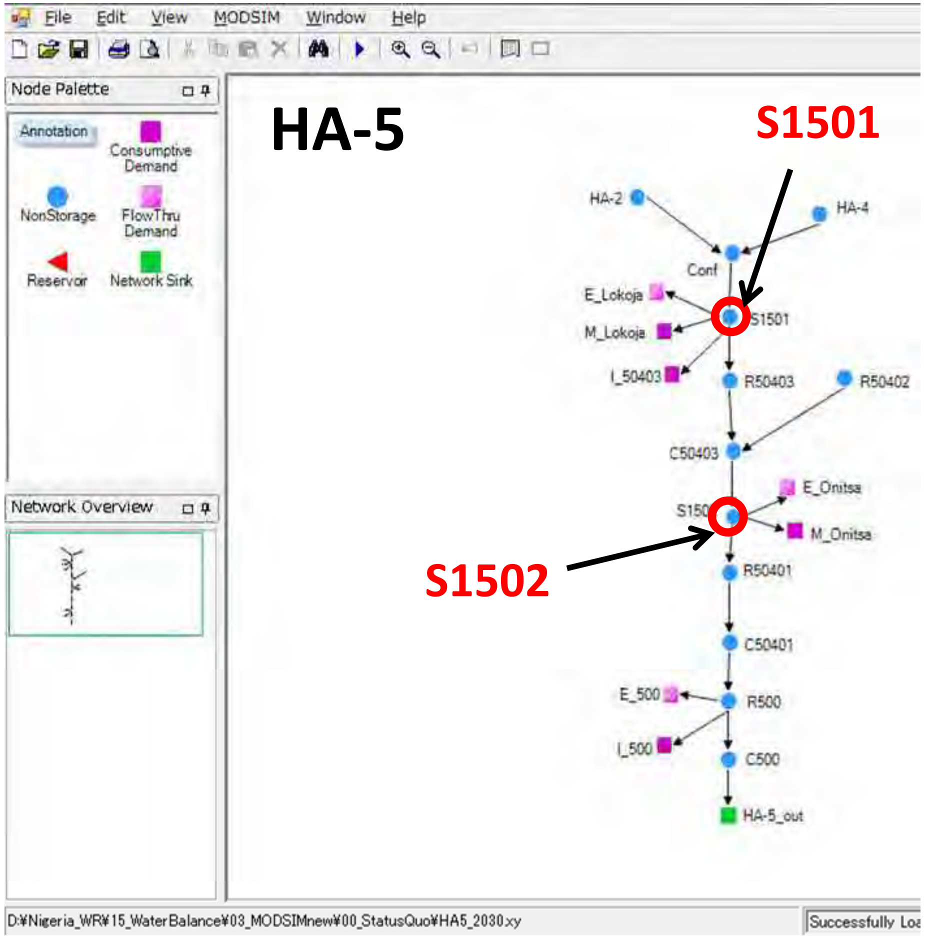
Annex-F SR3-4 MODSIM-DSS Model Set-up (1/6)

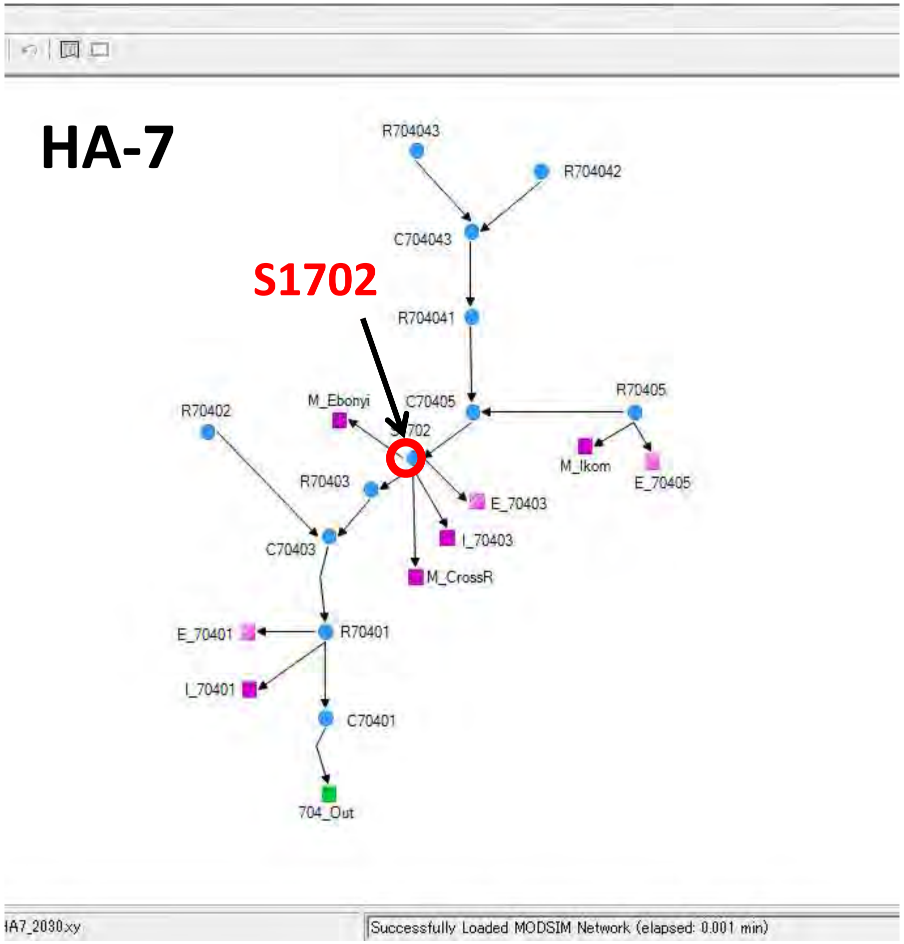


Annex-F SR3-4 MODSIM-DSS Model Set-up (2/6)

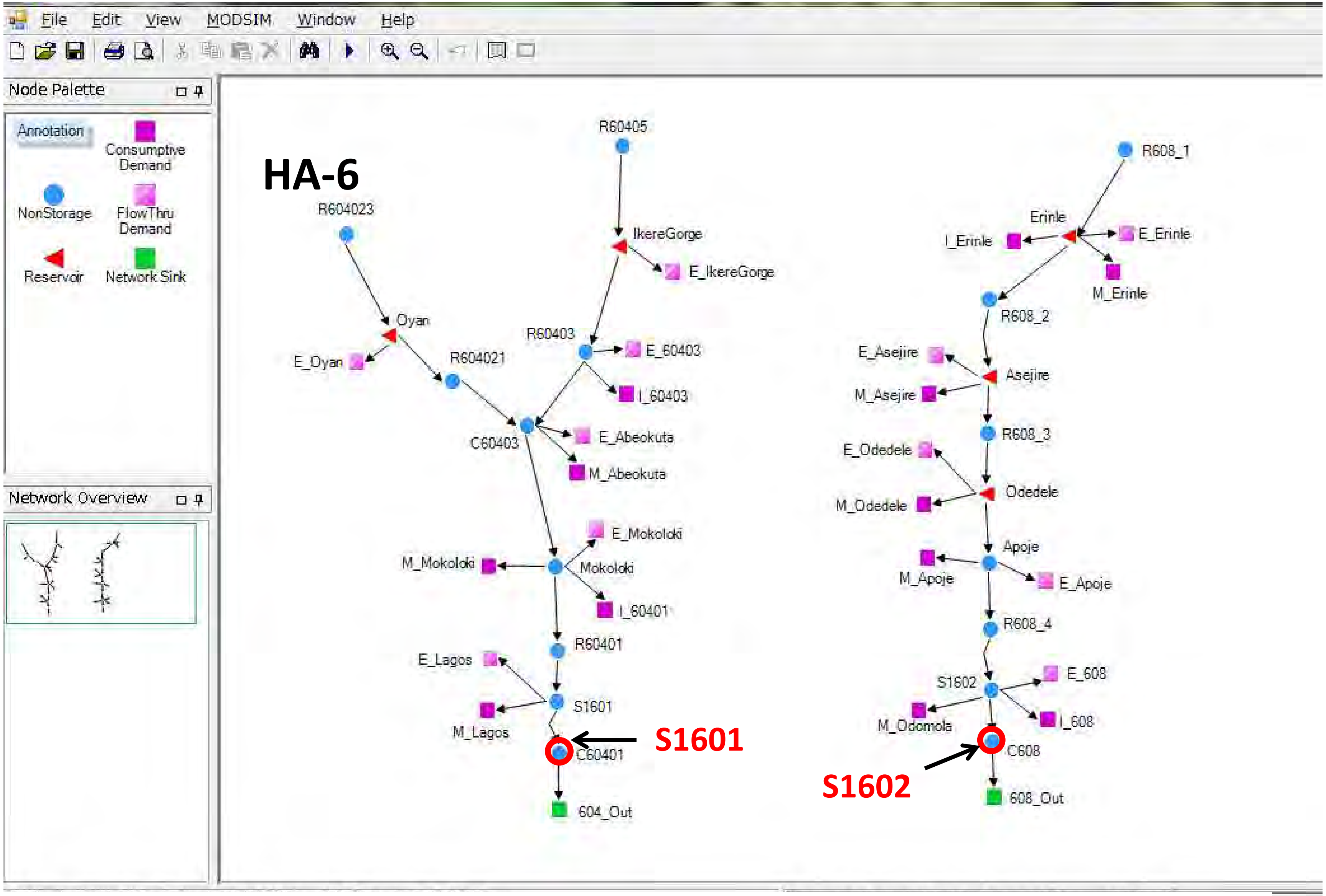


Annex-F SR3-4 MODSIM-DSS Model Set-up (3/6)

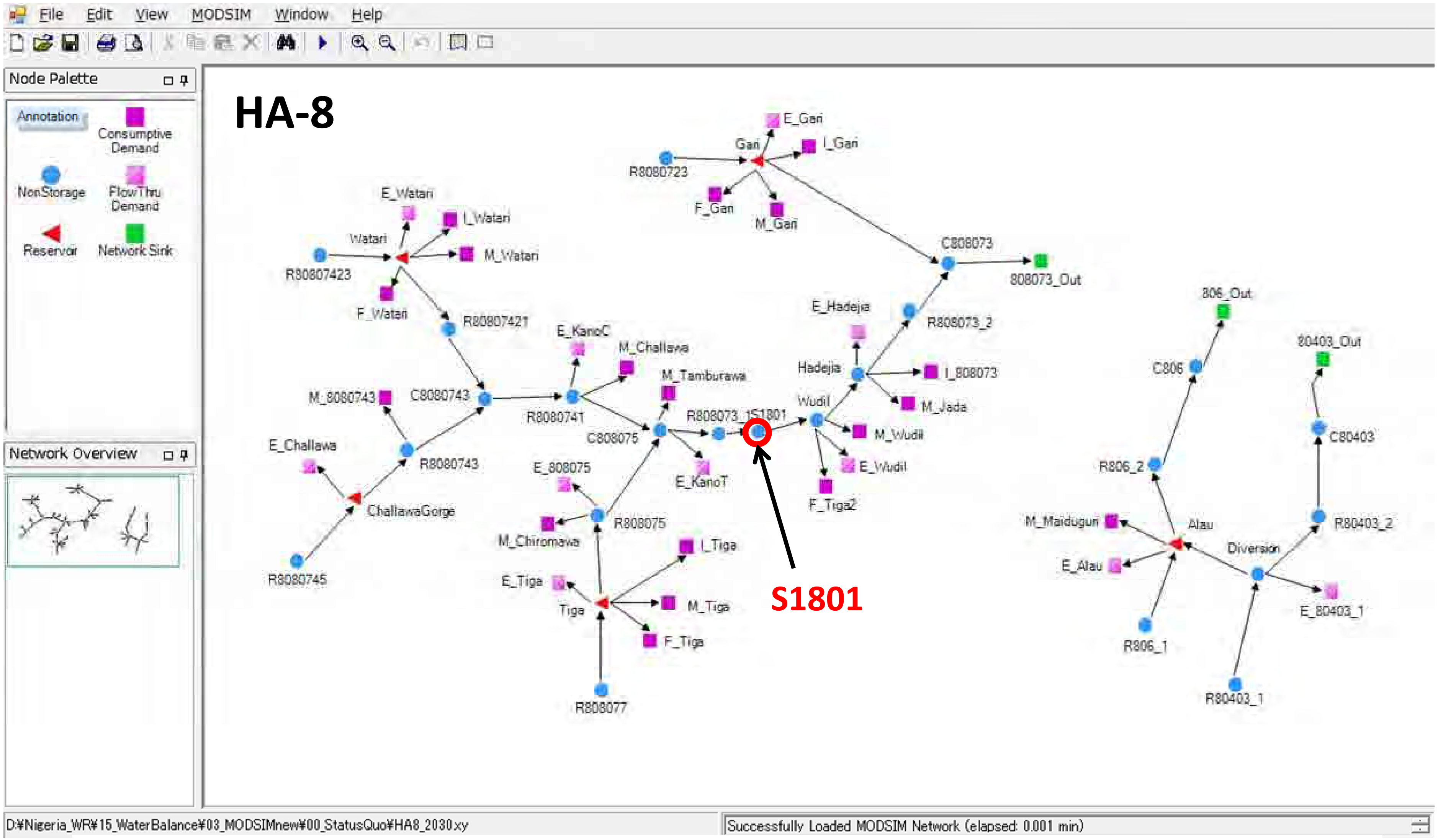




Annex-F SR3-4 MODSIM-DSS Model Set-up (4/6)

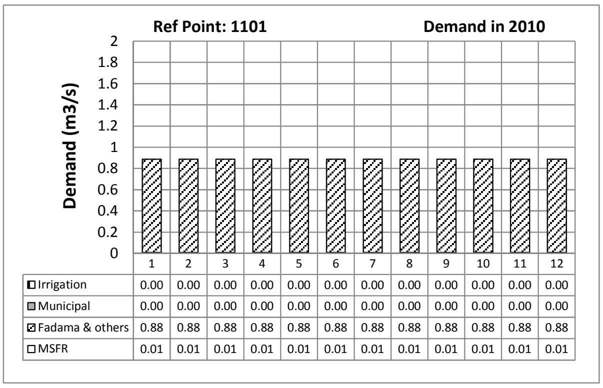


Annex-F SR3-4 MODSIM-DSS Model Set-up (5/6)

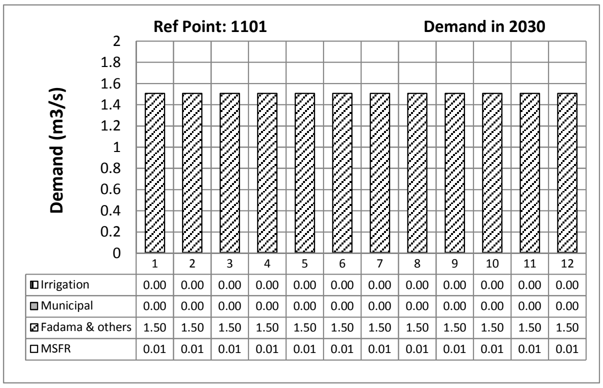


Annex-F SR3-4 MODSIM-DSS Model Set-up (6/6)

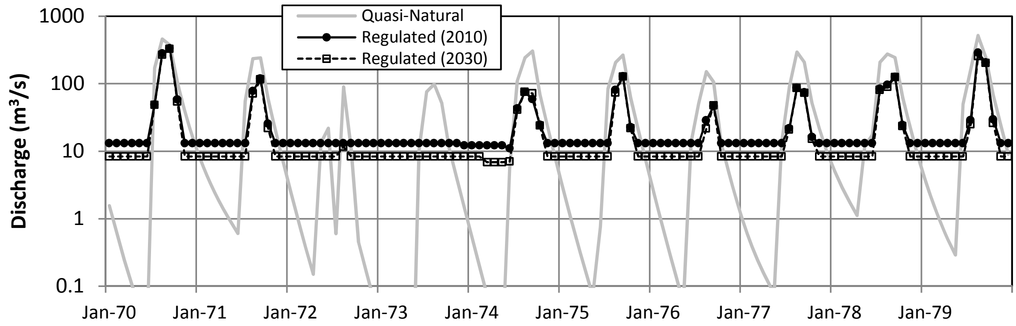
S1101

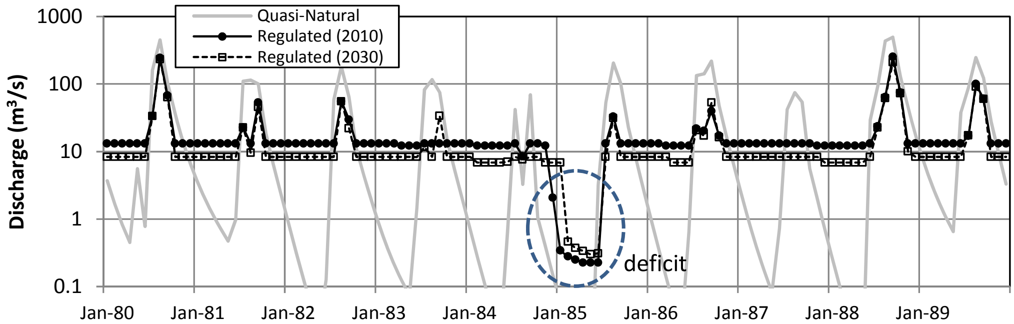


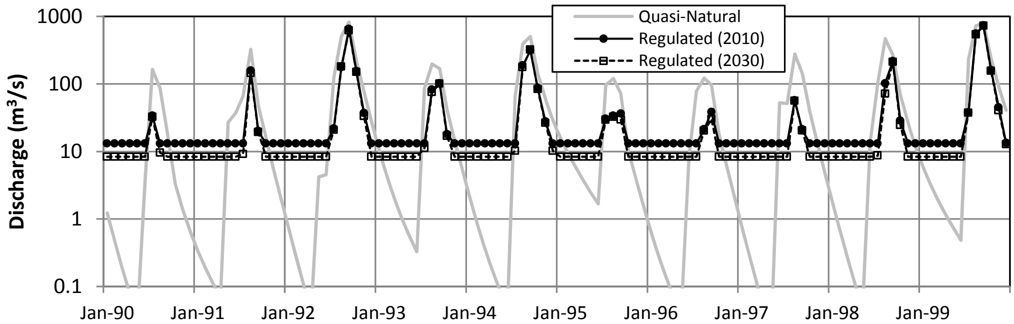
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
MSFR	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

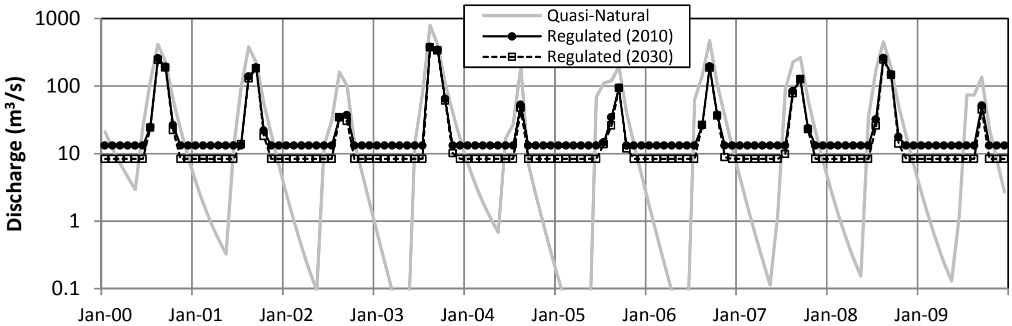


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
MSFR	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01



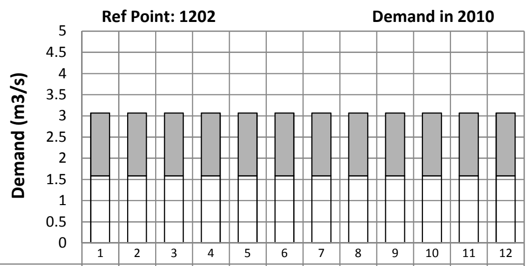




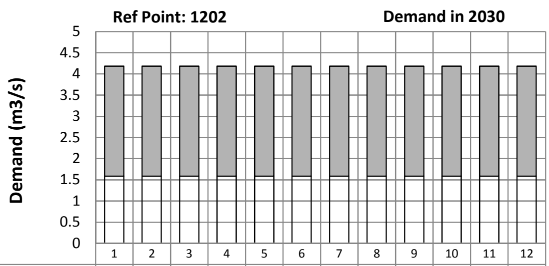


Annex-F SR3-5 Simulated Flow Condition at Representative Points (1/12)

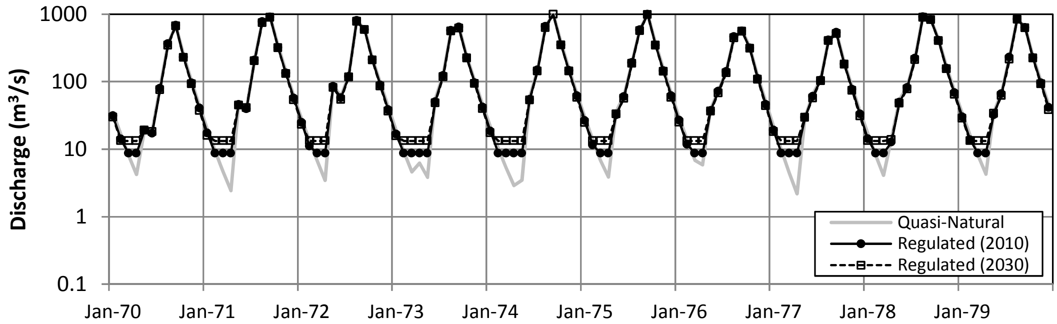
S1202

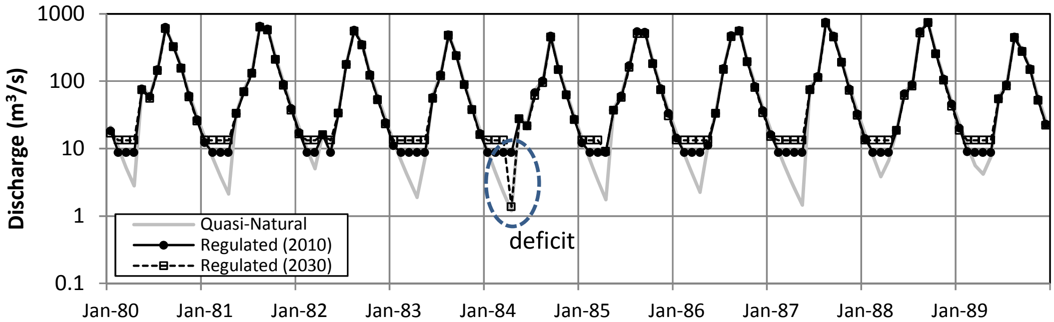


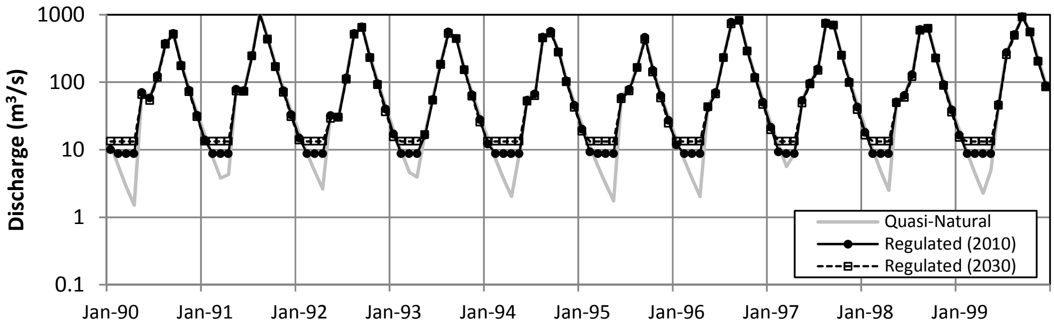
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59

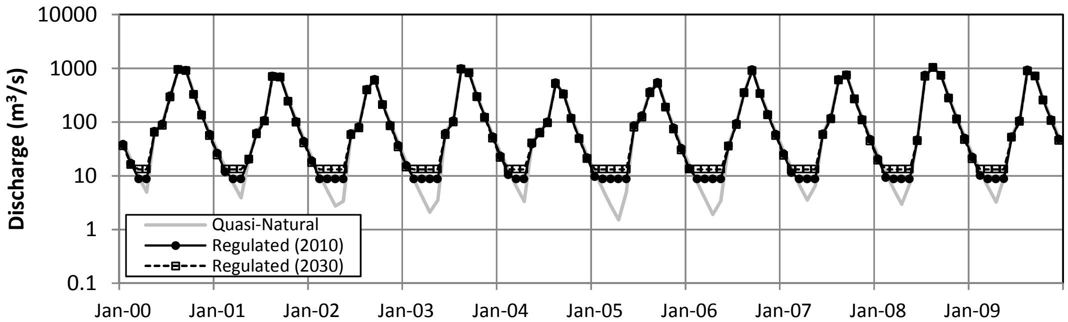


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59



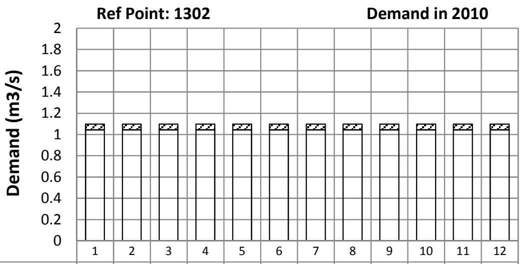




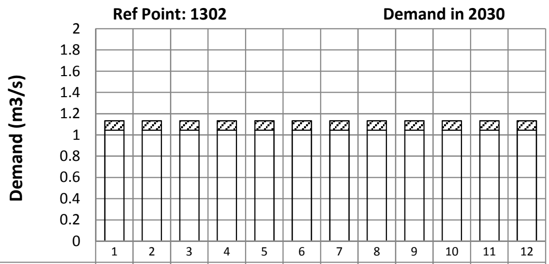


Annex-F SR3-5 Simulated Flow Condition at Representative Points (2/12)

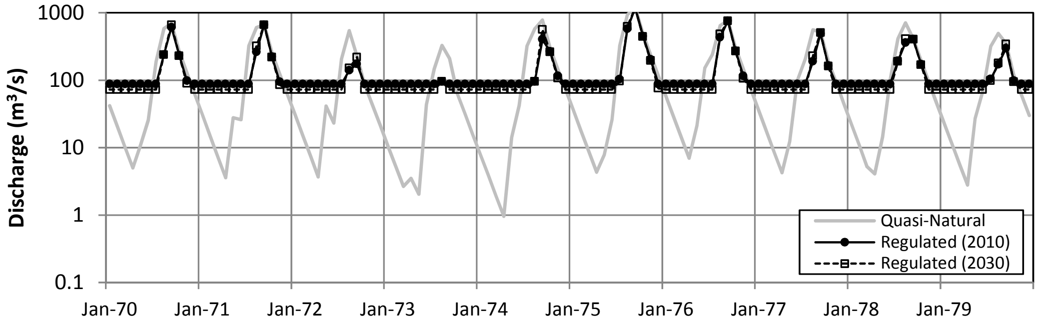
S1302

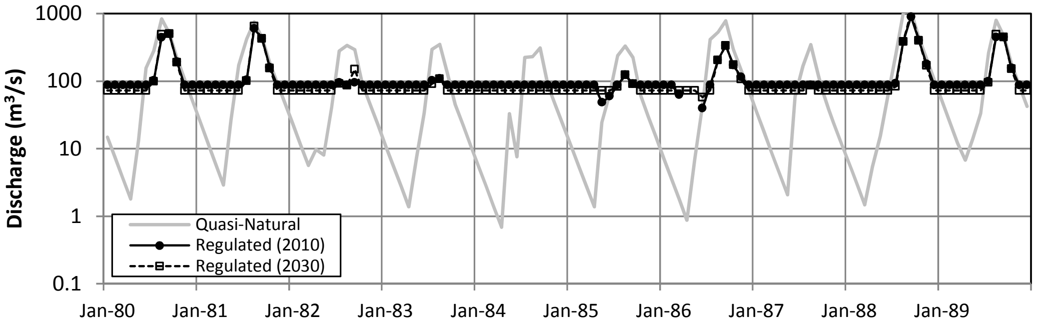


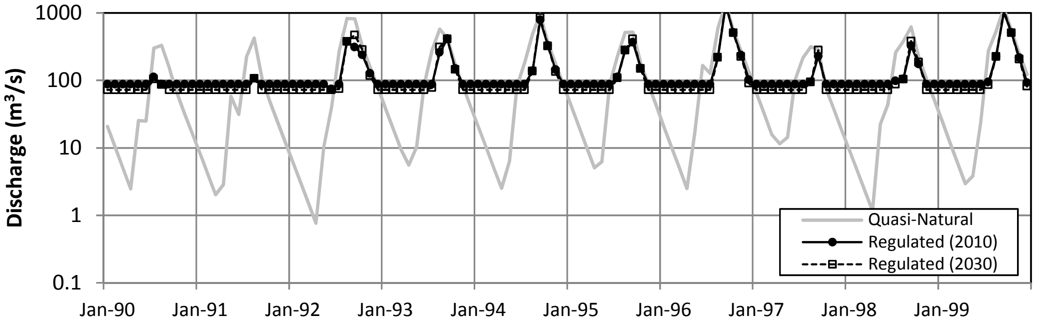
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
MSFR	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04

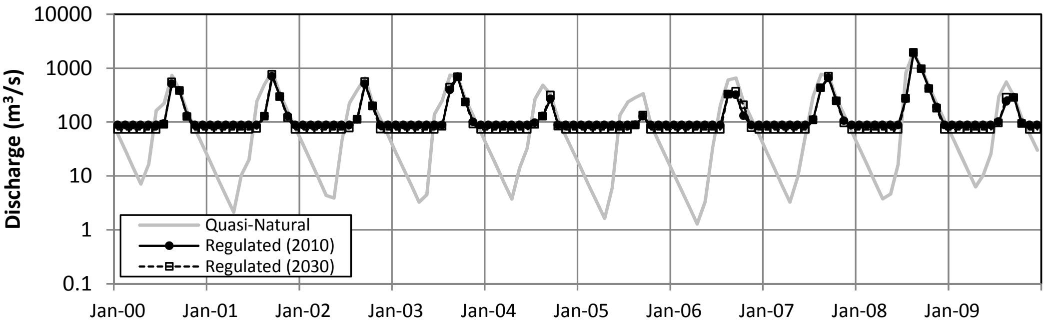


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
MSFR	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04



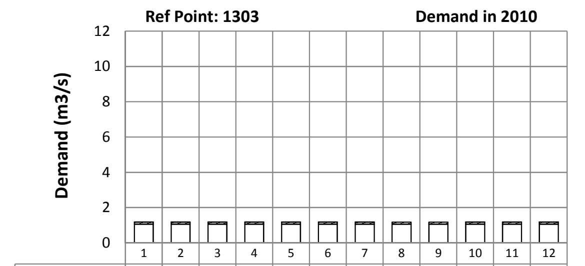




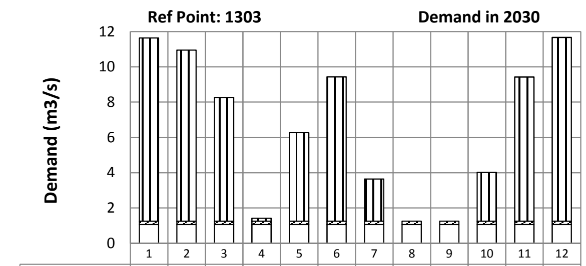


Annex-F SR3-5 Simulated Flow Condition at Representative Points (3/12)

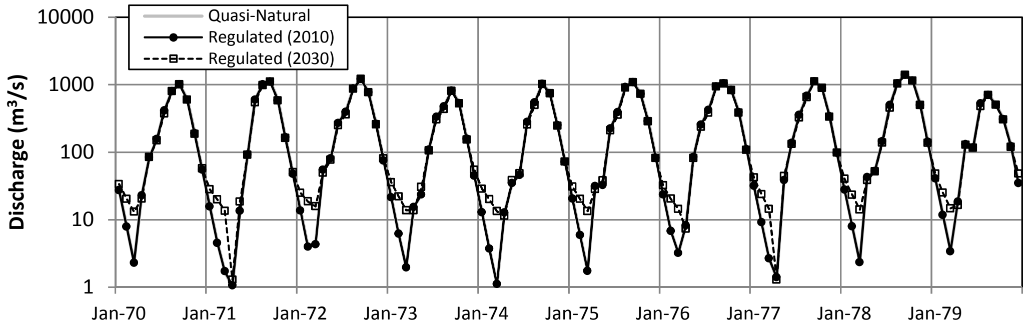
S1303

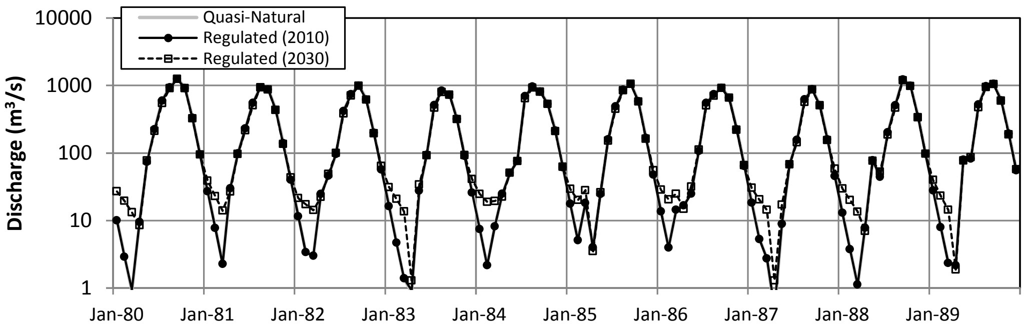


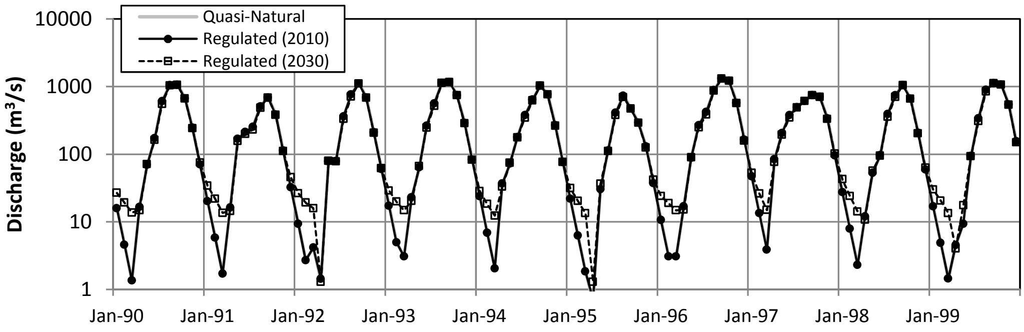
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
MSFR	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07

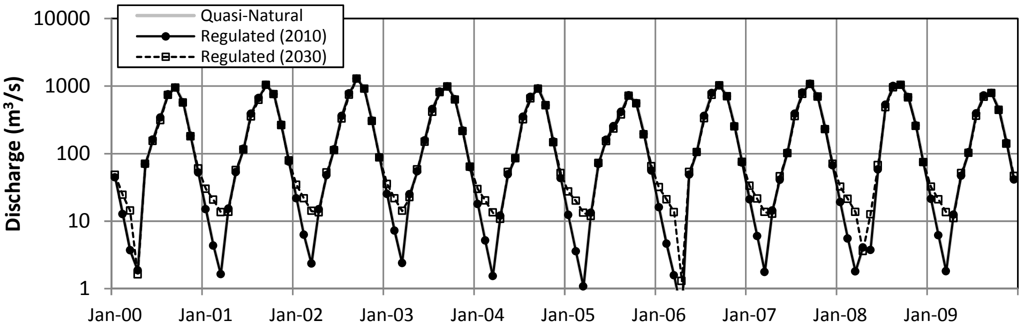


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	10.38	9.70	7.01	0.16	5.01	8.18	2.38	0.00	0.00	2.77	8.16	10.41
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
MSFR	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07



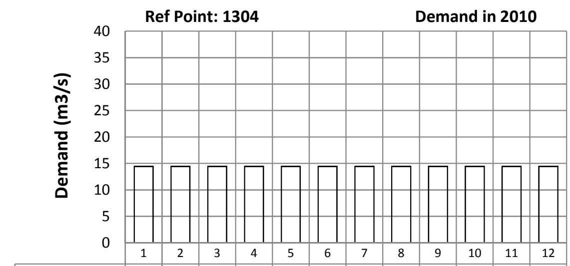




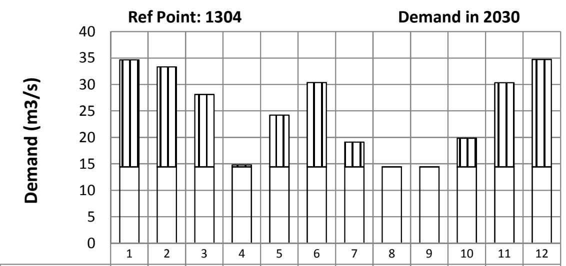


Annex-F SR3-5 Simulated Flow Condition at Representative Points (4/12)

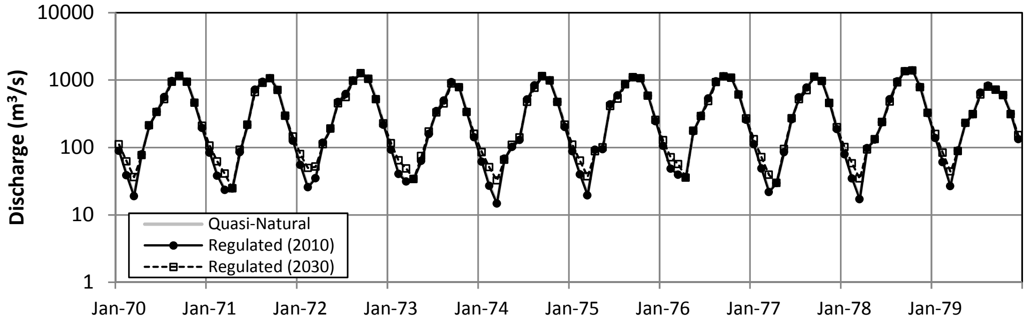
S1304

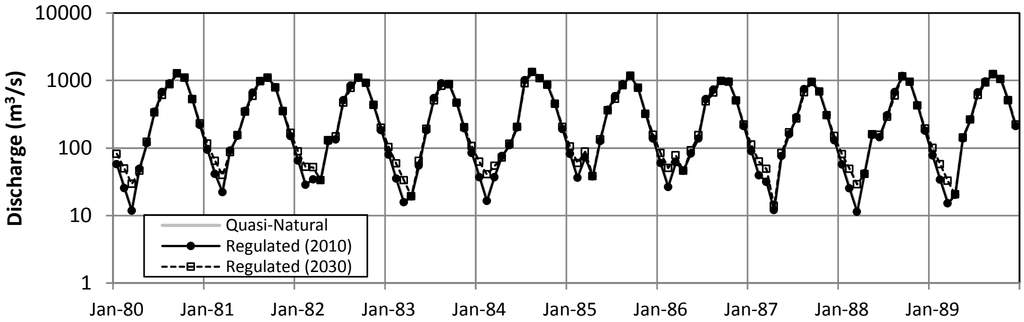


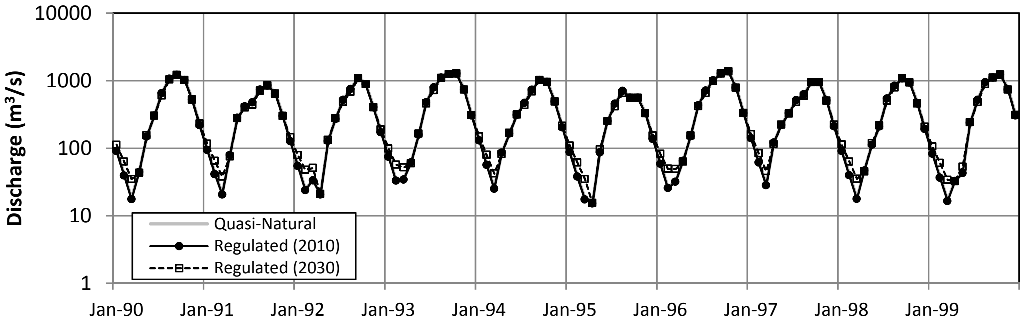
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
MSFR	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41

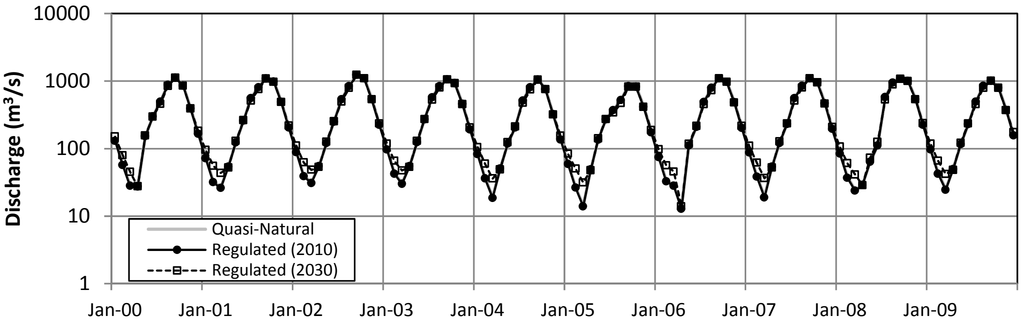


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	20.19	18.86	13.64	0.32	9.75	15.90	4.63	0.00	0.00	5.38	15.88	20.24
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
MSFR	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41



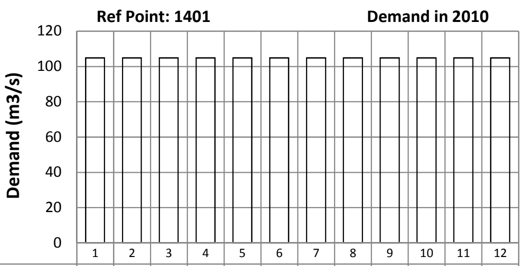




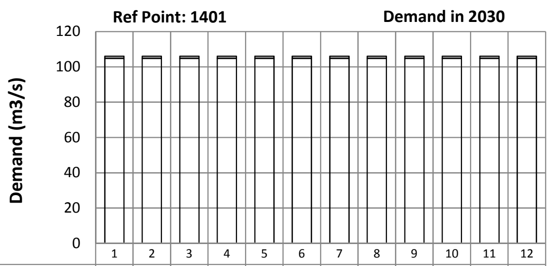


Annex-F SR3-5 Simulated Flow Condition at Representative Points (5/12)

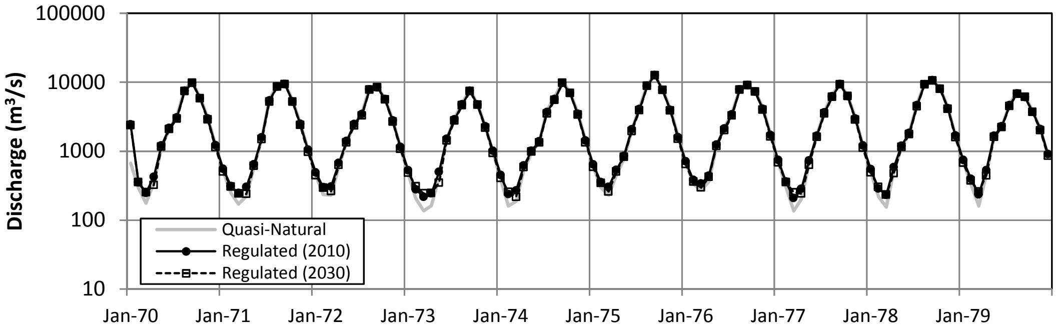
S1401

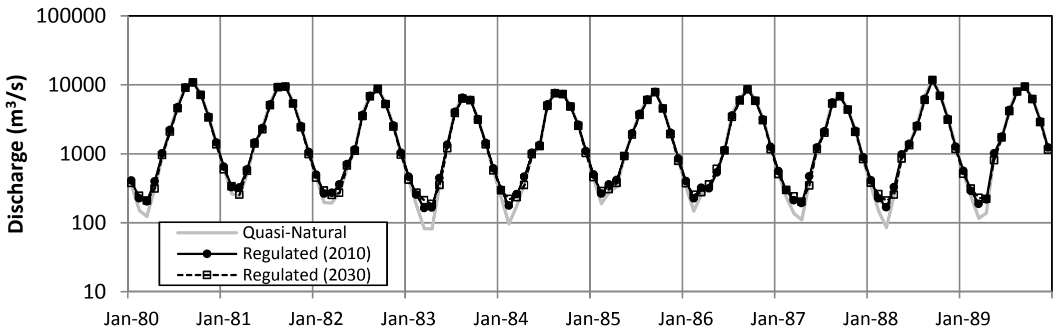


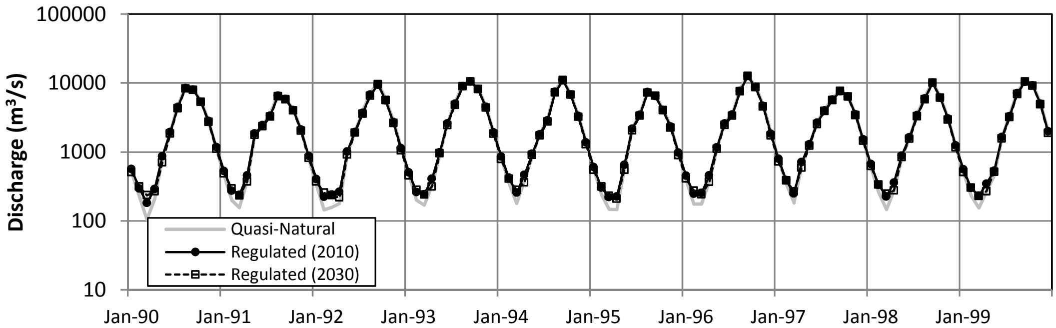
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	104.89	104.89	104.89	104.89	104.89	104.89	104.89	104.89	104.89	104.89	104.89	104.89

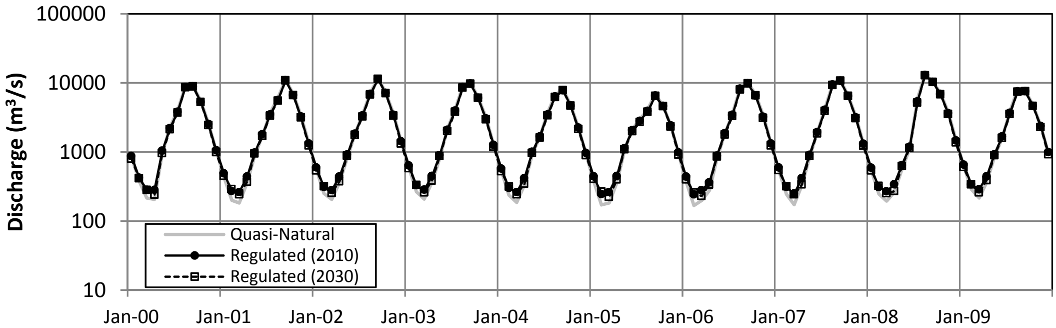


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	104.8	104.8	104.8	104.8	104.8	104.8	104.8	104.8	104.8	104.8	104.8	104.8



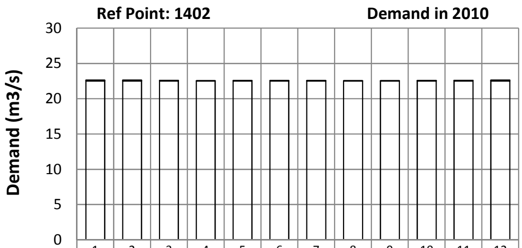




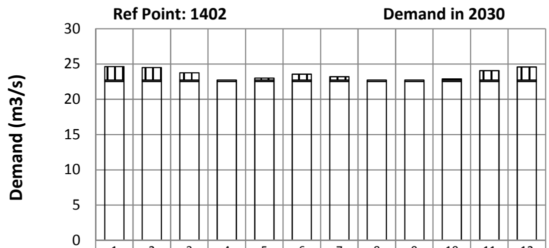


Annex-F SR3-5 Simulated Flow Condition at Representative Points (6/12)

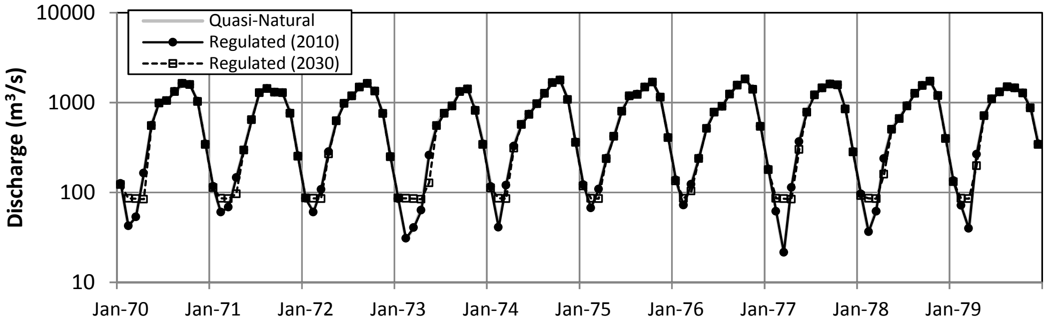
S1402

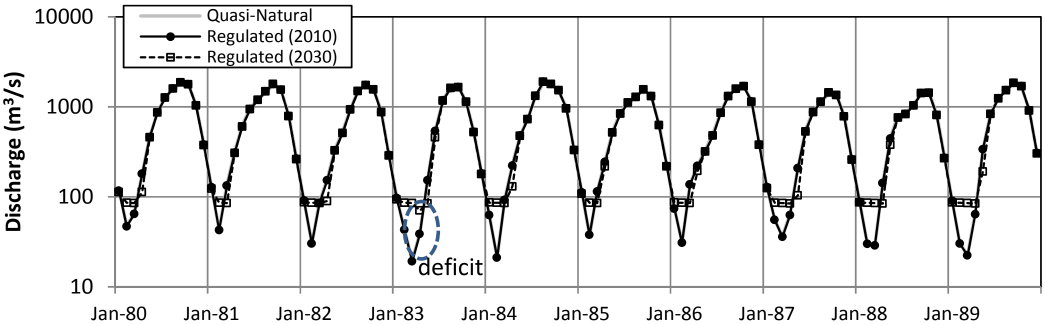


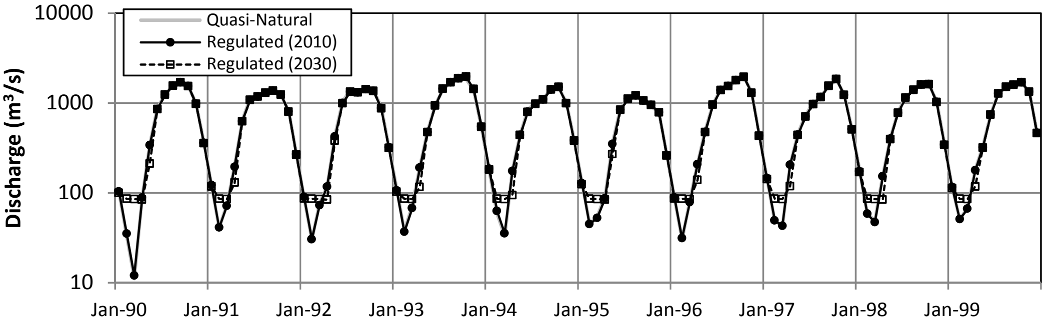
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.08	0.07	0.04	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.06	0.08
Municipal	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53

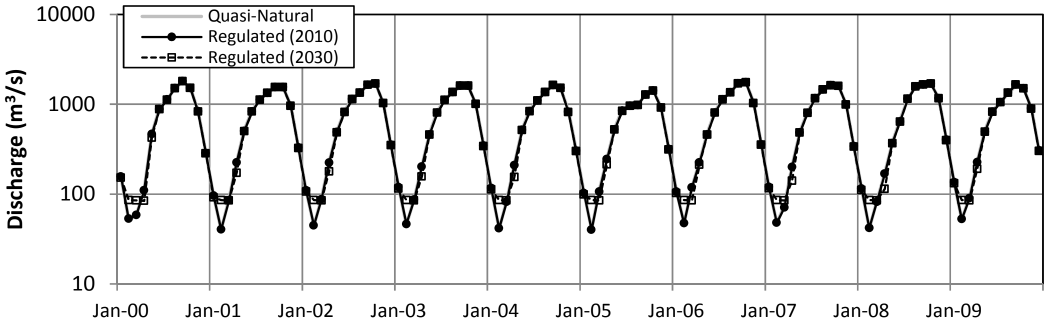


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	1.91	1.77	1.02	0.00	0.28	0.82	0.47	0.00	0.00	0.16	1.33	1.84
Municipal	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53	22.53



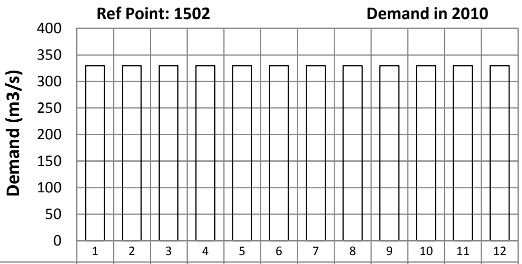




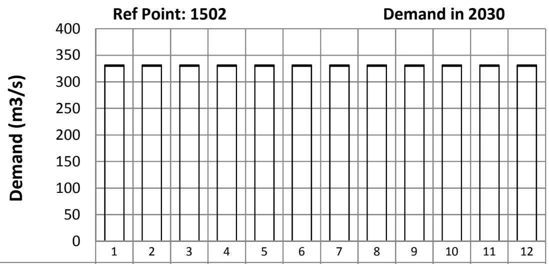


Annex-F SR3-5 Simulated Flow Condition at Representative Points (7/12)

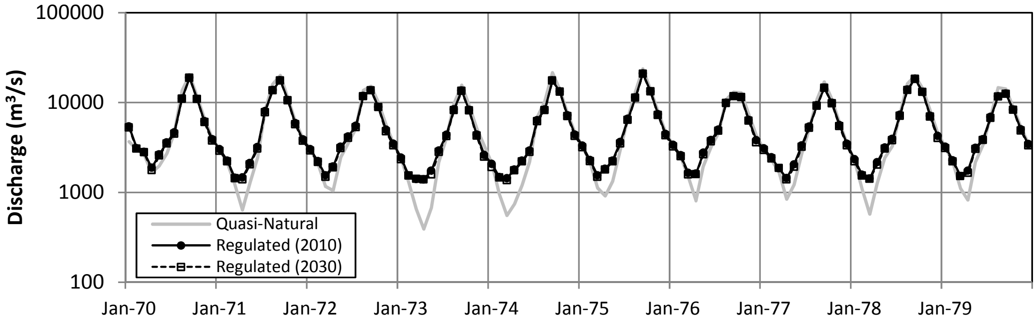
S1502

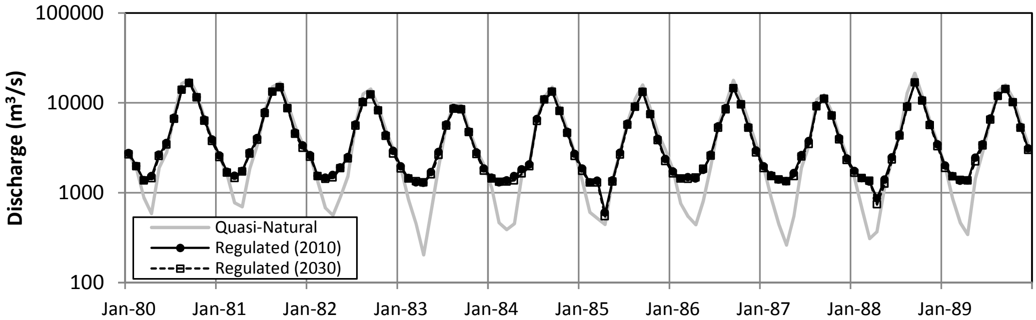


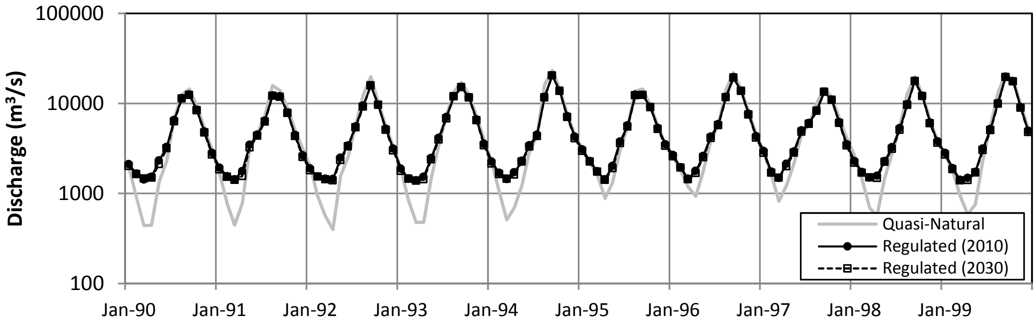
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	329.45	329.45	329.45	329.45	329.45	329.45	329.45	329.45	329.45	329.45	329.45	329.45

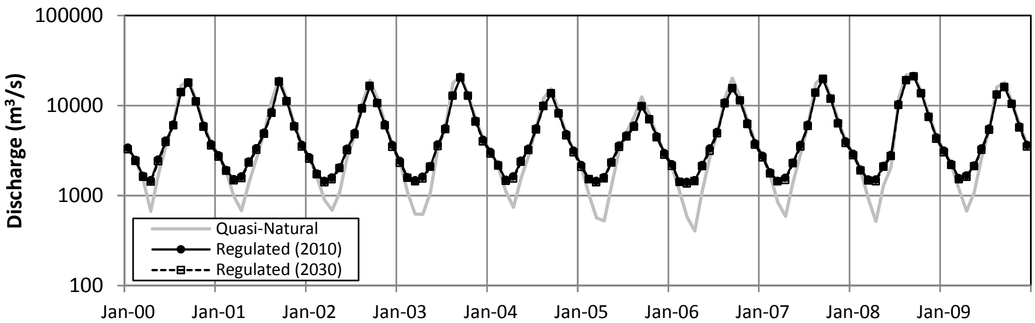


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	329.4	329.4	329.4	329.4	329.4	329.4	329.4	329.4	329.4	329.4	329.4	329.4



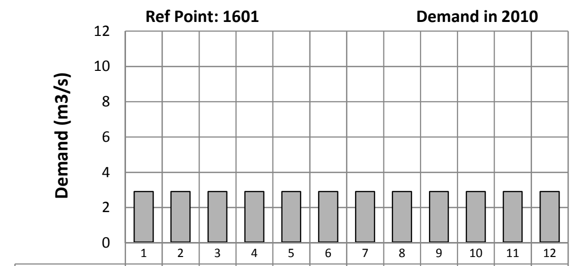




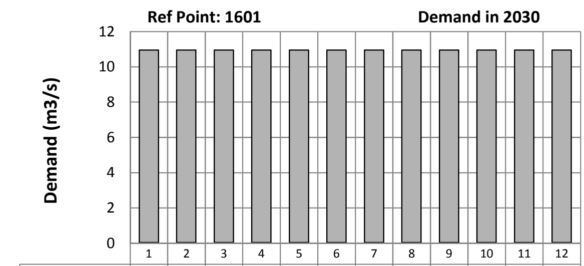


Annex-F SR3-5 Simulated Flow Condition at Representative Points (8/12)

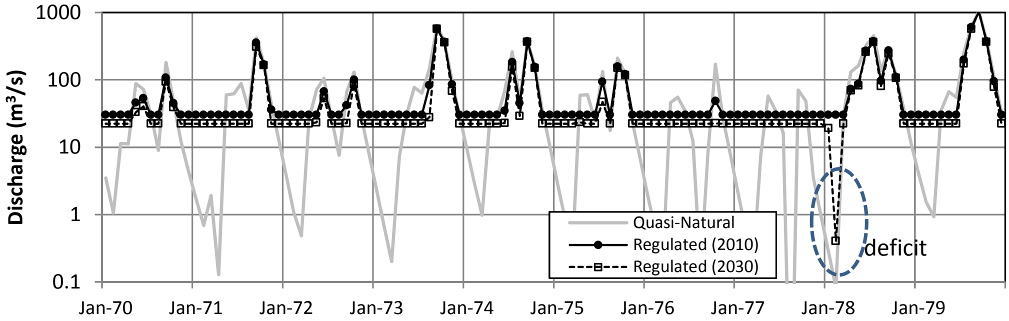
S1601

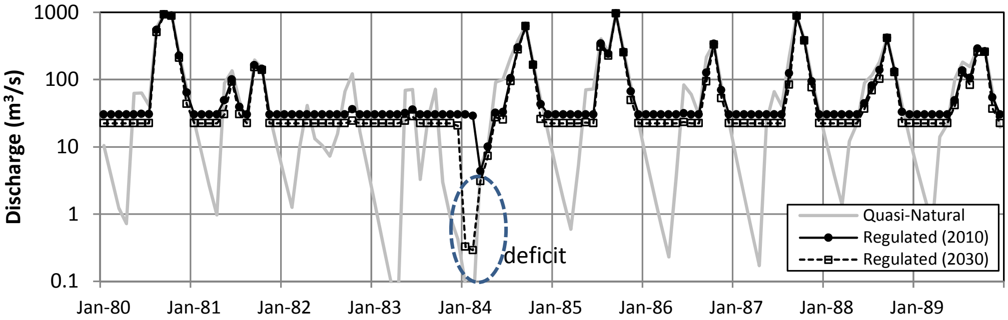


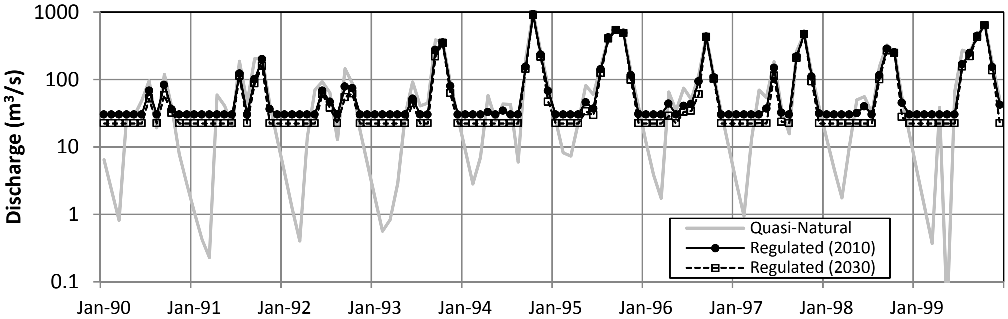
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

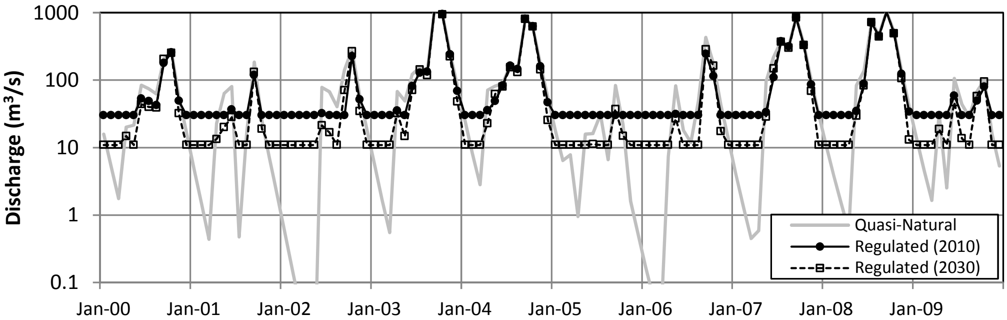


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04



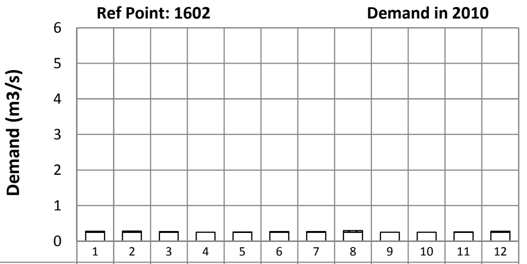




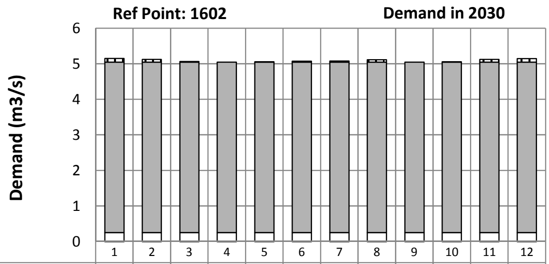


Annex-F SR3-5 Simulated Flow Condition at Representative Points (9/12)

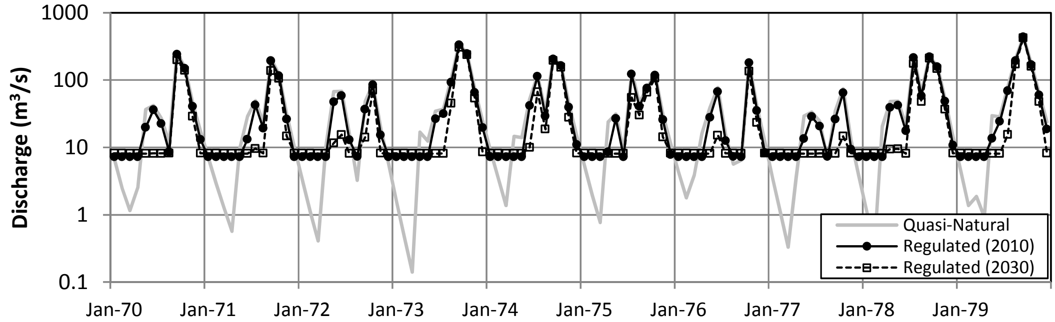
S1602

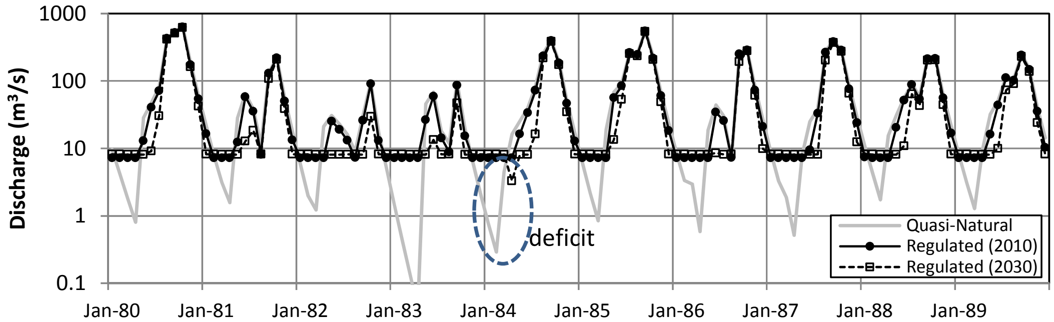


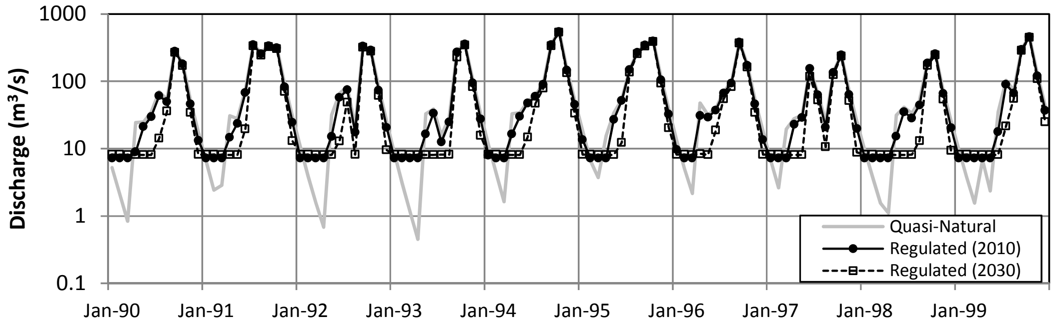
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.03	0.03	0.01	0.00	0.00	0.01	0.02	0.04	0.00	0.00	0.01	0.03
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26

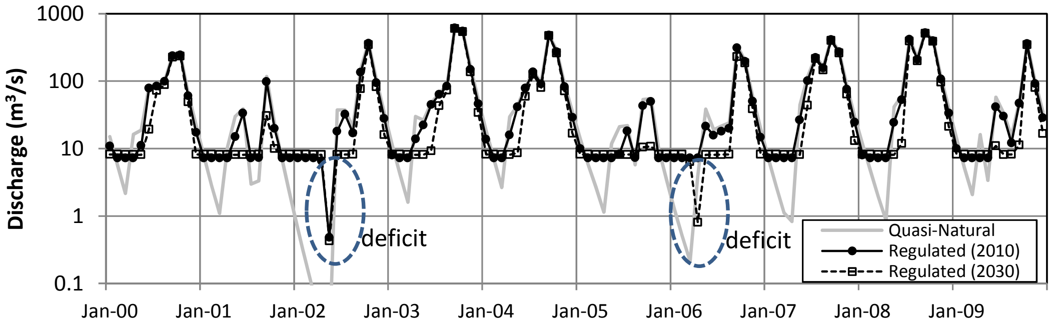


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.10	0.08	0.02	0.00	0.01	0.02	0.03	0.07	0.00	0.01	0.08	0.10
Municipal	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26



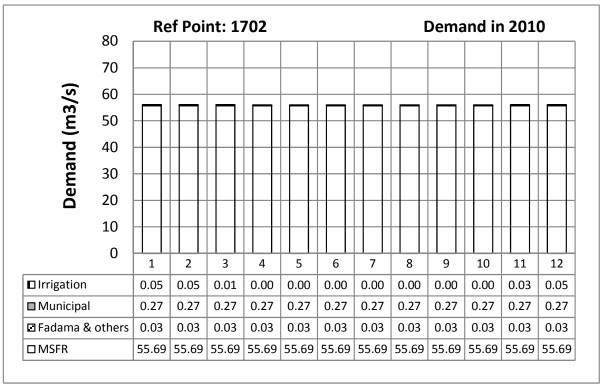




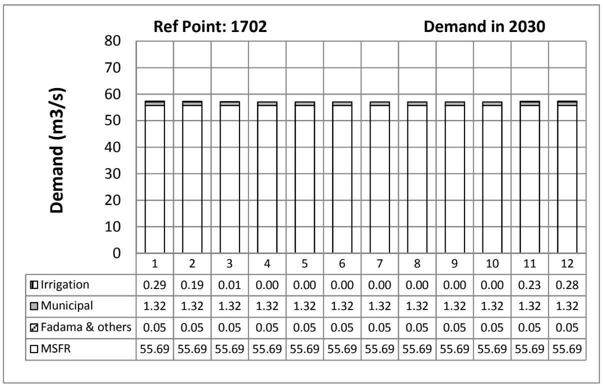


Annex-F SR3-5 Simulated Flow Condition at Representative Points (10/12)

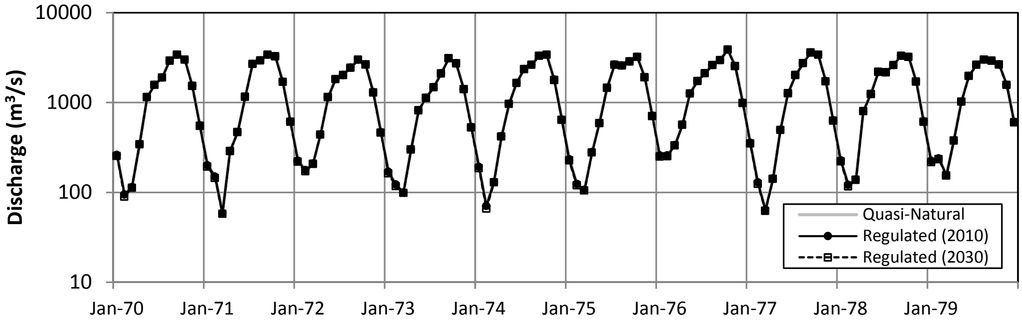
S1702

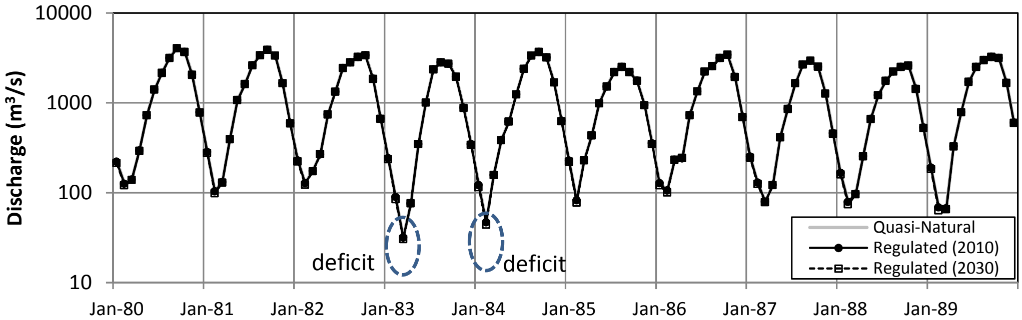


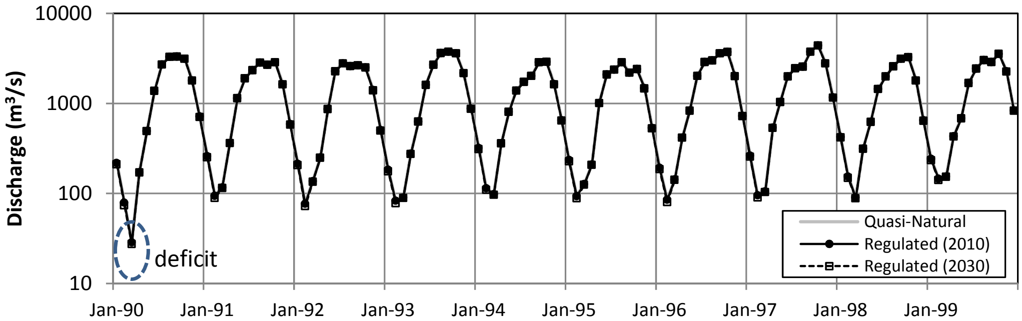
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.05	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05
Municipal	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Fadama & others	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
MSFR	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69

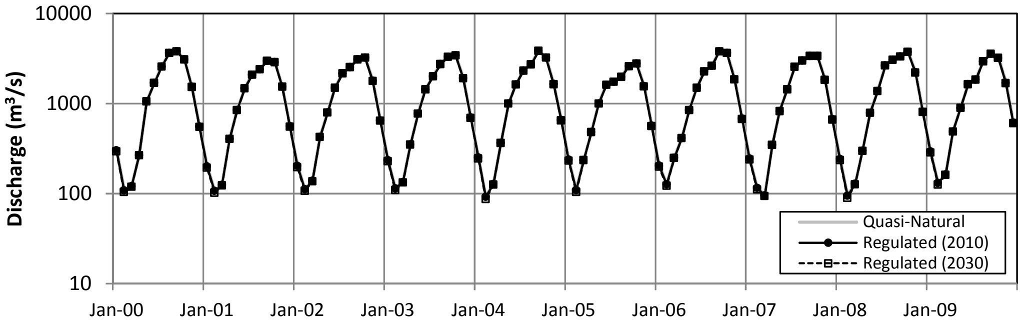


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.29	0.19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.28
Municipal	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
Fadama & others	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
MSFR	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69	55.69



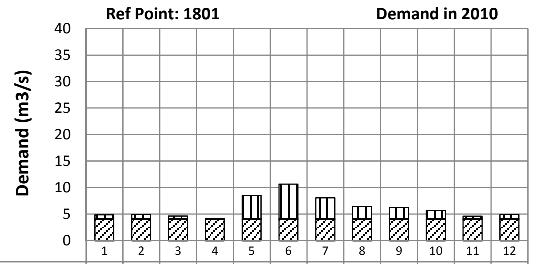




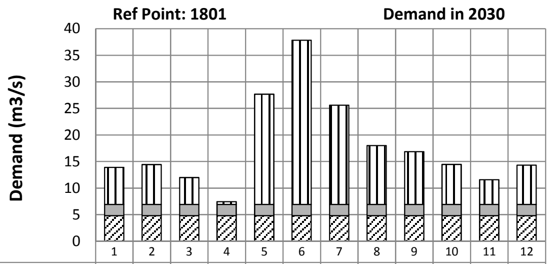


Annex-F SR3-5 Simulated Flow Condition at Representative Points (11/12)

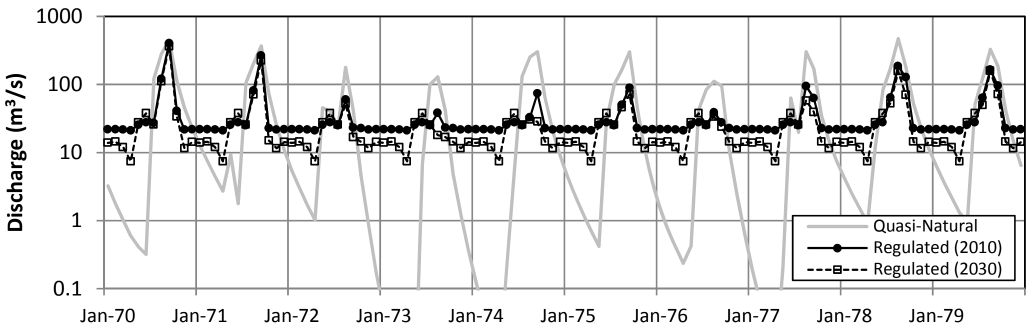
S1801

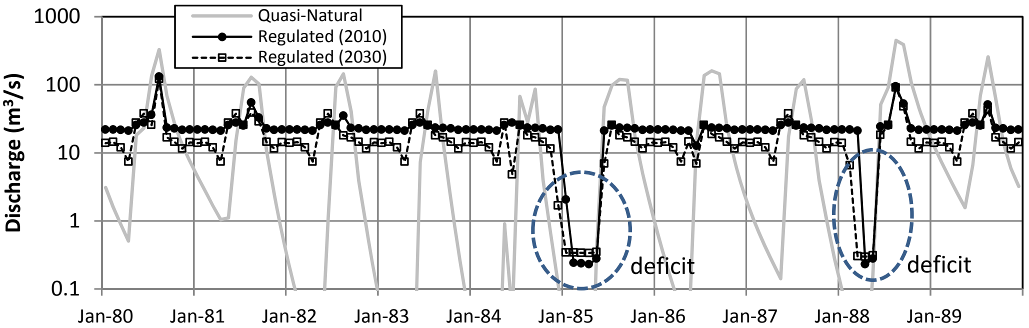


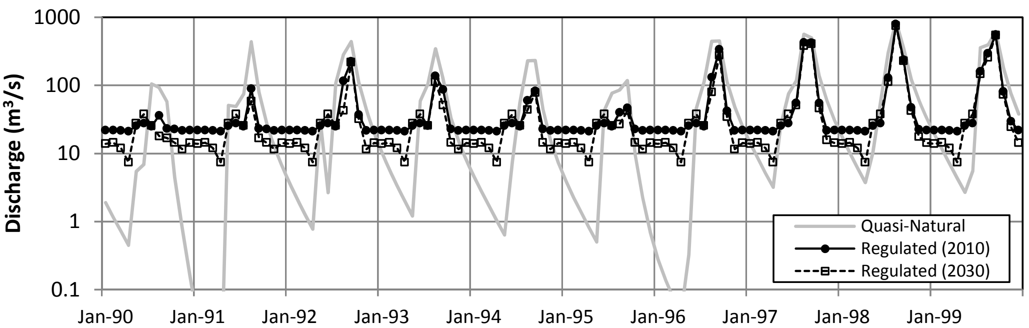
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.72	0.78	0.53	0.05	4.38	6.55	3.95	2.34	2.13	1.59	0.48	0.77
Municipal	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Fadama & others	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97
MSFR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

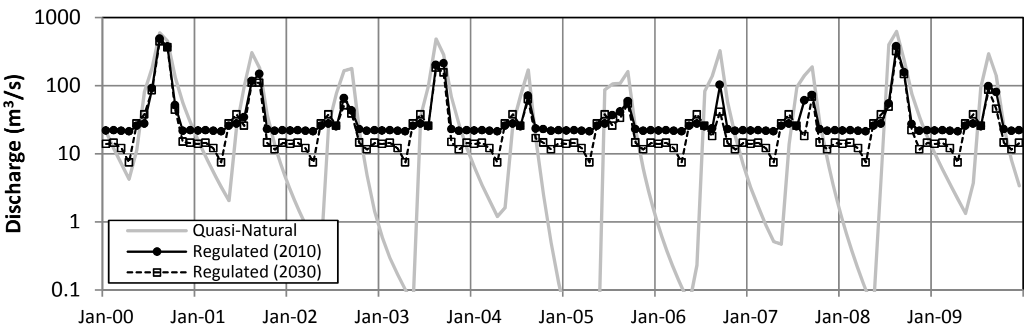


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	6.98	7.51	5.08	0.53	20.75	30.89	18.68	11.09	9.94	7.55	4.65	7.40
Municipal	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11
Fadama & others	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81
MSFR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00









Annex-F SR3-5 Simulated Flow Condition at Representative Points (12/12)