CHAPTER 10

PROJECT EVALUATION

CHAPTER 10 PROJECT EVALUATION

10.1 BENEFITS AND COSTS OF THE PROJECT

(1) Project Benefits

The following table summarizes the existing water supply conditions, the countermeasures to be taken in WSPCB and the project benefits.

Table 10.1 Existing Water Supply Conditions, Countermeasures and Benefits

Problems	Existing Conditions	Countermeasures in WSPCB	Project Benefits
Inadequate water supply quantity (Low pressure)	・The current actual water consumption is very low due to leakage and lack of water treatment capacity ・The average service pressure is negative to about 5 m, depending on the area.	・Expansion of water treatment capacity ・Leakage control ・Restructuring of the transmission and distribution network	・Average water demand will be met but in peak demand period, shortage will occur. ・Water pressure will be at least 15 m in the entire service area.
Inadequate water supply hours	・Less than 6 hr/day of supply hours for 41 % of the surveyed households and 6 – 12 hr/day for 25 %	・Restructuring of the transmission and distribution network	・24 hours basically, but at peak hour in peak demand period, shortage will occur. ・Equitable water transmission for the entire project area by efficient water transmission management.
Problems of water supply quality (Taste or high TDS)	・SWC: 670 mg/l ・SAA: 1,500 mg/l	・Construction of RO plant	・Blended water: 600 mg/l SWC: 670 mg/l SAA: 1,500 mg/l RO water: less than 200 mg/l
Problems of water supply quality (Color, turbidity and odor)	・The treated water of most of the treatment plants exceeds the water quality standards in turbidity and color. The treated water of 43 % of the water treatment plants contains E. Coli and it is inappropriate for domestic use.	・Rehabilitation of existing water treatment plants ・Use of adequate chemicals for treatment ・Leakage control measures ・Restructuring of the transmission and distribution network ・Water intake in the upstream of the Shat Al Arab	・The water treatment plants produce the treated water that meets the standards. ・The service pressure will be positive and leakage will be repaired so that contamination in pipes is eliminated.
Inappropriate maintenance of facilities	・The capability of O&M is not sufficient in treatment and leakage control.	・Capacity building program of operation and maintenance	・The capability of O&M will be improved.
Insufficient income	・The current level of revenue water ratio is low, resulting in low level of income	・Non revenue water (NRW) control measures (include leakage control) ・Financial management improvement program	・NRW will be reduced and income will be increased.

(2) Project Cost Base

The base of the project capital costs is summarized in the following table. The operation and maintenance costs are summarized in Table 8.5.

Table 10.2 Cost Basis of the Proposed Projects

(Million US$)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Construction works										
Direct Construction Cost + Admi	0.0	0.0	0.0	16.7	86.6	70.0	72.1	204.2	204.2	653.8
Tax and Duty	0.0	0.0	0.0	2.1	10.9	8.8	9.0	26.8	26.8	84.4
Engineering	0.0	0.8	6.4	7.1	7.4	18.0	19.0	19.0	19.9	97.6
Price Contingency	0.0	0.0	0.0	3.4	23.9	24.3	30.4	77.5	90.5	250.0
Physical Contingency	0.0	0.0	0.0	4.0	22.1	18.8	20.5	56.3	58.9	180.6
Total for Construction	0.0	0.8	6.4	33.3	150.9	139.9	151.0	383.8	400.3	1266.4
Capacity building programs	0.0	0.0	3.9	2.9	2.9	5.4	3.2	0.0	0.0	18.3

10.2 CONCEPT OF FINANCIAL AND ECONOMIC ANALYSIS

Financial and economic project analysis may be a new concept in Iraq. The following explains the concept of financial and economic analysis, which is quoted from “Guidelines for the Economic Analysis of Projects, Asian Development bank”.

The economic analysis of projects is similar in form to financial analysis: both appraise the profit of an investment. The concept of financial profit is not the same as economic profit. The financial analysis of a project estimates the profit accruing to the project-operating entity or to the project participants [MMPW, or BWD], whereas economic analysis measures the effect of the project on the national economy [Iraq or Iraqi citizen including Basrah citizen]. For a project to be economically viable, it must be financially sustainable, as well as economically efficient. If a project is not financially sustainable, economic benefits will not be realized. Financial analysis and economic analysis are therefore two sides of the same coin and complementary.

Both types of analysis are conducted in monetary terms, the major difference lying in the definition of costs and benefits. In financial analysis all expenditures incurred under the project and revenues resulting from it are taken into account. This form of analysis is necessary to assess the degree to which a project will generate revenues sufficient to meet its financial obligations, assess the incentives for producers, and ensure demand or output forecasts on which the economic analysis is based are consistent with financial charges or available budget resources.

Economic analysis attempts to assess the overall impact of a project on improving the economic welfare of the citizens of the country concerned. It assesses a project in the context of the national

economy, rather than for the project participants or the project entity that implements the project. Economic analysis differs from financial analysis in terms of both (i) the breadth of the identification and evaluation of inputs and outputs, and (ii) the measure of benefits and costs. Economic analysis includes all members of society, and measures the project's positive and negative impacts in terms of willingness to pay for units of increased consumption [or improved service], and to accept compensation for foregone units of consumption [or improved service]. Willingness to pay and willingness to accept compensation are used rather than prices actually paid or received because

- many of the project impacts that are to be included in the economic analysis either will be non-marketed, for example, biodiversity preservation, or incompletely marketed, such as, water supply and sanitation benefits. Thus, some form of non-market value must be estimated.
- many project impacts that are marketed will be bought and sold in markets where prices are distorted by various government interventions, by macroeconomic policies, or by imperfect competition.

Shadow prices may be used in estimating the willingness to pay and willingness to accept compensation values in the face of these market absences and market imperfections.

The benefits from a project constitute the extent to which the project contributes to increasing the value of the consumption [or improved service] available to society. Consumption [or improved service] can be defined broadly. Societal consumption [or improved service] may apply equally well to a society's willingness to pay for preservation of plant or animal species, as to society's willingness to pay for the consumption [or improved service] of agricultural produce or clean drinking water.

Costs reflect the degree to which consumption [or improved service] elsewhere in society is sacrificed by diverting the resources required by the project from other uses. The total net changes in consumption [or improved service] available to the society represent the net impact of the project. When the units of consumption [or improved service] are valued in terms of marginal willingness to pay for the units of increased consumption [or improved service] and marginal willingness to accept compensation for foregone units of consumption [or improved service], the resulting economic net benefits from the project will reflect the summation of the changes in the net income of the society as a whole, resulting from the situation with the project compared with that without the project.

Shadow prices are used to take into account the major impacts of a project where economic values differ from financial values. In many developing member countries, many prices paid and received

in the project accounts may come from relatively complete markets where the major impacts are captured in the transaction between buyer and seller, and are reflected by the prices paid and received. As structural adjustment and sectoral adjustment measures proceed, and as projects involving institutional and organizational approaches to market development are successfully implemented, the differences between financial values and economic values may lessen. The overall objective of the structural and sectoral adjustment programs, and of the projects financed by the Bank, is to attempt to create just such an economic environment in the Bank's developing member countries.

10.3 FINANCIAL EVALUATION

(1) Calculation Conditions and Project Cases for Analysis

Financial analysis is curried out to judge whether the proposed project is feasible [or profitable] or not or can be run from the financial view point of implementation entities, e.g. in this case, MMPW or BWD. Financial analysis is carried out by calculating financial internal rate of returns (FIRR) and other indicators (net present values (NPV) and benefit-cost ratio (B/C ratio)) based on the estimated project costs and revenue. In general, it is recognized by international financial institutions that the project is judged feasible if the FIRR of the project is more than about 10 %. The following are estimation conditions.

In this study, financial analysis was carried out for the total project and for some components of the project. Table 10.3 shows the cases of project components that were evaluated. Table 10.4 shows the calculation conditions.

Financial analysis including all costs was carried out for the projects of stage 5, stage 3, 2, and 2-4. In addition, financial analysis to find required water tariff level by which only operation and maintenance cost is covered from water charge are carried out. The detailed calculation sheets by cases are attached in APPENDIX J.

Table 10.3 Project Components to be evaluated

Case	Stage	Project Components
1	5	Total project components
2	3	Total project components without RO plant
3	2	Total project components without RO plant and distribution main facilities
4	2-4	Stage 2 project components and half capacity of RO plant

Table 10.4 Conditions of Financial Evaluation

Item	Value/explanation/formulation
Project life	40 years
Feasible FIRR criteria	More than 10 % is preferable
Discount rate for NPV and B/C ratio	10 %
Unit of water tariff	It is assumed that water meters will be installed to all customers by 2015 and the water will be sold by the volume consumed. Therefore, the unit of water tariff in the calculation should be ID/m^3, but not ID/household, which is the current unit of tariff.
Water tariff level	The current water tariff level by revenue water volume was calculated based on the estimated total revenue water volume and the current total revenue from the tariff. The estimated volume tariff value is 11.1 ID/revenued-m^3, or 0.0074 US$/revenued-$m^3$. Assuming 360 l/day for per capita consumption, the current water tariff level is 0.12 % of the average household income.
Tariff collection rate	The tariff collection rate will improve from the current 35 % to 60 % in 2015 and 75 % in 2025 and after.
Project revenue	0.0074 US$ x additional revenue water volume (revenued-m^3) by the project
Project capital cost	Direct construction cost, construction administration expenses, engineering cost and tax & duty are included in analysis.
Project O&M cost	Normal power supply are adopted for O&M cost in full cost recovery analysis
Project replacement cost	This cost will be spent every 15 years after the completion of the construction of Project

(2) Financial Analysis for Full Cost Recovery

Financial indicators were calculated based on the total project costs comprised of the capital and operation & maintenance costs. The results of calculation of financial indicators are summarized in Table 10.5. In the case of existing tariff level, FIRRs of all stages become negative and all the projects are judged as unfeasible. To make the stage 5 feasible, or to obtain more than 10 % of FIRR, the water tariff should be 100 times of the current tariff level, which is equivalent to 11 % of the average household income. The water tariff should be more than 5.5 % of the household income for the stage 3 and the stage 2-4, and 3.9 % for the stage 2. Since the estimated tariff levels are higher than the feasible water tariff level (2 – 3 % of the household income), all stages are judged unfeasible. However, the stage 2 has the highest FIRR and hence the most preferable stage.

Table 10.5 Calculation Results of Financial Indicators (Full cost recovery)

Case		Water price (US$/ m^3)	Net Present value [1] M US$	FIRR	B/C ratio [1]	Proposed price level (Existing price level (EPL))	
						Times of EPL	% of house income [2]
Stage 5	(1)	0.0074	-576	Negative	0.010	1	0.11%
	(2)	0.372	-283	Negative	0.514	50	5.5%
	(3)	0.743	16	10.4%	1.027	100	11.0%
Stage 3	(1)	0.0074	-298	Negative	0.020	1	0.11%
	(2)	0.372	-5	9.8%	0.983	50	5.5%
	(3)	0.743	294	20.7%	1.967	100	11.0%
Stage 2	(1)	0.0074	-199	Negative	0.029	1	0.11%
	(2)	0.372	94	15.1%	1.460	50	5.5%
	(3)	0.743	393	27.1%	2.919	100	11.0%
	(4)	0.260	4	10.3%	1.022	35	3.9%
Stage 2-4	(1)	0.0074	-304	Negative	0.019	1	0.11%
	(2)	0.372	-11	9.5%	0.966	50	5.5%
	(3)	0.743	288	21.0%	1.932	100	11.0%

Note:
1) in the condition of discount rate at 10 %
2) This value is percentage of expenditure for water in the monthly household income
Average of monthly household income is 836,000 ID/household/month (around 557 US$/household/month)
Average size of household is 7.9 persons. Planned water consumption is 338 lcd.
According to the above condition,
Water consumption of household = 7.9 person/hh x 338 lcd x 30 days = 80.1 m^3/month
Expenditure for water = 80.1 m^3/household/month x 0.0074 USD/m^3 = 0.59 US$/household/month
This amount is equivalent to 0.11% of the monthly average household income.

(3) Financial Analysis for Cost Recovery of Operation and Maintenance Cost

In Iraq, since the water supply bodies are subsidized from the central and local governments and the water tariff is set at very low level, the water supply bodies cannot be financed for all the costs based on the revenue collected. This is true of both capital cost and operation and & maintenance cost.

In financial analysis with the consideration to cover all costs (capital and operation and maintenance costs) from the revenue collected form water charge, all projects are judged unfeasible. In many countries, especially where water supply system has not developed well, the capital cost is recovered by government subsidy or general account and only operation and maintenance cost is required to be covered by the revenue collected from water tariff.

In this section, therefore, financial analysis is carried out to estimate water tariff level from which operation and maintenance cost can be recovered. In the analysis, the following 2 options of generator use are used considering the current power supply conditions stated in previous chapter. The results of calculation are shown in Table 10.6.

Option 1: 12 hours of generator use (current conditions)
Option 2: No generator use assuming the power supply condition will be improved in near future

As commonly understood, the maximum tariff level for sanitation service including water supply and wastewater disposal should be less than 2 -3 % of the household income although this depends on several factors and conditions. This project improves only water supply service but not domestic wastewater disposal. Therefore, at maximum 1- 2 % of the household income may be feasible for the water tariff.

Table 10.6 Required Water Tariff Level for Recovery of O&M Cost

Case		Water price (USD/Revenue water-m^3)	Required tariff level	
			Times of EPL	Percentage of house income
O&M cost recovery with generator option	Stage-5	0.223	30	3.3%
	Stage-3	0.104	14	1.5%
	Stage-2	0.082	11	1.2%
	Stage 2-4	0.126	17	1.9%
O&M cost recovery without generator option	Stage-5	0.149	20	2.2%
	Stage-3	0.052	7	0.8%
	Stage-2	0.052	7	0.8%
	Stage 2-4	0.104	14	1.5%

The estimated tariff level for the stage 5 project is more than 2 - 3 % of the average household income and requires a tariff hike of 20- 30 times of the current tariff. Therefore, the project is evaluated unfeasible. The projects of the stage 2, stage 3 and stage 2-4 are evaluated feasible irrespective of generator use. However, the tariff level of these projects requires an increase of at least 7 times of the current tariff and therefore a gradual tariff increase may be required considering political stability.

10.4 ECONOMIC EVALUATION

(1) Economic Costs

Economic analysis is curried out to judge whether the proposed projects [or the effect of improved service] is viable or not from the view point of national economy or Iraqi citizen including Basrah citizen. Economic analysis is carried out by calculating economic internal rate of returns (EIRR) of the project based on the economic project costs and economic benefits [or willingness to pay/willingness to accept the compensation].

The economic net benefits from the project will reflect the summation of the changes in the net income of the society as a whole, resulting from the situation with the project compared with that without the project. Therefore, the net economic benefits and costs are estimated as the economic benefits and costs with the project minus those without the project. In general, it is recognized by international financial institutions that the project is judged feasible if EIRR of the project is more than about 10 %. But commonly understood, if it is more than 5 %, the project could be economically

viable.

To convert the project costs into the economic costs, all distorted factors in the costs shall be removed. In Iraq, probably most of the prices of goods and services are distorted by government regulations and these distorted prices shall be converted into economic price. However, the degree of distortion and price difference between distorted price and economic price differ by goods or service. In this study, the main prices that are apparently affected by significant large distortion are converted as shown in the following table. The largest distorted price is for electricity.

Item	Adopted factor/value	Explanation
Imported materials	0.97	Standard Conversion Factor taken from CIA-the World Factbook 2004.
Electricity cost	0.0093 US$/kWh	Remarks ・ 0.064 US$/kWh (96 ID/kWh): The estimated price that Iraq imports the electricity from Turkey is adopted since this price may be less distorted.* ・ 0.04 US$/kWh (The estimated imported electricity tariff)* ・ 0.0093 US$/kWh: The estimated electricity price without distortion * ・ 3 ID/kWh (0.002 US$/kWh):Existing electricity tariff in Basrah for water supply facilities ・ 330 ID/kWh (0.22 US$/kWh):Electricity supply cost by private power generator * Source: Middle East Economic Survey, vol. XLIX, No. 33, 14-Aug-2006)
Duties and tax	deducted	This cost should be deleted from the costs.
Price and physical contingencies	deducted	These contingencies are not included in analysis.

The net economic costs are estimated by deducting the without project costs from those with the project costs.

(2) Economic Benefits

To estimate economic benefits, the willingness to pay, which was obtained by the socio-economic survey, is used. The net economic benefit is estimated as the deduction of the willingness to pay for the current water supply service from the willingness to pay for the improved service. In addition, as the economic benefits with the project, the willingness to accept the compensation is adopted. This is assumed as 2 – 3 % of the household income, which has been frequently quoted as the maximum payment for the sanitation service. The beneficial population is used for the service population of WSPCB in 2015. The following table summarizes these economic benefits.

Table 10.7 Summary of Economic Benefits

Item	Value (US$/capita/month)	Source
1. Willingness to pay for the current water supply service	0.21	JICA socio-economic survey
2. Willingness to pay for the improved service	0.73	JICA socio-economic survey
3. Willingness to accept the compensation (2 -3 % of the household income)	1.41～2.11 US$/capita/month	Commonly indicated by international institutions

Note: Average household income in Basrah: 836,000 ID/household/month (557 US$/household/month) – Socio-economic survey by the study team.

(3) Project Components

Same as the financial analysis, the following cases of project components were evaluated.

Table 10.8 Project Components to be Evaluated

Case	Stage	Project Components
1	5	Total project components
2	3	Total project components without RO plant
3	2	Total project components without RO plant and distribution main facilities
4	2-4	Stage 2 project components and half capacity of RO plant

(4) Results of Economic Evaluation

The results of economic evaluation are summarized in Table 10.9 and the detailed calculation sheets by case are attached in APPENDIX J. Assuming 3 cases of the economic benefits, the EIRRs of the stage 5 in all cases become negative and the stage 5 is judged economically not viable. The EIRR of only stage 2 give a value of more than 10 % assuming 3 % of the household income as the economic benefits and therefore the stage 2 is judged economically most viable.

Table 10.9 Results of Economic Evaluation

Stage	Economic Costs		Economic Benefits		EIRR
	Without project	With project	Without project	With project	
5	・ Replacement of existing facilities/equipment after life time use ・ Operation & maintenance of existing water supply system	Construction and O&M of total project components	0.21 US$/ca/month	0.73 US$/ca/month	Negative
				1.41 US$/ca/month	Negative
				2.11US$/ca/month	Negative
3		Construction and O&M of total project components without RO plant		0.73 US$/ca/month	Negative
				1.41 US$/ca/month	Negative
				2.11US$/ca/month	6.3 %
2		Construction and O&M of total project components without RO plant and distribution main facilities		0.73 US$/ca/month	Negative
				1.41 US$/ca/month	5.8 %
				2.11US$/ca/month	11.2 %
2-4		Stage 2 components and half of capacity of RO plant		0.73 US$/ca/month	Negative
				1.41 US$/ca/month	Negative
				2.11US$/ca/month	5.9 %

Note: The economic costs include replacement costs of facilities.

The current willingness to pay for the improved water supply service is 1 % of the household income. The willingness to pay can be changed or improved depending on the conditions or understanding of customers on the water supply service. To make the project more viable, therefore, the willingness to pay should be enhanced by information, education and communication (IEC) activities by the BWD.

Also there are other unmeasured economic benefits or indirect benefits such as health condition improvement are not included in this analysis. If these benefits are included, the project will be more viable.

10.5 EVALUATION FROM CUSTOMERS' SATISFACTION

From the JICA socio-economic survey, the problems of water supply services from the customer's perspective by service item were surveyed and dissatisfaction percentage of the respondents was calculated by service item. Using this percentage and assuming 100 % as full improvement of all services, the ratio of improvement of each service is estimated (Table 10.10). This ratio is called improvement contribution factor. Assuming the degree of improvement of service in each stage as shown in the table, total improvement point of each stage was calculated by multiplying the improvement contribution factors by the degree of improvement. For the stage 5, the total improvement point is 100 as all services are improved at 100%. In the stage 1, total improvement point is about 19 % and in the stage 2 it is about 70 %. The capital investment cost per improvement point was calculated to evaluate improvement efficiency as for investment. The unit improvement cost of the stage 2 is the lowest and thus it is judged as the most efficient investment project.

If the improvement point is adopted to the EIRRs in the previous section, the EIRRs of the stage 2 would be 70 % of the obtained EIRR, i.e. 3.6 % - 7.6 %.

Table 10.10 Calculation of Improvement Points and Capital Cost per Improvement Point by Stage

Item	The percentage of respondents who dissatisfy*	Satisfaction contribution factor	Assumed improvement ratio (%)					
			Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage2-4
Amount /pressure	94 %	21.8%	50	80	100	100	100	80
Service hours	67 %	15.5%	50	80	100	100	100	80
Turbidity	89 %	20.6%	0	100	100	100	100	100
Taste (salinity)	97 %	22.5%	0	0	0	100	100	50
Smell	85 %	19.7%	0	100	100	100	100	100
Total	-	100.0%						
Item			Satisfaction points					
Amount/pressure			10.9	17.4	21.8	21.8	21.8	17.4
Service hours			7.8	12.4	15.5	15.5	15.5	12.4
Turbidity, color			0	20.6	20.6	20.6	20.6	20.6
Taste (salinity)			0	0	0	22.4	22.4	11.2
Smell			0	19.7	19.7	19.7	19.7	19.7
Total (Improvement points)			18.7	70.1	77.6	100	100	81.3
Cost for improvement			Capital cost (Million US$)					
			184	329	687	1,118	1,266	529
Cost to gain 1 point			Cost to gain improvement 1 point (Million US$/point)					
			9.8	4.7	8.9	11.2	12.7	6.5

* The study team socio-economic survey

10.6 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR PROPOSED WATER SUPPLY PLAN

According to the Environmental Guideline for Infrastructure Projects (JICA, 2004), potential environmental impacts by the implementation of the proposed water supply plan were identified based on the results of screening, field surveys and data collection at the sites which were carried out by a local subcontractor.

(1) Components of Proposed Water Supply Plan

Following 7 components are proposed in the WSPCB.

1) Rehabilitation of distribution network
2) Rehabilitation of the existing water treatment plants (13 plants)
3) Construction of transmission system (transmission reservoir, pumping station and ring mains)
4) Construction of new water treatment plant
5) Constructions of main distribution facilities
6) Construction of new RO treatment plant

(2) Identification of Potential Environmental Impacts

The potential environmental impacts are evaluated using the checklist, in which 34 social, natural and pollution aspects are included. The results are shown in Table 10.11 and the following possible impacts are preliminarily identified.

1) Resettlement of residents may be required in land acquisition of the project sites. Land use and economic activities in the surrounding area of project site may be affected.
2) The existence of cultural heritages should be checked.
3) The project sites are located in the urban area of Basrah. The construction vehicles and machinery may affect traffic, and cause noise, vibration and dust in the surrounding areas of project sites and roads during the construction period.
4) When the existing pipe is replaced, it may cause health hazard of workers in cutting, transporting and disposing of asbestos cement pipe (ACP).
5) The wastewater discharged from RO plant may cause pollution of the river environment.

Table 10.11 Preliminary Screening Check List

No	Item	Evaluation	Comments
1	Involuntary resettlement	**B**	Project site is planned in urban area of Basrah.
2	Local economy such as employment and livelihood etc.	**N**	Positive impact on local employment.
3	Land use and utilization of local resources	**B**	Land use and economic activities in the surrounding area of project site may be affected.
4	Social institutions such as social infrastructure and local decision-making institutions	**N**	
5	Existing social infrastructures and services	**N**	
6	The poor, indigenous of ethnic people	**C**	Increase of water rate is required.
7	Misdistribution of benefit and damage	**N**	
8	Local conflict of interests	**N**	
9	Gender	**N**	
10	Children's rights	**N**	
11	Cultural heritage	**C**	It is necessary to check about the existence of a cultural heritage, because the project site is unutilized land.
12	Infectious diseases such as HIV/AIDS etc.	**C**	In the replacement of the existing pipe, it may cause works of cutting, transport and disposal of Asbestos Cement Pipe.
13	Air pollution	**B**	The construction vehicles and machinery may affect traffic, noise, vibration and dust in the circumference of project site and roads during construction period.
14	Water Pollution	**B**	Wastewater fron treatment plant (backwashing of filtration) is expected. Additional Sewage effluent.
15	Soil Contamination	**N**	
16	Waste	**B**	Sludge from treatment plant is expected.
17	Noise and Vibration	**B**	Same as "Air pollution"
18	Ground subsidence	**N**	
19	Offensive Odor	**N**	
20	Geographical features	**N**	
21	Bottom sediment	**N**	
22	Biota and ecosystem	**N**	
23	Water usage	**N**	
24	Accidents	**B**	Leakage of chlorine gas in the treatment plant is considered.
25	Global warming	**B**	Increase of electricity consumption is expected.
26	Others	**N**	
27	National park, protected area designated by the government (coast line, wetlands, reserved area for ethnic or indigenous people, cultural heritage), and areas being considered for national parks or protected areas	**N**	
28	Virgin forests, tropical forests	**N**	
29	Ecological important habitat areas (coral reef, mangrove wetland, tidal flats)	**N**	
30	Habitat of valuable species protected by domestic laws or international treaties	**N**	
31	Likely salts cumulus or soil erosion areas on a massive scale	**N**	
32	Remarkable desertification trend areas	**N**	
33	Archaeological, historical or cultural valuable areas	**C**	Same as "Cultural heritage"
34	Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or special socially valuable areas	**N**	

A – Serious impact is expected
B – Some impact is expected
C – Extent of impact is unknown and examination is needed. Impacts may become clear
N – No impact is expected

(3) Potential Environmental Impacts by Proposed Components

The potential environmental impacts by the proposed component are identified and their significance is preliminarily evaluated as below.

1) Rehabilitation of Distribution Network

The potential environmental impacts of rehabilitation of distribution network are as follows:

- Traffic congestion accident during construction work period
- Noise, vibration and dust during construction period
- Degradation of the living environment by the above-mentioned activities
- Health effect by replacement works and disposal of the existing asbestos cement pipes

Since the rehabilitation work is conducted in roads including community roads, it is possible to disturb the living environment of the residents. The following procedures should be carried out at the detail planning and construction stages with careful examination.

- Sufficient explanation and discussion with residents and community
- Assignment of complaint officers
- Assignment of traffic control staff
- Implementation of an adequate implementation scheme
- Consideration of working hours and construction method, if required

About 15 % of the distribution pipes are ACP in the Basrah city and the replacement works of ACP will be required in the rehabilitation of distribution network. It is highly possible that the scattering of asbestoses causes health hazard to the workers. Therefore, the scattering in the air and exposures to the workers should be minimized as much as possible during the rehabilitation works. The following are the countermeasures of asbestoses health hazard during pipe replacement work.

- The asbestoses affect mostly respiratory organs but asbestos intake by oral ingestion may not affect health. Therefore, the cutting work of ASP that scatters the asbestos should be minimized. When unavoidable, the cutting work should be done in a wet condition spraying water to avoid scattering, and workers should wear a protection mask.
- USAID proposed in the Bagdad water supply project that the aged ACP should not be touched and left buried, and new pipelines should be installed.
- Disposal method of ACP should be further examined and appropriate methods should be determined based on the policy of the relevant environment department.

2) Rehabilitation of the Existing Water Treatment Plants

The rehabilitation work of the existing water treatment plants is carried out within the water treatment

sites. The potential environmental impacts of rehabilitation of the existing water treatment plants are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- The noise, vibration and dust during the construction period
- Degradation of the living environment by the above-mentioned items

Basically, the impacts during the construction work are the same as the rehabilitation of distribution network. Unlike health hazard by replacement of ASP, however, there is no significant potential environmental impact during the construction stage. Also no significant negative impact is expected during the operation of water treatment plants after the rehabilitation work.

3) Construction of Transmission System

a) Transmission Reservoir and Pumping Station

The potential environmental impacts of the constructions of transmission reservoir and pumping stations are as follows:

- Traffic congestion during the construction period
- Noise, vibration and dust during construction period
- Noise and vibration from pump and generator at operation stage
- Degradation of the living environment by the above-mentioned items
- Damage of cultural heritages and important natural environment

From the results of field survey, it was confirmed that the proposed site is a public land located near the highway intersection (coordinate: 30°32' 16.75''N, 47° 44' 02.06''E) in vacant lots in the desert area (see Appendix K1). Also there is no resident lot and no economic activity in the proposed sites. Therefore, it could be concluded that there will be no impact during the construction work.

The noise and vibration from pump and generator facilities in operation works can be reduced by arrangement of buffer zone and plantation surrounding the buildings.

The locations of cultural heritage in Basrah are shown in Appendix K2. There is no cultural heritage in this area.

b) Transmission Ring Mains

The potential environmental impacts of the construction of the ring mains are as follows:

- Traffic congestion during construction work period
- Noise, vibration and dust during construction period
- Degradation of the living environment by the above-mentioned items

- Damage of cultural heritages and important natural environment

The degree of these impacts depends on the location of road, the conditions of roads or the neighborhood along the proposed ring mains. The degree of impacts is evaluated based on the results of field surveys.

The proposed route of the ring mains is shown in Appendix K3. The route was classified into 8 sections according to the conditions of road and the circumference. The characteristics of sections in the ring main are explained in Table 10.12. It was confirmed by site survey that there was basically sufficient space for construction work, and it may not be required to control the traffic during a construction period. The surrounding areas of the route from point-1 to point-4 shown in Appendix K3 are commercial zone, and it may be required that suitable implementation scheme along these route should be considered.

As shown in Appendix K2, there is no cultural heritage on the route of the ring mains. Moreover, the construction would be done in the existing roads and any cultural heritage would not be expected.

Table 10.12 Road Conditions along the Route of Ring Mains

Section No.*	Paved / unpaved	Road width	Existence of frontage road	Building density	Remarks
Section-A	unpaved road	1	No	5	The road situation is poor.
Section-B	paved road	4	Yes	3	Trunk road There is bus terminal (Point-4*)
Section-C	paved road	2	Yes	1	Major thoroughfare-community road There are 2 commercial area (Point-1,2*)
Section-D	paved road	1 - 2	No	2	Community road
Section-E	paved road	3	Yes	1	Major thoroughfare
Section-F	unknown			-	There is no road
Section-G	paved road	2 - 3	Yes	1	City major thoroughfare-trunk road
Section-H	paved road	3	Yes	1	City major thoroughfare-trunk road There is commercial area. (Point-3*)
Road width (including frontage road, road maintenance area and parking space) 1 less than 10 m 2 from 10 to 15 m 3 from 15 m to 30 m 4 more than 30 m					
Building density along road 1 Building density is distributed continuously 2 Continuous in general (between 1 and 2) 3 Dispersive 4 Sparse 5 Almost nothing					

Note: *: refer to Appendix K3

4) Construction of New Water Treatment Plant

The potential environmental impacts of in the construction of new water treatment plant near the Al Hartha 25 MG and Basrah Unified plants are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- Noise, vibration and dust during construction stage
- Noise, vibration and others during operation stage
- Degradation of the living environment by the above-mentioned items
- Damage of cultural heritages
- Water pollution by backwashing of filtration and sludge of coagulation process
- Leakage accidents of chlorine gas

Based on the results of field surveys, the lands on the north, south and west sides of the existing water treatment plants are private properties. However, the land between Al Hartha 25 MG and Basrah Unified plants is a public land, and this area is recommended as the proposed project site from the field survey (see Appendix K5 and Appendix K6).

Basically, the impacts during the construction work are the same as the rehabilitation of distribution network.

The potential environmental impacts during the operation are the same as two existing water treatment plants. The noise and vibration from pump and generator facilities during operation stage can be reduced by arrangement of buffer zone and plantation surrounding the buildings.

The wastewater of backwashing from filters and the sludge removed from sedimentation basins are discharged to the Shat Al Arab. The contents of wastewater and sludge are the same as the river water but include aluminum sulfate during the coagulation process. Aluminum sulfate is not harmful substance and therefore, the discharge of the wastewater and the sludge does not affect river environment.

In water treatment plant, chlorine is used for disinfection of water. If chlorine leaks occur, the workers in water treatment plant and the residents living in the surrounding area would be affected. Adequate safety measures should be considered at planning and operation stages and the emergency plan for accident is required.

5) Constructions of Main Distribution Facilities

The 13 sites in Basrah city have been proposed by the study team for main distribution facilities. The potential environmental impacts of the construction of these service reservoirs /transfer pumping

stations /elevated tanks are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- Noise, vibration and dust during construction stage
- Noise, vibration and others during operation stage
- Degradation of the living environment by the above-mentioned items
- Relocation of houses or homeless people
- Change of landscape and impacts on the scenery in surrounding environment

In addition to the sites proposed by the study team, new sites have been proposed by the local subcontractor as a result of field surveys. Some sites proposed by the study team are owned by private owners but all the proposed sites by the local contractor are currently located in vacant lots or open area. These results of field surveys are summarized in Table 10.13 and shown in Appendix K7, Appendix K8 and Appendix K9.

Table 10.13 Results of Field Survey (Project sites for Distribution facilities)

Supply Zone	Original Proposed Site by the study team (coordinate)	Remarks	Proposed Site by the Field Survey by Subcontractor (coordinate)	Remarks
1			30 º 30 ' 26.84 " N 47 º 47 ' 35.47 " E	
2	30 º 32 ' 49.9 " N 47 º 46 ' 58.47 " E	Crowded illegal houses	30 º 33 ' 5.41 " N 47 º 47 ' 13.56 " E	The site is open area and nearest to the proposed ring main
3	30 º 32 ' 8.38 " N 47 º 46 ' 15.59 " E	Crowded houses	30 º 32 ' 7.56 " N 47 º 48 ' 13.40 " E	The site is open area and nearest to the proposed ring main
4	30 º 31 ' 6.14 " N 47 º 49 ' 24.62 " E	Crowded houses	30 º 31 ' 14.92 " N 47 º 49 ' 27.52 " E	The site is open area and nearest to the proposed ring main
5	30 º 30 ' 42.73 " N 47 º 50 ' 16.85 " E	no problem		
6	30 º 32 ' 23.54 " N 47 º 45 ' 53.52 " E	Crowded houses	30 º 32 ' 23.22 " N 47 º 46 ' 19.42 " E	The site is open area and nearest to the proposed ring main
7	30 º 31 ' 26.76 " N 47 º 52 ' 4.35 " E	no problem		
8	30 º 29 ' 50.45 " N 47 º 47 ' 32.46 " E	the site is near street	30 º 29 ' 45.90 " N 47 º 47 ' 30.43 " E	The site is open area and nearest to the proposed ring main
9	30 º 29 ' 48.27 " N 47 º 48 ' 49.92 " E	Crowded houses	30 º 29 ' 19.31 " N 47 º 48 ' 43.28 " E	The site is open area
10	30 º 28 ' 31.76 " N 47 º 48 ' 19.70 " E	no problem		
11	30 º 27 ' 10.26 " N 47 º 48 ' 20.18 " E			
12	30 º 27 ' 47.36 " N 47 º 47 ' 1.69 " E			

The construction of main distribution facilities may have significant impacts in terms of affecting living environment for the following reasons:

- The planned site is located in the Basrah central city area where it is crowded with residences and business. Therefore, the distance between the facilities and the residence may not be enough.

- The current vacant lots would be changed by residence or business activities.
- It was informed that the current vacant lots would be illegally occupied by homeless in near future.

To decide the exact sites of these facilities, the concerned city offices should be consulted to avoid significant impacts to economic activities.

6) Construction of RO Treatment Plant

The potential environmental impacts of the construction of RO treatment plant near the Al Hartha 25 MG and Basrah Unified WTP are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- Noise, vibration and dust during construction stage
- Noise, vibration and others during operation stage
- Degradation of the living environment by the above-mentioned items
- Damage of cultural heritages
- Water pollution by discharge of wastewater during desalinization process

The RO treatment plant will be located at the same site of the new water treatment plant. Therefore, the potential environmental impacts during construction and operation stages is same as the construction stage of the water treatment plant.

The brine from desalination process in RO plant is discharged to the Shat Al Arab. This wastewater contains high salinity (TDS of 5,000 mg/l) which may cause significant impact on the river environment. The increase of TDS concentration was calculated as follows and it was confirmed that the increase (from 1,800 mg/l to 1,880 mg/l) would not give significant impact. Also there is no discharge of sludge from this treatment plant.

Estimation of TDS of the Shat AL Arab after Discharge of RO brine wastewater	
Wastewater from desalination process: TDS concentration: Water volume:	 5,400 mg/l-TDS 1.4 m^3/s
Receiving water bodies: TDS concentration: Water flow:	Shat Al Arab river 1,500 mg/l-TDS 80 m^3/s (water flow at Amara, 80 – 150 m^3/s as monthly average from 1975 to 2003)
Increase ratio of TDS of the SAA after discharge of wastewater:	less than 4.8 % (1,570 mg/l-TDS)

(4) Conclusions

Potential environmental impacts by the implementation of WSPCB have been identified based on the

field surveys and data collection by the local subcontractor. As a result of the analysis, no significant impact of the proposed plan was identified. However, the following possible impacts are identified.

Project Component	Possible Impact
1. Rehabilitation of distribution networks	・ When the existing pipe is replaced, it may cause health hazard to workers in cutting, transporting and disposing of asbestos cement pipe (ACP). The impact is avoidable with appropriate measures.
2. Rehabilitation of existing water treatment plants	・ No impact
3. Construction of transmission system	・ No impact
4. Construction of new water treatment plant	・ Impact of sludge disposal is considered but judged minor.
5. Construction of RO	・ The wastewater discharged from RO plant may cause pollution of the river environment but it is judged minor.
6. Construction of main distribution facilities (13 zones)	・ According to selection of the land for the proposed facilities, resettlement of residents can be avoided but land acquisition may be required.

For smooth implementation of the projects, public and all other stakeholders should be involved through stakeholder meetings and public hearings, where the information on the proposed plan should be disclosed, stakeholders' opinions should be collected, and consultation with stakeholders should be carried out.

CHAPTER 11

CONCLUSIONS AND RECOMMENDATIONS FOR WSPCB

CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS FOR WSPCB

11.1 CONCLUSIONS AND RECOMMENDATIONS

The Water Supply Plan for the Central Basrah (WSPCB) targeting the year 2015 with a staged development plan was formulated in this report. The results of the study were summarizes as follows:

1. The planning area includes the central Basrah comprising Al Basrah district center and Al Hartha center and rural area, with a population of 1,257,000 and the average day water demand of 608,000 m^3/day in 2015.

2. The major components of the WSPCB are as follows:

Facilities	Capacity/Quantity
1. Rehabilitation of network	Dia.110 mm - 700 mm, 285 km
2. Rehabilitation of water treatment plant (WTP)	13 plants in Central Basrah (424,400 m^3/day) Note: Finally, only 3 plants will be utilized (264,000 m^3/day)
3. Treated water transmission system	
(1) Transmission reservoir (TR)	64,000 m^3
(2) Transmission pumping station (TPS)	710,000 m^3/day x 40 m head
(3) Ring mains and connections to MDF	Dia.600 mm - 2000 mm, 33,000 m
4. New water treatment plant	
(1) Treatment plant	465,000 m^3/day
(2) Treated water pumping station	369,000 m^3/day x 40 m head
5. Main distribution facilities (MDF)	13 water distribution zones
(1) Strengthening of distribution mains	Dia.200 mm- 700 mm, 25,100 m
(2) Distribution reservoir (for 12 zones)	186,000 m^3 in total
(3) Transfer pumping station (for 12 zones)	945,000 m^3/day (39,800 m^3/hr) in total
(4) Elevated tank (for 12 zones)	12,300 m^3
6. Reverse osmosis plant	362,000 m^3/day (output)

Note: one of the 13 main distribution facilities is now under construction.

In addition, the execution of following programs was proposed to strengthen the capacity of the Basrah Water Directorate (BWD) and thus to establish the sound and sustainable water supply operations.

(1) Non-revenue water reduction program

(2) Organization and institutional capacity building program

3. It was confirmed that the WSPCB could be considered as part of the Mini M/P, which is targeted for the year 2025. The WSPCB comprises the most urgent and higher priority components in the Mini M/P and all the facilities proposed in WSPCB will be integrated with the water supply system proposed in the Mini M/P.

4. The total cost of the WSPCB was estimated at 1,266 million US$, comprised of 559 million US$ as direct construction cost and the remaining as indirect cost.

5. It is proposed that the WSPCB be developed in several stages as the total project of WSPCB is considerably large in capital cost and the number of components and it is possible to implement by component.

6. Considering the problems of water supply service from the customers' perspective identified in the socio-economic survey and required sequence for construction, the following 5 stages are proposed.

Stage 1:	Rehabilitation of distribution network and construction of transmission system
Stage 2:	Stage 1 components and rehabilitation of existing water treatment plants and construction of a new water treatment plant
Stage 3:	Stage 2 components and construction of main distribution facilities (13 distribution zones)
Stage 4:	Stage 3 components and construction of a new RO plant and expansion of the new water treatment plant as pretreatment of RO
Stage 5:	Stage 4 components and expansion of the RO plant and the water treatment plant to compensate the treatment capacity of existing water treatment plants (10 plants) to be abandoned

7. Upon discussion with the Iraqi side, following stage 2-4 including requirement of TDS improvement was added as a strong request of the Iraqi side.

Stage 2- 4:	Stage 2 components and construction of half capacity of RO plant of the stage 4

After further discussions and considering an adequate project scale, stage 1, stage 2 and stage 2-4 were selected as candidates of the priority project.

8. The current cost of annual operation and maintenance for the Basrah water supply system is 5 billion ID, out of which only 14 % or 0.7 billion ID was recovered through the water charge. The total project requires 30.0 billion ID for annual operation and maintenance with normal power supply conditions, and 54.3 billion ID by half day power supply using on-site generators and half day normal power supply reflecting the existing power supply conditions.

9. As a result of financial evaluation, with the existing tariff level, FIRRs of all stages become negative and all projects are judged as unfeasible. To make the stage 5 financially feasible, or to obtain more than 10 % of FIRR, the water tariff should be 100 times of the current tariff level, which is equivalent to 11 % of the average household income. The water tariff should be more than 5.5 % of the household income for the stage 3 and the stage 2-4, and 3.9 % for the stage 2. Since the estimated tariff levels are higher than the feasible water tariff level (2-3 % of the household income), all stages are judged unfeasible. However, the stage 2 has the highest FIRR and hence the most preferable stage.

10. Judged from the tariff levels, by which the only operation and maintenance cost is recovered, the stage 5 project is evaluated unfeasible and the projects of the stage 2, stage 3 and stage 2-4 are evaluated feasible. However, the tariff level of these projects requires a increase of at least 7 times of the current tariff and therefore a gradual tariff increase may be required considering political stability.

11. As a result of economic evaluation, the implementation of the stage 5 is not economically viable. However, the projects of the stage 3, stage 2-4 and stage 2 are economically viable assuming 3 % of the household income for the willingness to accept the compensation for the improved service. The project of the stage 2 gives the highest economic internal rate of return (EIRR) of 11.2 %.

11.2 SELECTION OF PRIORITY PROJECT

Three candidates of the priority projects, stage 1, stage 2 and stage 2-4, which were agreed between the study team and the Iraqi side, were compared based on the project evaluation described in Chapter10 of this report as shown in Table below.

Comparison Items	Stage 2-4	Stage 2	Stage 1
Quantity Satisfaction	100%	100%	70%
Quality (except TDS) improvement	100%	100%	No improvement
TDS Improvement	Yes, but not enough (894 mg/l)	No Improvement	No Improvement
Project Costs (million USD)	529	329	184
O & M Costs (Ratio)	2.5	1	-
Operation and maintenance difficulty	Very difficult	Moderate	Moderate
Financial feasibility**	9.5 %	15.1 %	-*
Economic feasibility (EIRR)	5.9 %	11.2 %	-*

*: Benefits are negligible.
**: Assuming 0.372 US$/revenue-$m^3$ for the water tariff (50 times of the current tariff level or 5.5 % of the average household income)

While the stage 1 project has the lowest project cost, it has less improvement effect in terms of quantity and no benefit in water quality improvement. Although the stage 1 project is an essential component for the improvement of water supply system, the benefit of the stage 1 project alone would not have practical improvement effect. Therefore, the stage 1 was eliminated from the candidate of the priority project. Comparison of the stage 2 and the stage 2-4 projects is summarized as follows:

- As for improvement benefits, the difference between two stages is that stage 2-4 would improve the water quality in terms of TDS to some degree.
- In all other comparisons, the stage 2 has bigger advantages than the stage 2-4.

The stage 2-4 would be selected as the priority project if the estimated TDS improvement is considered to count for additional project cost of 200 million US$, the burden for the operational and maintenance costs and challenges for the difficult RO operations.

It is true that the customers are expecting the improvement of water supply including TDS reduction but their first priority for improvement is the water quantity and the improvement of the water quality is the second preference.

The study team wished to conclude that the estimated TDS improvement would be not enough and thus does not overcome other disadvantages, and to select the stage 2 project as the priority project.

However, as the Iraqi side strongly claimed residents' desires for the TDS improvement, it was agreed that the stage 2-4 be selected as the priority project for feasibility study on conditions that the project would be appraised by Japanese government in the application of Japanese Yen loan, and there is possibility that RO component would be excluded from the Japanese Yen loan component.

CHAPTER 12

FEASIBILITY STUDY FOR PRIORITY PROJECT

CHAPTER 12 FEASIBILITY STUDY FOR PRIORITY PROJECT

12.1 COMPONENTS AND DESIGN CONDITIONS OF PRIORITY PROJECT

12.1.1 Project Components

The Water Supply Plan for the Central Basrah (WSPCB) was formulated with a staged development plan comprising five stages and one additional stage and in the chapter of conclusions and recommendations of WSPCB, stage 2-4 was selected as the priority project for feasibility study comprising following components except the component of "Strengthening of existing distribution mains." After evaluation through network analysis to ensure appropriate distribution pressure without main distribution facilities, the strengthening of the existing distribution network was included in the priority project, which was originally included in stage 3 of WSPCB. This is included as the item 6 of the project components listed below:

1. Rehabilitation of distribution network
2. Rehabilitation of existing water treatment plants
3. Construction of a water treatment plant
4. Construction of a reverse osmosis (RO) plant with half the capacity of stage 4
5. Construction of water transmission system
6. Strengthening of existing distribution mains

In WSPCB, institutional capacity building programs including non-revenue water control programs were prepared to develop the required institutional capacity of Basrah Water Directorate (BWD) for project implementation and management of the proposed water supply system. This non-technical component is of vital importance to ensure the sustainability of BWD and the project. Therefore, the implementation of the programs is included in the priority project components.

The priority project including these technical and non-technical measures is preliminarily designed and evaluated in this part of the report.

The project components of stage 2-4 are shown in the following table and compared with the project components of WSPCB.

Project component	Relationship between priority project and WSPCB
(1) Rehabilitation of distribution network	・ Same as WSPCB (stage 5).
(2) Rehabilitation of existing water treatment plants	・ Same as WSPCB (stage 5).
(3) Construction of a water treatment plant (WTP)	・ Construction of the part of the water treatment plant proposed in WSPCB (stage 5).
(4) Construction of a reverse osmosis (RO)	・ Construction of half capacity of RO facilities of the stage 2-4.
(5) Construction of water transmission system	・ Main transmission facilities: Construction of part of the WSPCB (stage 5) ・ Transmission mains: Same as WSPCB (stag e5) ・ Connection mains will be constructed to connect between the existing WTP and transmission mains
(6) Strengthening of distribution mains and creation of 13 distribution zones	・ Distribution zones: Delineation of 13 zones ・ Distribution mains: Same as WSPCB (stage 5) ・ Main Distribution Facilities: Not construction.
(7) Institutional capacity building program	・ Higher priority programs shall be implemented to increase the capacity of Basrah Water Directorate (BWD) for operation and maintenance of the facilities constructed.

12.1.2 Design Conditions

(1) Design Criteria

The same design criteria as those considered in design of the WSPCB projects is used for the priority project and is shown in Table 12.1.

Table 12.1 Design Criteria for Priority Project

<table>
<tr><th>Item</th><th>Value/Explanation</th></tr>
<tr><td>Project area</td><td>Basrah District including Basrah City and Al Hartha</td></tr>
<tr><td>Target year</td><td>The year 2015</td></tr>
<tr><td>Target water demand</td><td>Water demand in 2015</td></tr>
<tr><td>Design per capita consumption (Lpcd)</td><td>
<table>
<tr><th>Category</th><th>Domestic</th><th>Commercial</th><th>Industrial</th><th>Total</th></tr>
<tr><td>Basrah</td><td>300</td><td>30</td><td>30</td><td>360</td></tr>
<tr><td>Towns with Industry</td><td>200</td><td>30</td><td>30</td><td>260</td></tr>
<tr><td>Towns without industry</td><td>200</td><td>30</td><td></td><td>230</td></tr>
<tr><td>Rural</td><td>200</td><td></td><td></td><td>200</td></tr>
</table>
</td></tr>
<tr><td>Water treatment capacity</td><td>Average day water demand</td></tr>
<tr><td>Transmission pipe capacity</td><td>Maximum day water demand (1.4 x average day water demand)</td></tr>
<tr><td>Distribution pipe capacity</td><td>Peak hour water demand (1.6 x maximum day water demand)</td></tr>
<tr><td>Total dissolved solid (TDS) of water sources</td><td>SWC: 670 mg/l (average of water quality analysis in June and August 2006)
SAA: 1,500 mg/l (considering several sources of water quality analysis including JICA survey)
Tigris: 1,100 mg/l (considering several sources of water quality analysis including JICA survey)</td></tr>
<tr><td>Reverse osmosis plant</td><td>TDS of RO treated water: 200 mg/l
RO plant water recovery rate: 75 %</td></tr>
<tr><td>Water quality</td><td>The tolerable limit of TDS as per the Iraqi standards is 1,500 mg/l. Generally, it is said in Iraq that 700 mg/l is the upper limit of potable water quality. The tolerable limit as per WHO standards is 1,000 mg/l and the WHO recommendation is less than 600 mg/l. The following are WHO explanation.
<table>
<tr><th>TDS (mg/l)</th><th>Organoleptic properties</th></tr>
<tr><td>Less than 300</td><td>Excellent</td></tr>
<tr><td>300 -600</td><td>Good</td></tr>
<tr><td>600-900</td><td>Fair</td></tr>
<tr><td>900-1200</td><td>Poor</td></tr>
<tr><td>Greater than 1200</td><td>Unacceptable</td></tr>
</table>
In this plan, supplied water shall comply with the Iraqi standards except TDS. As for TDS, the target was not decided but a value less than 900 mg/l is preferable based on the above TDS properties.</td></tr>
<tr><td>Water supply pressure</td><td>The proposed distribution pressure shall be ensured with which 4 stories buildings can receive water directly from the network, 0.15 MPa (15 m water pressure) at tap.</td></tr>
<tr><td>Water supply hours</td><td>Basically, 24 hours continuous water supply should be ensured. In case supply volume is not enough, water rationing shall be adopted.</td></tr>
<tr><td>Water supply area</td><td>The water shall be equitably distributed in the distribution area, either by continuous supply or rationing for the entire Basrah District (Basra City and Al Hartha Center and Rural).</td></tr>
<tr><td>Leakage ratio</td><td>From current 50 % (assumed) to 30 % in 2015</td></tr>
</table>

(2) Estimated Water Demand

The same water demand projection as WSPCB was used. In WSPCS, 13 water distribution zones and 6 sub-zones were delineated and the zone demand for 2015 were estimated as shown in Table 12.2. The water transmission system was designed to be able to convey the maximum day water demand to each zone.

Table 12.2 Estimated Zone Population, Average Day and Maximum Day Water Demand for Basrah District (Basrah City and Al Hartha) in 2015

Zone	Population	Average Day Water Demand (m^3/day)	Max Day Water Demand (m^3/day)
1	52,429	27,000	37,800
2	51,231	26,300	36,900
3	57,804	29,700	41,600
4	69,653	35,800	50,100
5	82,713	42,500	59,600
6	84,613	43,500	60,900
7	80,481	41,400	57,900
8	89,436	46,000	64,400
9	81,056	41,700	58,400
10	74,055	38,100	53,300
11	57,487	29,600	41,400
12	40,490	20,800	29,100
13	85,927	44,200	61,900
Z-total	**907,375**	**466,600**	**653,300**
Sub-zone			
S1	31,177	16,000	22,400
S2	31,415	16,200	22,600
S3	14,483	7,500	10,400
S4	66,550	34,200	47,900
S5	97,000	36,000	50,400
S6	109,000	31,200	43,600
S-total	**349,625**	**141,100**	**197,300**
Total	**1,257,000**	**607,700**	**850,600**

(3) Utilization of Existing Water Supply Facilities

Three existing water treatment plants will be utilized in WSPCB but all 13 existing water treatment plants will be utilized in the priority project. Existing water transmission and distribution pipelines and water treatment plants proposed to be used in the water supply system together with the facilities to be constructed through the priority project are summarized in Table 12.3 and Table 12.4.

Table 12.3 Existing Transmission and Distribution Pipelines to be utilized

Facilities	Capacity/remarks
1. Transmission pipeline	To be used after rehabilitation (A 900 mm line from Basrah Unified plant will be used as distribution pipe to transfer water for local demand in Al Hartha.)
2. Distribution network	To be used after rehabilitation
3. Raw water transmission system	- Pipeline and pumping station in R-Zero shall be used. - 2 lines of raw water mains (dia. 1200 mm) from R-Zero to Al Hartha shall be converted to and used for treated water transmission mains from the new water treatment plant at Al Hartha to transmission reservoir.

Table 12.4 Existing Water Treatment Plants to be utilized

No	Name	Type	District	Water Source		Year of const.	Treatment Capacity (m^3/day)	
							Design	Actual
1	R-Zero	C.U.	Al Basrah	SWC		1996	120,000	96,000
2	Al Hartha 25 MG	C.U.	Al Hartha	SWC	SAA	1986	120,000	96,000
3	Basrah Unified	Conv	Al Hartha	SWC	SAA	1978	80,000	72,000
4	Garma 1	C.U.	Al Basrah	SWC	Garma Ali	1986	38,400	30,700
5	Garma 2	C.U.	Al Hartha	SWC	Garma Ali	1986	8,400	6,700
6	Al Maqil (Basrah Port)	Conv	Al Basrah		SAA	1936	13,500	12,200
7	Al Maqil 1	C.U.	Al Basrah	SWC	SAA	2004	14,400	11,500
8	Jubaila Old UP	Conv	Al Basrah	SWC	SAA	1936	24,000	21,600
9	Jubaila 2 CU	C.U.	Al Basrah	SWC	SAA	1986	24,000	19,200
10	Ribat CU	C.U.	Al Basrah	SWC	SAA	1985	14,400	11,500
11	Brad'ia 1	Conv	Al Basrah	SWC	SAA	1957	24,000	21,600
12	Brad'ia 2	Conv	Al Basrah	SWC	SAA	1964	24,000	21,600
13	Brad'ia 3 CU	C.U.	Al Basrah	SWC	SAA	1987	4,800	3,800
	Total						509,900	424,400

(4) Proposed Facilities

The proposed water supply system of priority project is shown in Figure 12.1 and the capacity of proposed water supply facilities of the priority project is shown in Table 12.5.

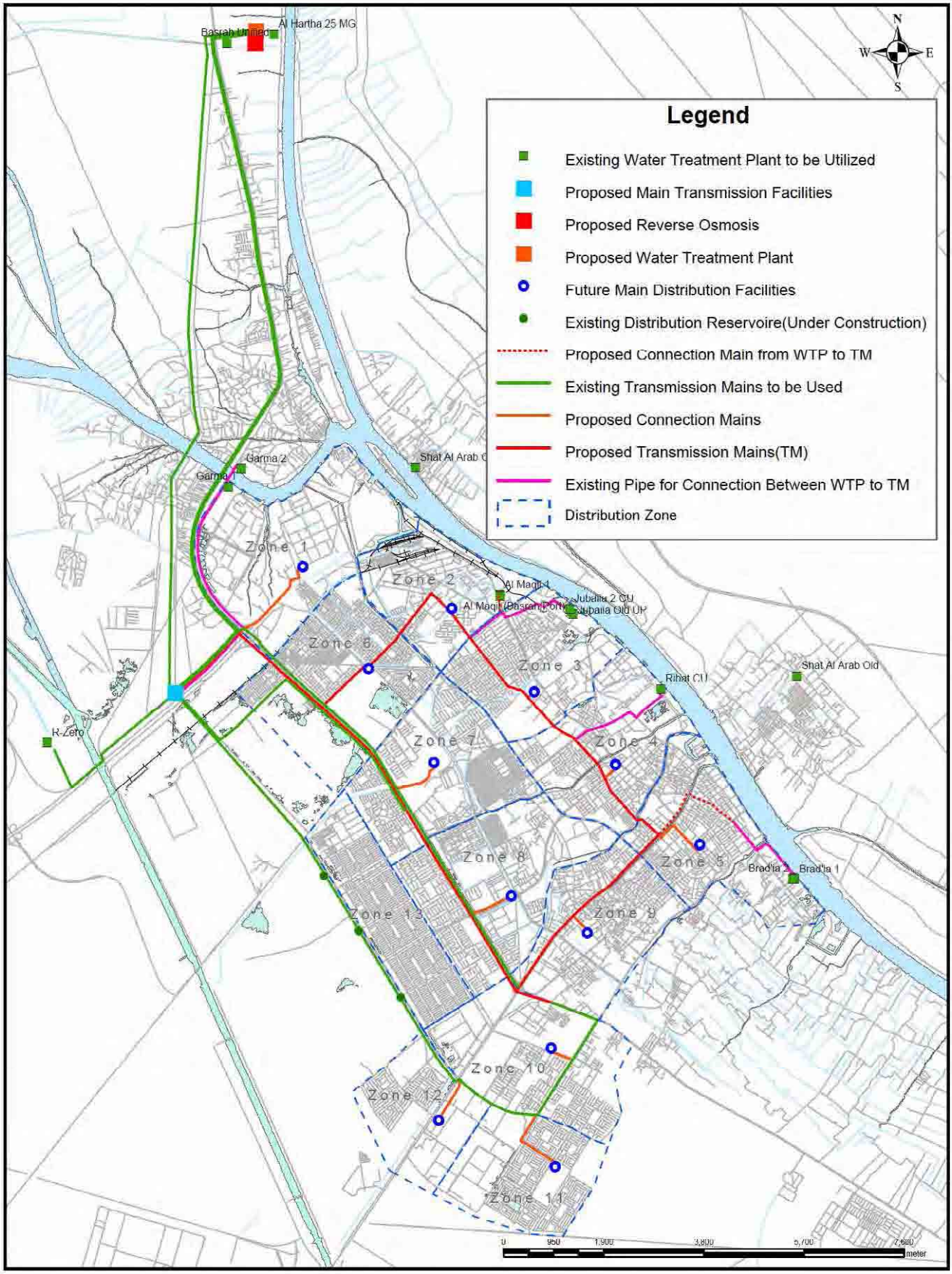
Table 12.5 Summary of Proposed Water Supply Facilities

Project component	WSPCB (Stage 5)	Priority project (Stage 2-4)
1. Rehabilitation of network	Dia.110 mm - 700 mm, 285 km	Dia.110 mm - 700 mm, 285 km
2. Rehabilitation of water treatment plant (WTP)	13 plants (424,400m^3/day) Note: finally only 3 WTPs (264,000 m^3/day) will be utilized.	13 plants (424,400m^3/day)
3. Transmission system		
(1) Transmission reservoir (TR)	64,000 m^3	48,000 m^3
(2) Transmission pumping station (TPS)	710,000 m^3/day x 40 m head Note: The water is supplied to customers through the main distribution facilities.	538,000 m^3/day x 60 m head Note: The water is supplied directly from TPS to customers without the main distribution facilities.
(3) Ring mains and connections	Dia.600 mm - 2000 mm, 33,000 m	Dia.600 mm - 2000 mm, 35,200 m Note: Connection mains from the existing WTPs to transmission mains are included.
4. New water treatment plant		
(1) Treatment plant	465,000 m^3/day	245,000 m^3/day
(2) Treated water pumping station	369,000 m^3/day x 40 m head	192,000 m^3/day x 40 m head
5. RO plant	362,000 m^3/day (output)	145,000 m^3/day (output)
6. Distribution Facilities *	13 water distribution zones	13 water distribution zones
(1) Strengthening of distribution mains	Dia.200 mm- 700 mm, 25,100 m	Dia.200 mm- 700 mm, 25,100 m
(2) Distribution reservoir (for 12 zones)	186,000 m^3 in total	-
(3) Transfer pumping station (for 12 zones)	945,000 m^3/day (39,800 m^3/hr) in total	-
(4) Elevated tank (for 12 zones)	12,300 m^3 in total	-

Note: * One zone is under construction.

(5) Design Water Flow Balance

The same water demand as WSPCB is adopted. In WSPCB, the 3 existing WTPs are planned to be utilized but all 13 existing WTPs will be utilized in the priority project. Therefore, the water supply system of this part is different from that of WSPCB. Based on the above design conditions, a flow regime or balance of the project area was designed as shown in Figure 12.2 and Figure 12.3. Using this flow regime, the capacity of water supply facilities was calculated.



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Sorroundings in the Republic of Iraq	Proposed Water Supply System of Priority Project	Fig No. 12.1

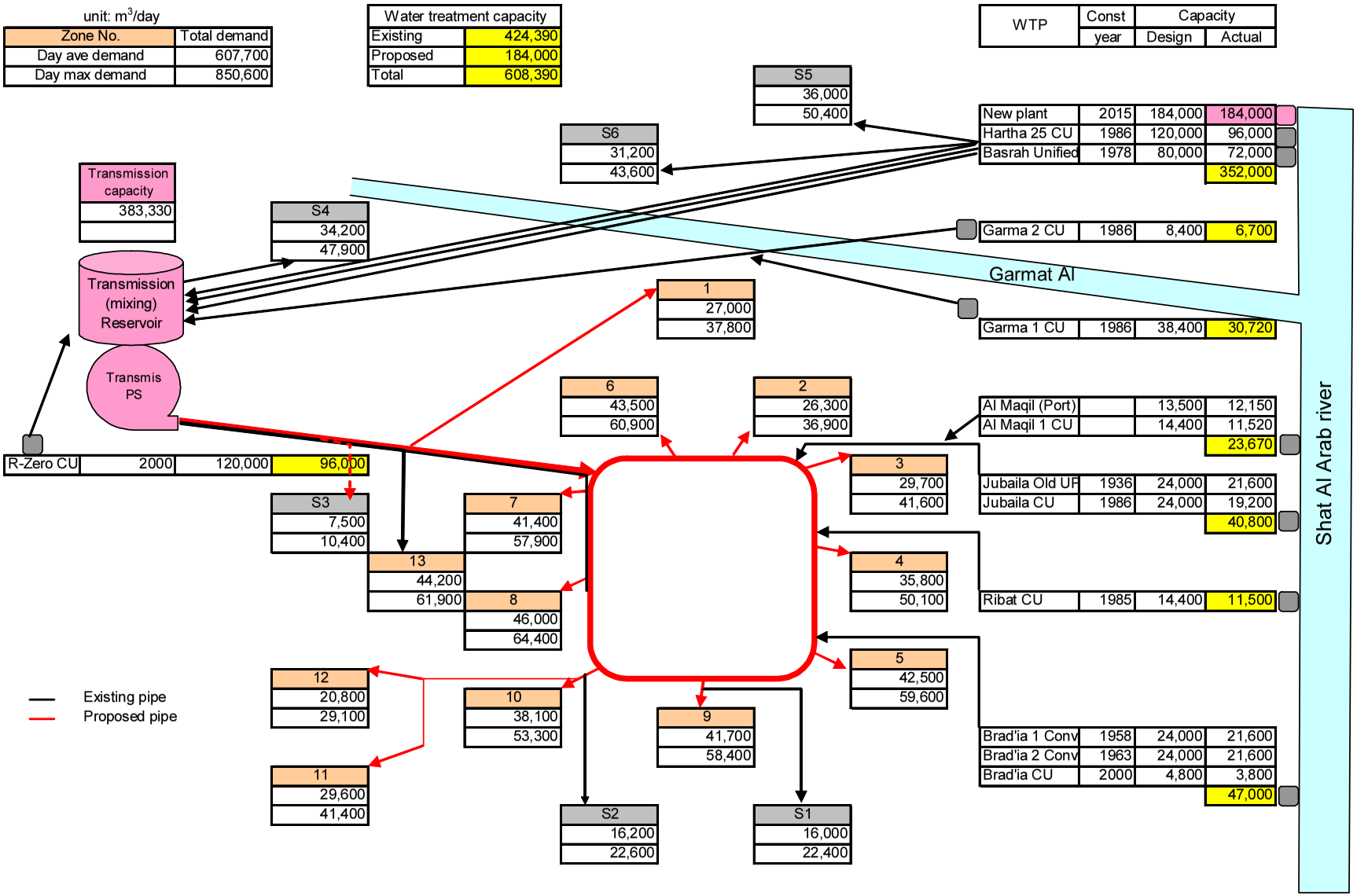


Figure 12.2 Schematic Layout of Design Flow Regime/Balance in Project Area (Priority Project)

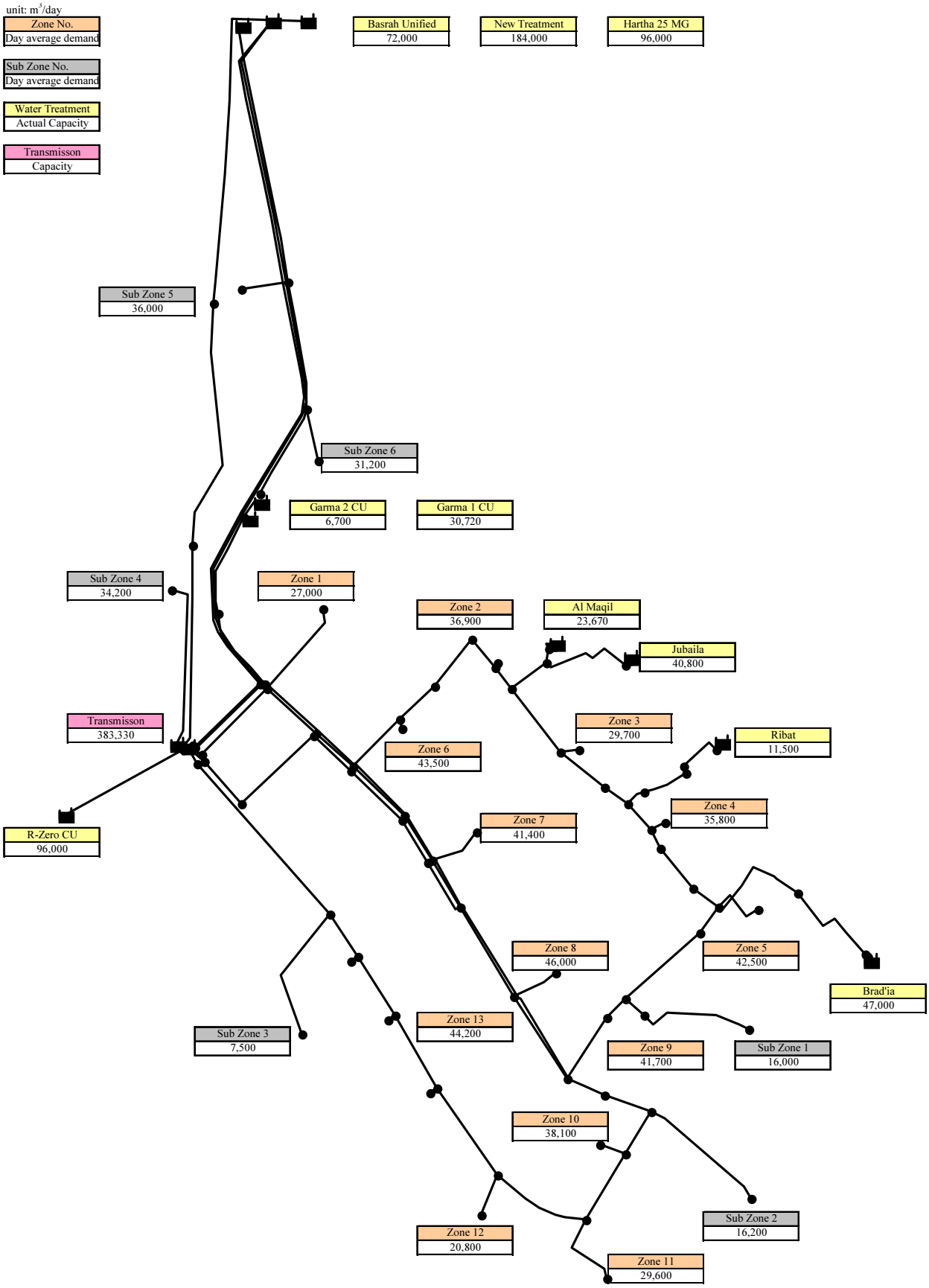


Figure 12.3 Design Flow Regime/Balance in Project Area

12.2 FACILITY DESIGN

12.2.1 Rehabilitation Works

In WSPCB, the rehabilitation works for distribution network and water treatment facilities were identified and following scopes were decided.

(1) Distribution Network

The scope of the rehabilitation works for the distribution network was preliminarily estimated as given in Table 12.6. However, these works shall be of temporal scopes due to lack of information on the existing distribution network. Therefore, further inspection of the existing network is required to finally decide the detailed scope of works and prioritization of implementation at the next design stage.

Table 12.6 Preliminary Scope (Length and Diameter) of Distribution Network Rehabilitation

Pipe diameter (mm)	Length (m)
700	7,000
500	6,500
400	1,000
225	18,500
160	54,000
110 or less	198,500
Total	**285,500**

(2) Rehabilitation of Existing Water Treatment Plants

Most of the existing facilities need rehabilitation, especially the mechanical and electrical equipment. In the priority project, all existing water treatment plants should be utilized in the short term after rehabilitation. Since they are used as the short term solution, the scope of the rehabilitation works was planned not for full rehabilitation that includes rehabilitation of civil structure but for mainly replacement of mechanical and electrical equipment for life extension of the existing water treatment plants.

Based on the information supplied from the sites, preliminary rehabilitation works were identified as listed in Table 12.7. However, these works shall be temporary in scope and further inspection of the

facilities is required to decide the detailed scope of works at the next design stage.

Table 12.7 Rehabilitation Works for Existing Water Supply Plants

Facilities	Rehabilitation works
(1) R-Zero 25 C.U.	C.U. (25), Storage tank, High lift PS (8), Low lift PS (9), Chlorine system, Electrical equipments (33kv/11kv) substation & low tension equipments, Diesel generators, Plant buildings, Waste water pumps (4)
(2) R-Zero Raw Water Pumps	Al Hartha pumps (6), Basrah Unified. Pumps (6), Al Jubaila pumps (4), Bradiah pumps (3), Shuaiba pumps (4), Abu Al Khasseb pumps (6), Khor Al Zubair pumps (3), Plant buildings, Electrical equipments, Mechanical equipments
(3) Al Hartha 25 C.U.	C.U. (25), Storage tank, High lift PS (8), Low lift PS (7), Chlorine system, Electrical equipments, Diesel generators, Plant buildings
(4) Basra Unified	Gravity sand filters (20), Storage tank, High lift PS (7), Low lift PS (5), Chlorine system, Electrical equipments, Diesel generators , Plant buildings, Sedimentation tanks (4), Alum dosing system, Back washing system, Pneumatic system & measuring equipments
(5) Garma 1	C.U. (8), Low lift PS (3), Chlorine system, Electrical equipments, Diesel generators, Plant buildings
(6) Garma 2	C.U. (7), Low lift PS (2), Chlorine system, Electrical equipments, Diesel generators, Plant buildings
(7) Rabat	C.U. (3), Low lift PS (3), Chlorine system, Electrical equipments, Diesel generators, Plant buildings
(8) Al Maqil 1	C.U. (3), Low lift PS (2), Chlorine system, Electrical equipments
(9) Jubaila 1	Pressure sand filters (12), High lift PS (3), Low lift PS (3), Chlorine system, Electrical equipments, Diesel generators, Plant buildings, Sedimentation tanks (2), Alum dosing system, Back washing system, Inlet piping system
(10) Jubaila 2	C.U. (4), Low lift PS (2), Chlorine system, Electrical equipments, Diesel generators, Plant buildings
(11) Bradiah 1	Pressure sand filters (14), High lift PS (4), Low lift PS (4), Chlorine system, Electrical equipments, Diesel generators, Plant buildings, Sedimentation tanks (2), Alum dosing system, Back washing system
(12) Bradiah 2	Pressure sand filters (14), High lift PS (4), Low lift PS (4), Chlorine system, Electrical equipments, Diesel generators, Plant buildings, Sedimentation tanks (2), Alum dosing system, Back washing system
(13) Bradiah C.U.	C.U. (1), Low lift PS (2), Chlorine system, Electrical equipments, Plant buildings

Note: The number in parentheses indicates the number of units of rehabilitation works.

12.2.2 Proposed New Water Treatment Plant and Reverse Osmosis Plant

(1) Flow of Water Treatment System

In WSPCB, it is proposed that a new water treatment plant including RO plant should be located in the vacant lands between the existing Al Hartha 25 MG and Basrah Unified plants. The capacity of the water treatment plant is calculated as shown in Figure 12.15 and rounded up as follows and given in Figure 12.4:

- New water treatment plant: 235,000 m^3/day (←231,500 m^3/day)
- New reverse osmosis plant: 145,000 m^3/day (←143,500 m^3/day)

- Transmission pump for treated water to transmission reservoir: 192,000 m^3/day (←188,900 m^3/day)
- Transmission pump for Basrah Unified: 55,000 m^3/day (←55,100 m^3/day)

The existing water treatment plants should be utilized and the treated water should be transferred to the proposed transmission reservoir by proposed pumping station and existing transmission pipelines. The connections among these plants or the water flow of this system are planned as depicted in Figure 12.4.

In the system, the treated water of Al Hartha 25 MG plant is directly transferred to the transmission reservoir. However, the treated water of Basrah Unified plant should be distributed to Al Hartha district for the local water demand (67,000 m^3/day) after mixing with RO treated water. To achieve this, some part (60,000 m^3/day out of 72,000 m^3/day) of the treated water of Basrah Unified plant should be transferred to a new reservoir constructed with the new water treatment plant to adjust TDS concentration by mixing. Then, some portion (55,000 m^3/day) of the mixed water should be returned to the existing reservoir. The amount of the transferred water is decided in such a way that TDS concentration equalize over the project area.

In the system, the treated water of R-Zero plant is also directly transferred to the transmission reservoir.

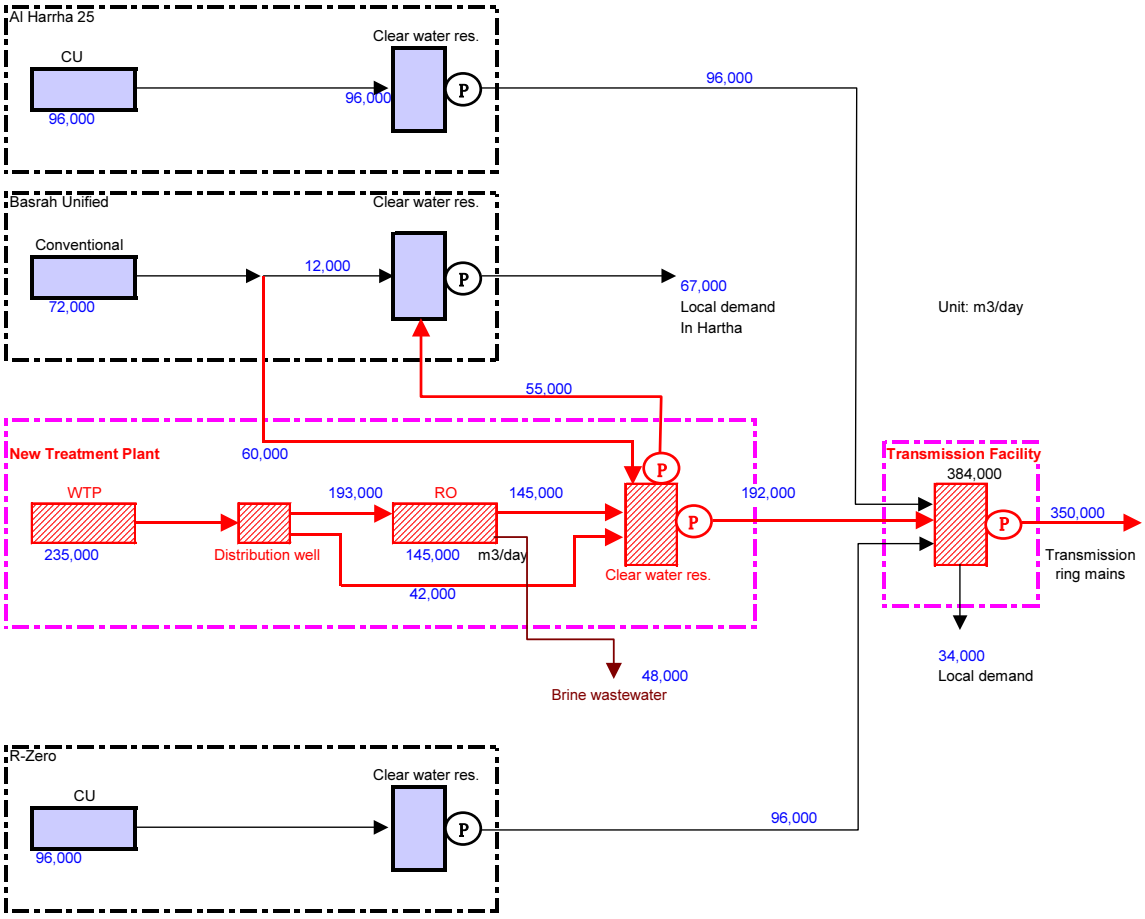


Figure 12.4 Flow of Water Treatment System Upstream of Transmission Facilities

(2) Proposed Water Treatment Plant and Reverse Osmosis

1) Estimated Capacity

In WSPCB, conventional rapid sand filtration method, which is an effective method to treat river water and the most commonly used throughout the world, is adopted for treatment process. As compared with compact unit, this process has easy operation and maintenance, posses less trouble and has longer life time.

In WSPCB, RO method was adopted to reduce salinity. RO system requires pre-treatment such as multi-layer filters, activated carbon process or ultra-filtration. The detailed process and design criteria of RO should be decided through detailed investigation of water quality of the Shat Al Arab and a pilot project for 1 year is recommended to decide this. In this plan, preliminarily multi-layer filter process has been proposed for the pre-treatment.

The capacity of each facilities of the treatment plant is decided considering the loss of water from the

treatment process such as sludge drainage from sedimentation basin, back wash of rapid sand filter and in-plant use. The capacities of reverse osmosis plant, treated water reservoir and transmission pumping station are decided based on the flow of water treatment system shown in Figure 12.4. Table 12.8 shows the decided capacity of each facility.

Table 12.8 Capacity of Process of Proposed Water Treatment Plant

Facilities			Capacity	Ratio
Water Treatment Plant			235,000m^3/day	Plant nominal capacity (NC) x 1
Raw Water Pump			244,400m^3/day	NC x 1 x 1.04
Mixing Basin			258,500m^3/day	NC x 1 x 1.10
Flocculation Basin				
Chemical Sedimentation Basin				
Rapid Sand Filter				
Chemical Facilities				
Reverse Osmosis Plant	(Input)	TDS 1,500mg/l	193,000m^3/day	Recovery rate: 75%
	(Output)	TDS less than 200mg/l	145,000m^3/day	
Clear (Treated) Water Reservoir			8,000m^3	1 hour storage capacity of the total capacity of treated water transmission pump
Transmission Pump for Transmission Main Reservoir			192,000m^3/day	
Transmission Pump for Basrah Unified WTP			55,000m^3/day	

2) General Layout of Proposed Water Treatment Plant

The proposed water treatment facilities should be constructed in the land owned by BWD between the existing Al Hartha 25 MG and Basrah Unified plant site. The layout of the facilities in the site was decided considering following points.

- The land used for the proposed facilities should be minimized so that the large land remains available for future expansion
- Proposed facilities such as operation room, transmission pump and RO plant that require frequent operation and maintenance should be located in the center of the site so that, when the plant is expanded in future, those facilities can be located at the center symmetrically to the proposed facilities. This makes the operation of both the proposed and future facilities easier.
- Proposed facilities should be arranged in the site in such a way that water flow line is smooth and hydraulic loss is minimized. This minimizes not only the construction cost but also operation and maintenance cost.
- The smooth operation and maintenance line should be considered.

The layout of proposed water treatment facilities is decided as illustrated in Figure 12.5.

3) Sludge and Wastewater Disposal

The sludge and wastewater are generated from treatment processes and the methods of disposal or recycle are planned as follows:

Sludge and wastewater	Method of disposal/recycle
Settled sludge in sedimentation basin	Once every half year, one sedimentation basin shall be drained and sludge shall be manually removed and discharged to Shat Al Arab.
Backwash wastewater from sand filter	The wastewater from sand filters shall be returned to mixing basin for recycle after being stored in drainage tank.

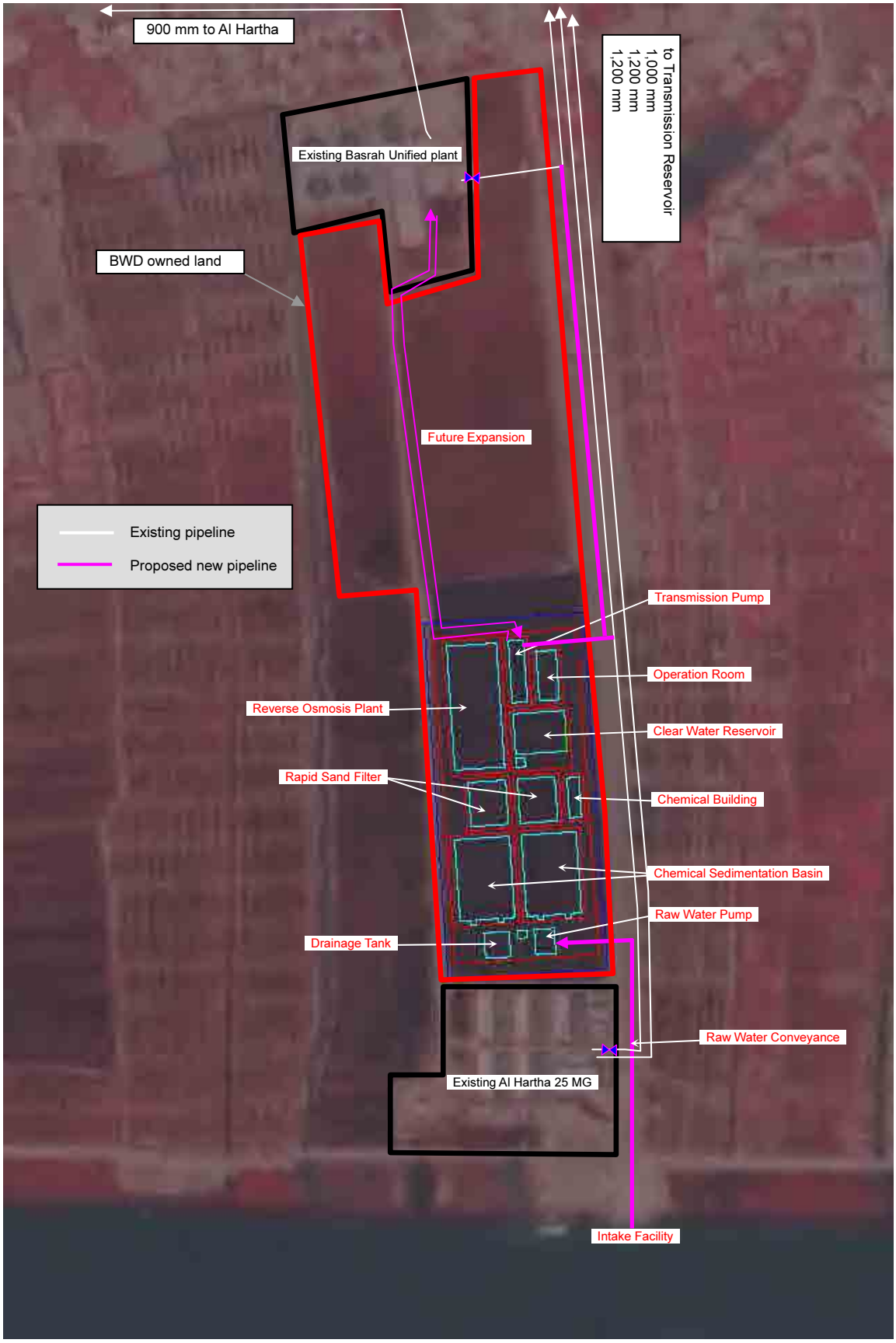


Figure 12.5 Layout of Proposed Water Treatment Plant (Priority Project)

4) Facility Plan

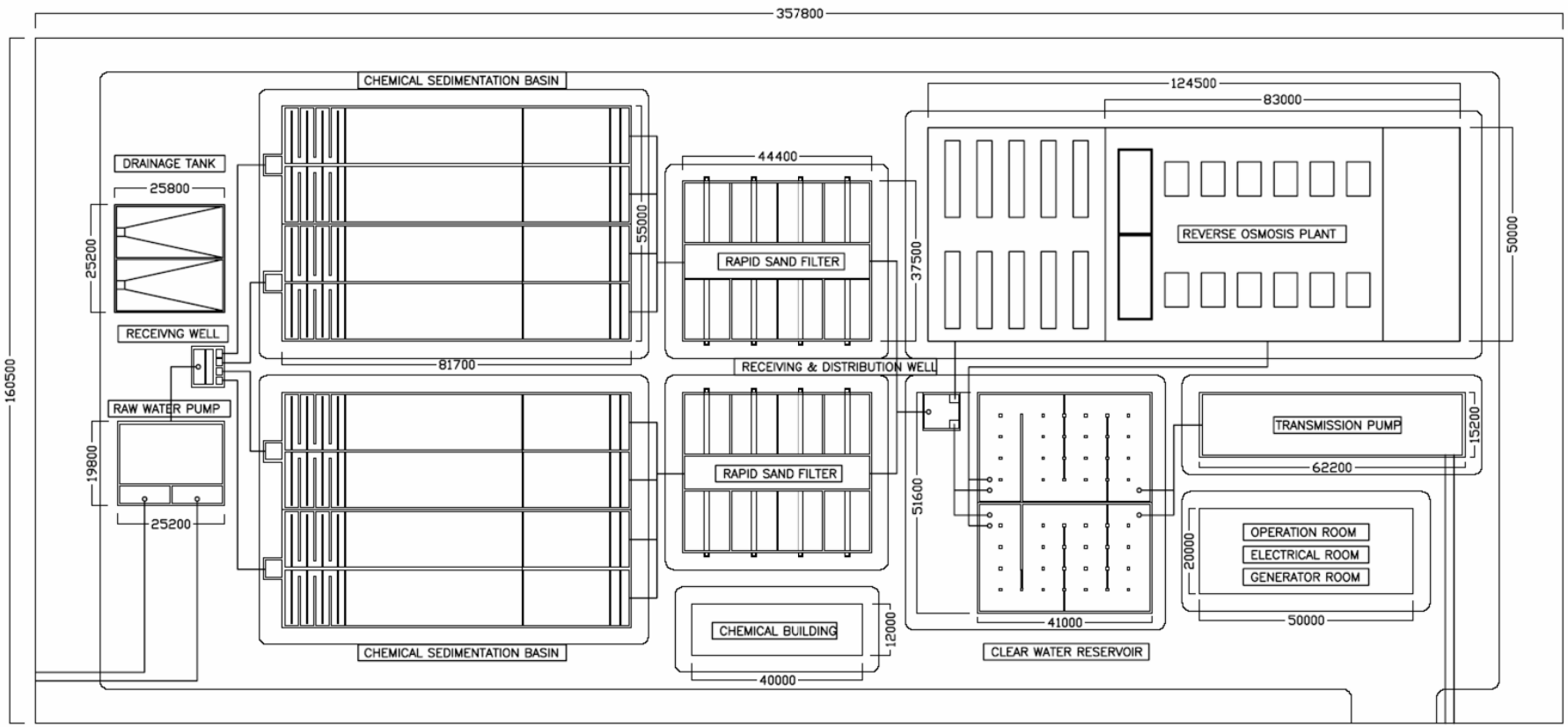
The specifications of each facility and civil structures were decided according to capacity and design criteria. The summary of proposed facilities is shown in Table 12.9 and the details of the proposed capacity are showed in Appendix M. The following facility drawings are attached.

Figure 12.6 General Layout of New Water Treatment Plant
Figure 12.7 Hydraulic Profile of New Water Treatment Plant
Figure 12.8 System Flow Diagram of New Water Treatment Plant

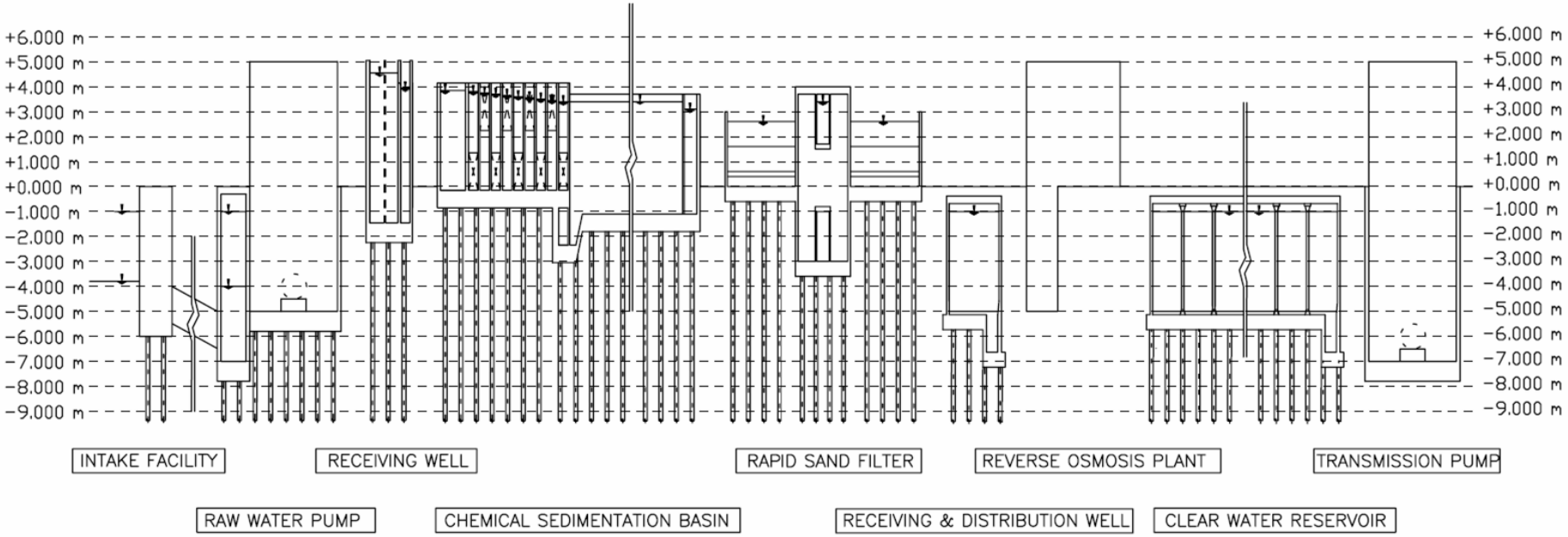
Table 12.9 Summary of Capacity of Proposed Facilities in Water Treatment Plant

Facilities	Specification
1. Intake Facilities	
Intake Gate	RC Structure with Bar Screen and stop-log
Raw Water Conveyance	DCIP dia.1600mm x 2units
2. Raw Water Pump Facilities	
Raw Water Tank	RC Structure : W4m x L12m x H6.2m x 2units
Underground Structure	RC Structure : W14m x L24m x H5m
Building	Building : W14m x L50m x H5m
Transmission Pump	Centrifugal Pump 56.6m^3/min x 10m head x 140kW x 4units
Monitoring device	Flow Meter : dia.1100mm x 1unit
3. Receiving Well	
Structure	RC Structure : W8m x L6m x H6m
Inlet Gate	Gate :W1.2m x L1.2m x 4units
4. Mixing Basin	
Structure	RC Structure : W4m x L4m x H4.5m x 4units
Mixer	Rapid Mixer x 4units
Inlet Gate	Gate :W0.8m x L0.8m x 8units
5. Flocculation Basin	
Baffling Flocculation	RC Structure : W13m x L15.9m x H4.5m x 8units
6. Chemical Sedimentation Basin	
Structure	RC Structure : 24,000m^3 x 2 (W60m x L100m x 4.5m)
Collector	Sludge Collector x 8units
Drain Valve	Sluice Valve : dia.200mm x 8units
7. Rapid Sand Filter	
Gravity Sand Filter	RC Structure : W10.6m x L14m x H3.5m x 16units Filter Sand : 600mm Filter Gravel :200mm Collection system : Strainer type
Valves	Inlet Valve : Motor-driven sluice valve dia.600mm x 16units Treated water Valve: Motor-driven sluice valve dia.600mm x 16units Back Wash Valve: Motor-driven sluice valve dia.600mm x 16units Surface Wash Valve: Motor-driven sluice valve dia.400mm x 16units Drain Valve: Motor-driven sluice valve dia.600mm x 16units
Back Wash Pump	Centrifugal Pump 50.5m^3/min x 10m head x 123kW x 3units
Surface Wash Pump	Centrifugal Pump 19.0m^3/min x 30m head x 139kW x 2units
8. Receiving & Distribution Well	
Reservoir	RC Structure : W8m x L8m x 4.5m
9. Chemical Facilities	
Building	Building : W12m x L40m x 6m
Chlorine Equipment	Chlorine Cylinder 1.0ton x 19units Dosing Equipment (for Pre Injection) 40kg/h x 6units Dosing Equipment (for Post Injection) 16kg/h x 3units Chlorine Neutralization Equipment x 1unit

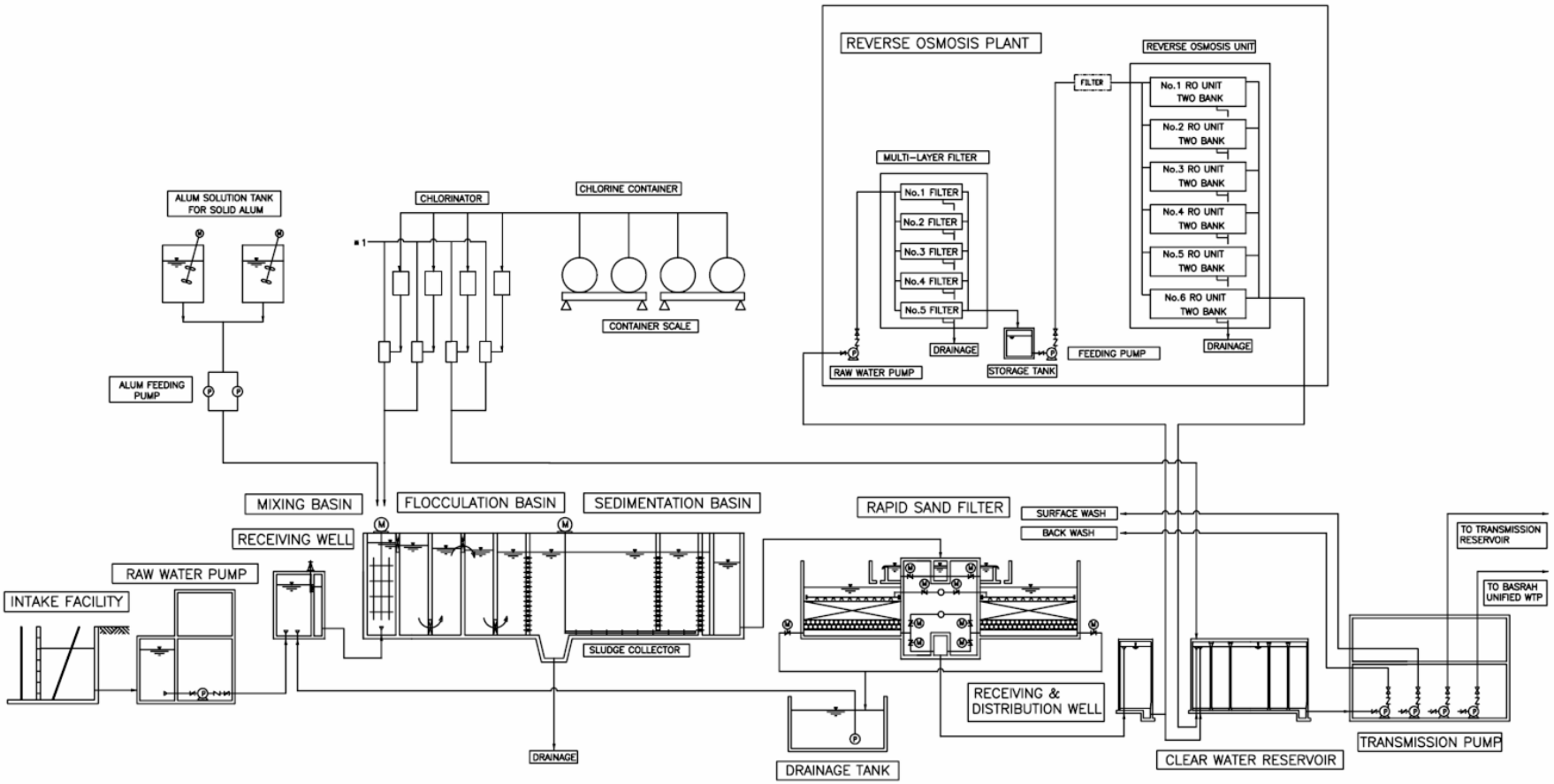
Facilities	Specification
Aluminum Equipment	Mixer Tank 15.0m^3 x 4units Injection Pump 2,500L/h x 6units
10. Reverses Osmosis Plant	
Building	Building : W50m x L83m x 7m
Multi-Layer Filter	Multi-Layer Filter dia.3500mm x L17m x 10units
Reverse Osmosis Unit	Reverse Osmosis Unit (Two banks system) x 12units
Generator	Diesel Generator : 3125kVA x 3 units
11. Clear Water Reservoir	
Structure	RC Structure : W25m x L40m x 4.5m x 2units
Monitoring device	Level sensor
12. Treated Water Pump Facilities	
Underground Structure	RC Structure : W14m x L61m x H7m
Building	Building : W14m x L60m x 5m
Pump	Transmission Pumps Centrifugal Pump 44.4m^3/min x 40m head x 440kW x 4units Pumps form Basrah Unified plant Centrifugal Pump 12.7m^3/min x 10m head x 40kW x 4units
Monitoring device	Flow Meter : dia.1000mm x 1unit Flow Meter : dia.600mm x 1unit
13. Drainage Tank	
Structure	RC Structure : W12m x L25m x 4.5m x 2units
Return Pump	Return Pump 6.6m^3/min x 10m head x 22kW x 2units
14. Electrical & Operation & Generator Facilities	
Building	Building : W20m x L50m x 4m
Electrical Equipment	Receiving Panel and Transformer
Operation System	Monitoring Equipment
Generator	Diesel Generator : 1500kVA x 2 units



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Surroundings in the Republic of Iraq	General Layout of New Water Treatment Plant	Fig No. 12.6



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Surroundings in the Republic of Iraq	Hydraulic Profile of New Water Treatment Plant	Fig No. 12.7



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Surroundings in the Republic of Iraq	System Flow Diagram of New Water Treatment Plant	Fig No. 12.8

12.2.3 Treated Water Transmission Main from New Water Treatment Plant

There are two existing raw water transmission mains (1,200 mm x 2 lines) that convey raw water from R-Zero to Al Hartha 25 MG and Basrah Unified plant. Once the priority project is implemented, these pipelines will not be required as the water source conveyer for both the plants, because the raw water would come from only the Shat Arab. It is proposed that these pipelines be utilized to transfer the treated water of the new water treatment plant to the proposed main transmission facilities, i.e. to transmission reservoir to minimize the capital cost of the project.

12.2.4 Transmission Facilities and Transmission Ring Mains

In the priority project, transmission facilities (transmission reservoir (TR), transmission pumping station (TPS) and transmission ring mains (TRM)) are planned to be constructed without the distribution main facilities (DMF) (ground reservoir, transfer distribution pump and elevated tower) for the 12 distribution zones, which will be constructed at a different construction stage. Considering this staged implementation and the adoption of design criteria in Table 12.10, the capacity of the transmission facilities are calculated as shown in Table 12.11 and the layout of these transmission facilities are shown in Figure 12.9.

Table 12.10 Design Criteria of Main Transmission Facilities and Transmission Ring Mains

Facilities	Design Criteria
Transmission ring mains	Maximum day water demand (1.4 x average day water demand)
Transmission reservoir	3 hours of the average day water demand
Transmission pump station	Maximum day water demand (1.4 x average day water demand)

Table 12.11 Capacity of Transmission Facilities

Facilities	Priority Project (Stage 2-4)	WSPCB (Stage 5)
Transmission Reservoir	48,000m^3	64,000m^3
Transmission Pump Station	538,000m^3/day	710,000m^3/day

The routes of the transmission ring mains and required branches are planned to ring around the center of Basrah City. The diameter of transmission pipeline was estimated by hydraulic network analysis so as to transfer the required amount of water to the connection points of each distribution zone.

The connection mains from the transmission ring main are planed to reach the distribution main

facilities of each zone that would be constructed in future. In the priority project, without distribution main facilities, the connection mains should be connected directly to distribution mains.

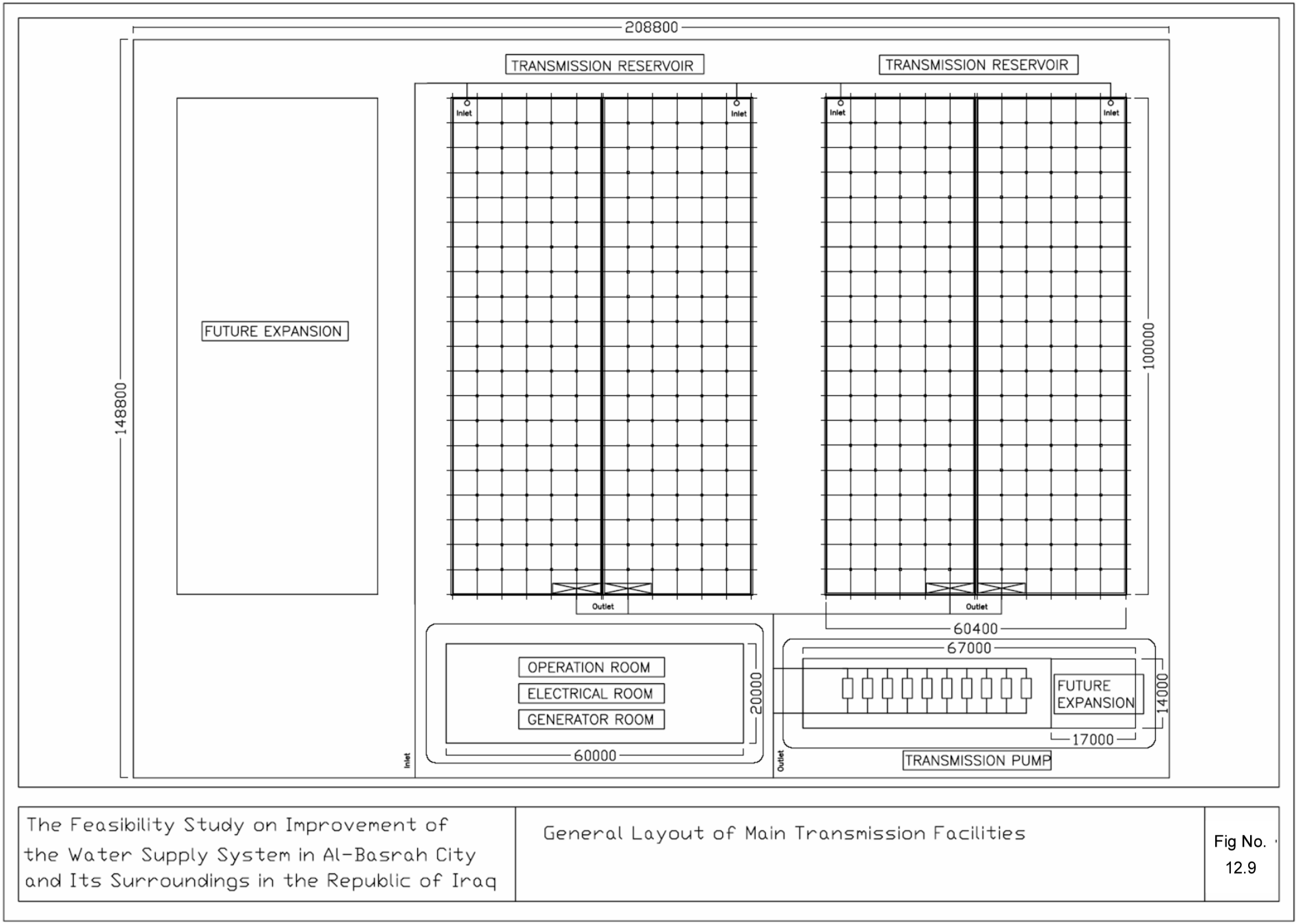
In the priority project, the existing water treatment plants are utilized. To connect these water treatment plants and the transmission mains, some of the existing distribution mains are used and some connection mains are newly planed as required. This connection would enable TDS of the supplied water to equalize through the project area. The route of the connection mains was decided as the shortest distance from the existing plants to the transmission ring mains.

Civil structure of the transmission reservoir and the specification of transmission pumping station and management building were designed according to the estimated capacity and design criteria stated previously. The summary of the transmission facilities and transmission pipelines are shown in Table 12.12 and the details of calculation are showed in Appendix M. The following facility drawings are attached.

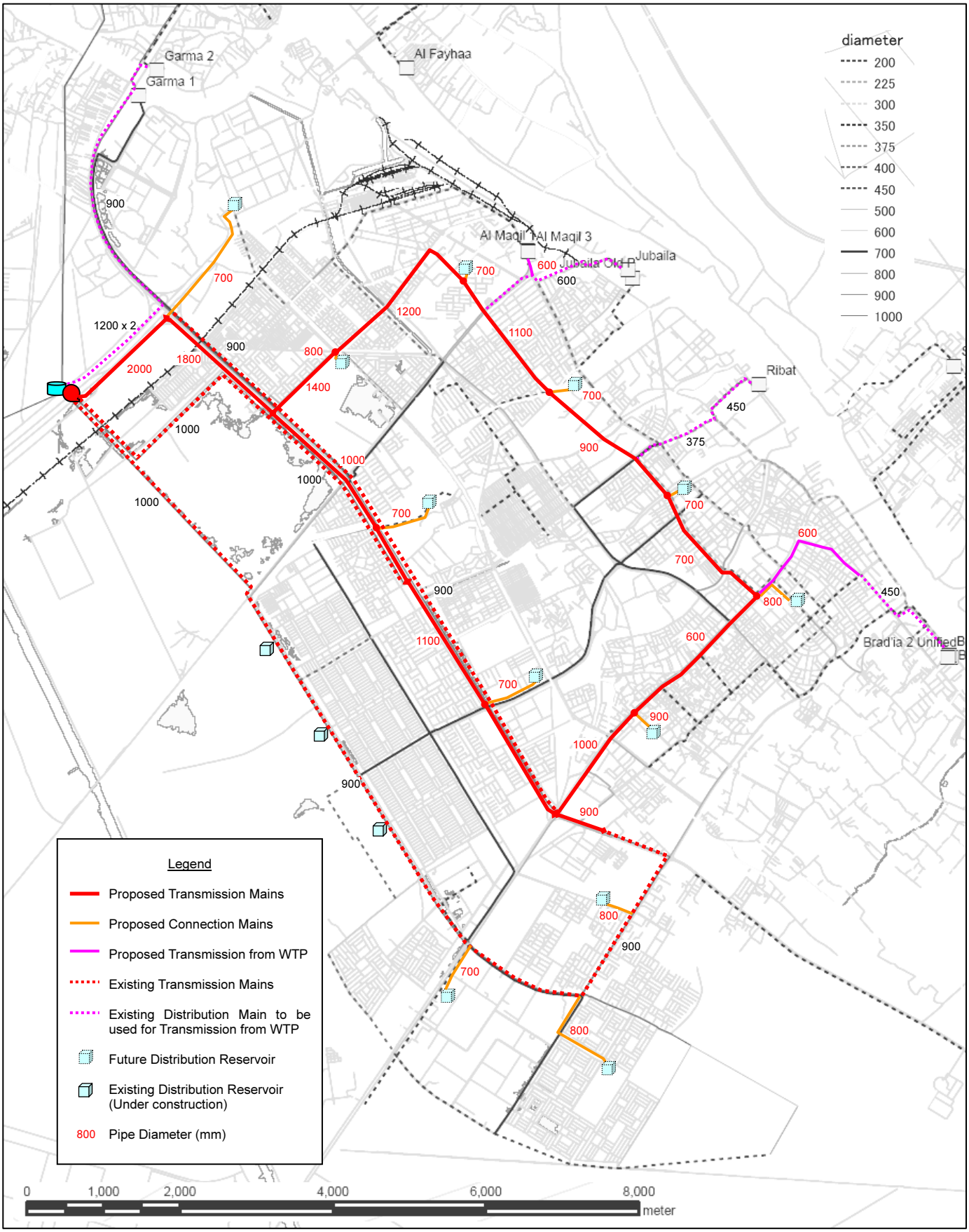
Figure 12.9 General Layout of Main Transmission Facilities
Figure 12.10 Proposed Transmission System for Priority Project with Existing Transmission Mains

Table 12.12 Facility Plan of Transmission Facilities and Transmission Pipelines

Transmission Pipeline			
Diameter (mm)	Transmission Ring Mains (TRM) (m)	Connection Mains From TRM to Distribution Mains (DM) (m)	Connection Mains from Existing WTPs (m)
2,000	1,900	0	0
1,800	2,000	0	0
1,400	1,200	0	0
1,200	2,500	0	0
1,100	3,600	0	0
1,000	5,500	0	0
900	3,800	400	0
800	0	3,000	0
700	1,800	5,000	0
600	2,300	0	2,200
Sub-total	24,600	8,400	2,200
Total	35,200 m		
Transmission Reservoir			
Reservoir	RC Structure : 24,000m^3 x 2 (W60m x L100m x H4.5m)		
Transmission Pumping station			
Building	Building : W14m x L50m x H7m		
Transmission Pump	Centrifugal Pump : 53.4m^3/min x 60m head x 780kW x 8units		
Transmission Management station			
Building	Building : W14m x L50m x H4.5m		
Electrical Equipment	Receiving Panel and Transformer		
Operation System	Monitoring Equipment		
Generator	Diesel Generator : 3125kVA x 3 units		



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Surroundings in the Republic of Iraq	General Layout of Main Transmission Facilities	Fig No. 12.9



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Sorroundings in the Republic of Iraq	Proposed Transmission System for Priority Project with Existing Transmission Mains	**Fig No.** 12.10

12.2.5 Distribution Mains and Zoning

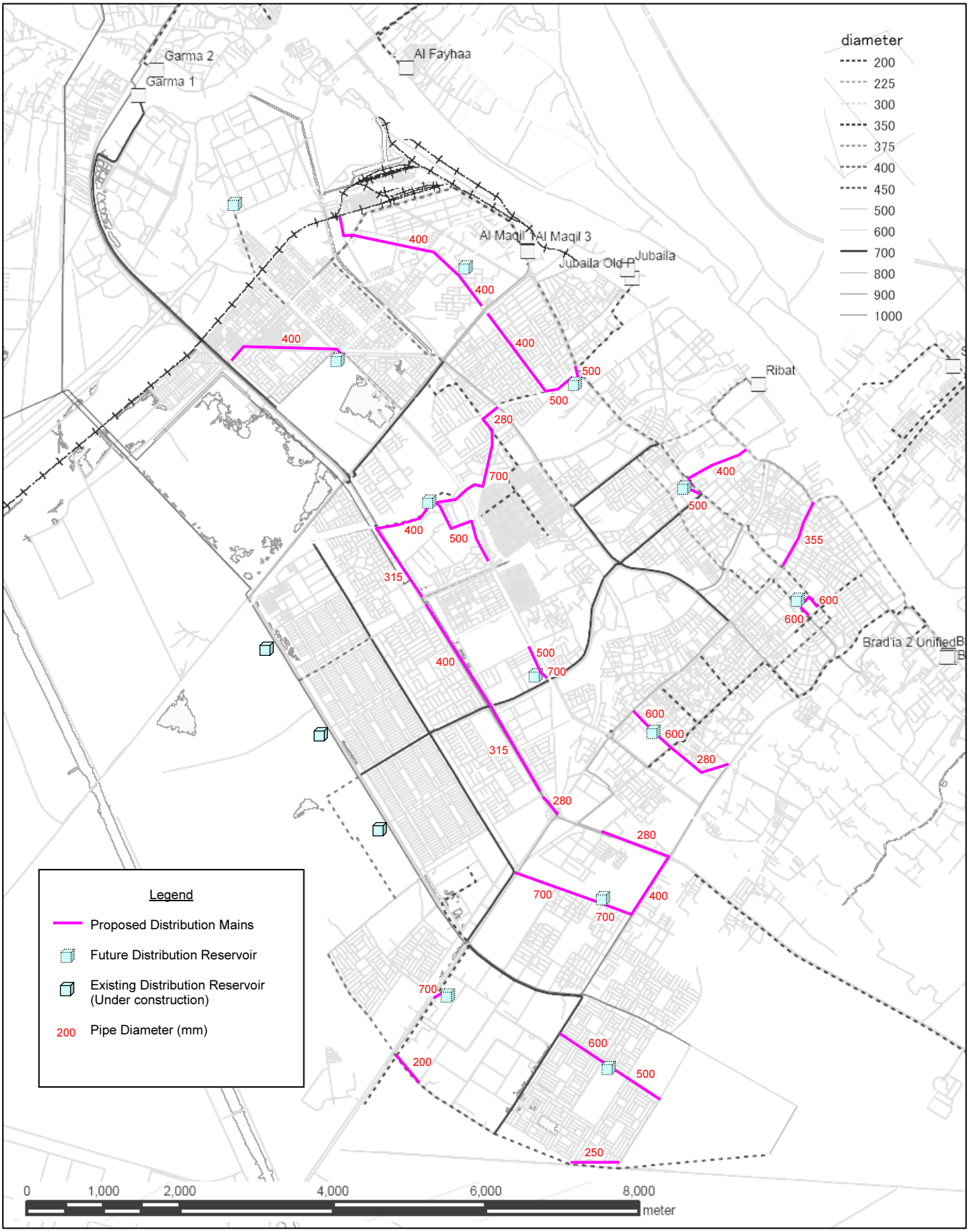
In WSPCB, the delineation of the 13 distribution zones and distribution main facilities (ground reservoir, distribution pump and elevated tower) for each zone was planned, but the distribution main facilities are not selected as the priority project.

Also in WSPCB, restructuring and strengthening of the distribution network to create distribution zones were planned. To equalize the benefits to all the customers, zoning and restructuring and strengthening of the distribution network are required and therefore it is proposed to be included in the priority project.

The distribution mains were designed to ensure appropriate distribution pressure in the network using network analysis. The analysis results are shown in Appendix E. The summary of required distribution mains are shown in Table 12.13 and Figure 12.11. In addition, required stop valves are estimated for delineation of 13 distribution zones.

Table 12.13 Proposed Distribution Mains for Network Strengthening and Restructuring

Diameter (mm)	Length (m)
700	3,500
600	2,000
500	6,300
400	6,100
355	2,500
315	2,600
280	2,200
250	1,000
200	900
Total	**27,100**



The Feasibility Study on Improvement of the Water Supply System in Al-Basrah City and Its Surroundings in the Republic of Iraq	Proposed Distribution Mains with Existing Distribution Mains (Priority Project)	Fig No. 12.11

12.3 INSTITUTIONAL CAPACITY BUILDING FOR PRIORITY PROJECT

12.3.1 Selection of Priority for Capacity Building

In WSPCB, following five strategies were prepared to develop adequate institutional capacity of Basrah Water Directorate (BWD).

Strategy-A: Smooth implementation of the JBIC loan project
Strategy-B: Formation of legal framework for water supply policy and direction
Strategy-C: Execution of autonomous and unified administration of BWD after the national decentralization and de-concentration reform
Strategy-D: Establishment of efficient and effective O&M system
Strategy-E: Ensuring adequate budget for operation and maintenance as an autonomous and unified administration body

In these strategies, the implementation of the strategies D and E are of most importance for appropriate management and operation & maintenance for the facilities proposed in the priority project and thus these strategies were focused in the priority capacity building target.

Strategy-D: Establishment of efficient and effective operation & maintenance system

The system of operation and maintenance of the existing facilities is not properly established and functioned. In the priority project, the water supply facilities will be refurbished or newly constructed. These facilities should be operated and maintained appropriately by experts and skilled operators. To do so, the development of technical capacities of staff is required and an efficient and effective O&M system should be established.

Strategy-E: Ensuring adequate budget for O&M toward an autonomous and unified administration body

Adequate budget for O&M of the water supply facilities is required for autonomous and unified administration body without relying on government subsidy in future. To achieve this, the bill collection system of BWD should be upgraded and intensive campaigns to raise the awareness of customers to promote payment of proper tariff that covers at least operation and maintenance cost should be carried out.

12.3.2 Proposed Organization

To improve the existing organization, following measures are recommended:

- Simplifying and restructuring of the management of command lines
- Strengthening of customer service
- Strengthening of audit system

Considering these measures, a new organization of BWD is proposed and shown in Figure 12.12 and it is recommended that audit committee and customer service department should be established in the organization. The responsibilities of the new organization of BWD are proposed as shown in Table 12.14.

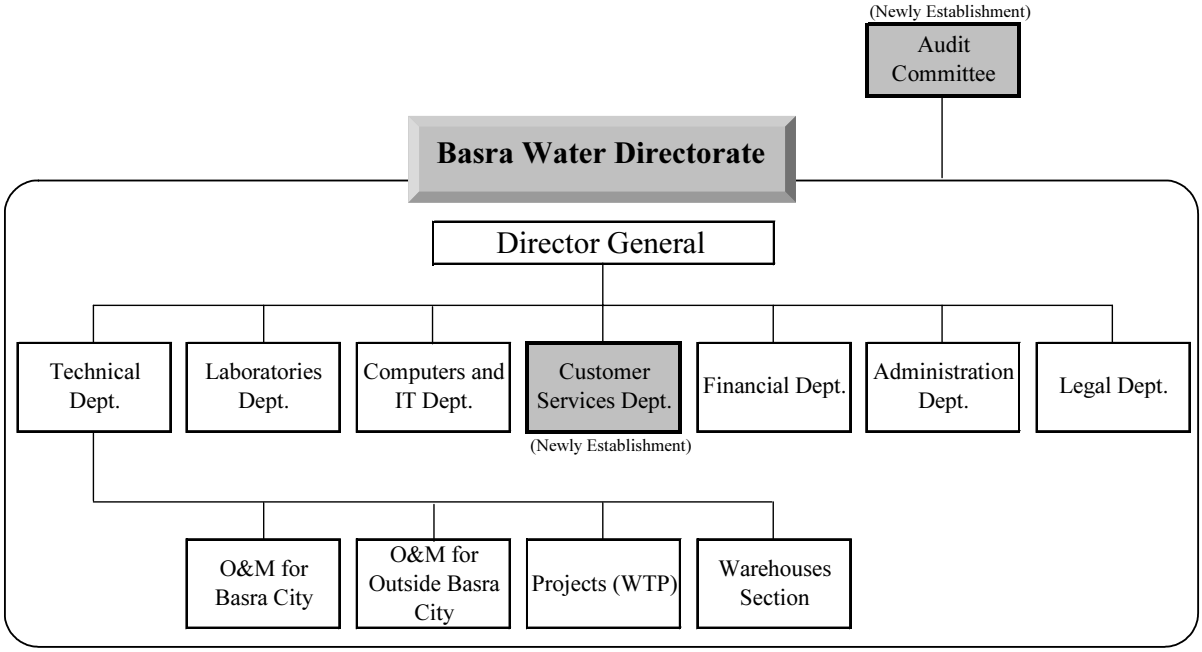


Figure 12.12 Proposed Organization of BWD

Table 12.14 Proposed Responsibilities of BWD by Department

Department	Responsibilities
Technical Dept.	• Prepare maintenance schedules for distribution networks and projects, • Perform the necessary maintenance for leakage in pipes and expansion of distribution pipes, • Design the new distribution networks, • Operate and maintain water treatment plants, the new reservoir and RO, • Operate and maintain the pumping stations, • Produce drinking water, • Supervision of the construction of new water plants and networks, and • Supervision of the construction of new buildings.
Laboratory Dept.	• Monitor the produced water quality in water treatment plants, and • Coordinate with the Environment Dept. and the Health Dept. of Basrah Governorate.
Computer and IT Dept.	• Prepare the programs for the Directorates work (salaries, employees, vehicles, etc), • Operate and maintain the existing computers, • Operate software such as GIS, GPS, and • Develop the programs for the database for registration, maintenance method of pipes and the water distribution management.
Customer Service Dept.	• Registration of customers, • Awareness campaign on payment, • Sales promotion, • Take prompt action on claim, • Customer service relation works, and • Billing and Tariff collection.
Financial Dept.	• Organize daily accounting records, • Organize the yearly audit review for revenues and expenditures and general ledger, • Organize the book records for the different activities including allowances, • Pay salaries for staff, and • Prepare an estimated budget for each year.
Administration Dept.	• Carry out human resources development (capacity building), • Organize the yearly salary raise and incentives, • Issue the orders for hiring, firing, retirement, and transfer, and • Prepare external communications in addition to preparing the reports related to Water Dept. employees.
Legal Dept.	• Organize special contracts for all activities of the Directorate, • Follow on legal cases against the directorate, • Follow on the process of acquisition of lands used for the Directorate projects, and • Check and verify on the legal problems that can occur from and against the Directorate employees.

12.3.3 Capacity Building Measures

The operation and maintenance system should be improved and modernized for efficient and effective O&M through the following capacity building measures focusing on the selected strategies.

(1) Measures for Establishment of Adequate Operation & Maintenance System

After completion of construction works of the project, the BWD staff should operate and maintain the proposed facilities together with existing facilities efficiently and effectively by improved institutional capacity and considering guidelines/manuals prepared by the project consultant and the contractor.

Some of the specific areas for training are listed in Table 12.15.

Table 12.15 Example of Staff Training Needs by Work Area

Subject area	Examples of Training Activity
Technical capacity building	
Water Treatment Plant	・Prevention of contamination ・Monitoring of raw and treated water quality and control of water quality ・Determining correct combination/amount of water treatment chemicals ・Adding and mixing chemicals ・Checking coagulation conditions ・Operation of conventional water treatment and maintenance ・Operation of reverse osmosis and maintenance ・TDS control ・Keeping records
Pumps	・Operation and maintenance of mechanical and electrical equipment ・Keeping records ・Minor repairs
Water transmission main flow management	・Transmission water flow management for distribution zones ・Daily inspection of leakage or damaged portion
Water quality analysis and management	・Determine sampling sites, sample collection ・Determine types of analyses ・Analyze data, frequency of sampling, reaching conclusions ・TDS management
Service reservoirs	・Water level monitoring and control ・Keeping and analysis of records
Distribution lines	・Daily inspection of leakage or damaged portion ・Repair of defects, collecting and recording data
Service lines	・ditto
Water leaks and non-revenue water control	・Training on water leakage detection using modern equipment ・Preparation of annual leakage reduction plan ・Gathering, recording and analysis of data
Repairs of mechanical / electrical gadgets	・Up grade repairing skill ・Basic records and data analysis
Meter repair	・Detecting problems and repairing meters using modern techniques
Non-technical capacity building	
Data collection, checking and editing, summarizing	・Identify data types ・Develop databases, preparation of formats, data checking
Corporate planning & strategy	・Organization vision ・Organization strategy, long-term and short-term plan
Targets & work programming	・Setting targets ・Program preparation to achieve targets ・Monitoring, program review, evaluation
Information & communication materials	・Determine subjects, types of materials for different situations, using IE materials
Store management & inventory control	・Store management principles ・Inventory control ・Creation and operation of computer-aided inventory system
Customer & client management	・Preparation of customer databases ・Identify data types, customer/client feedback ・Complaints management and recording
Data analysis & reporting	・Data analysis, preparation of tables, reporting

(2) Database Development and Management

In principle, basic data and information important for management of the water supply system are records (ie. numbers of customers, number of meters, population, number of industries, etc.) and information on figures and objects (drawings, maps and plans).

1) Registration system of customers

The development of a customer database should be a priority. In this regard, it is necessary to identify data needs, design proper formats for data collection and continuously update the collected data. The database should cover all customers. It should produce information such as names, addresses and phone numbers. The paid customers should be identified in details such as the customer type of water connection. The database should also cover customer complaints and how well the complaints are handled. These databases should be continuously updated as new and revised data are gathered.

- Customer information
- Type of water use (domestic use/ commercial use/ industrial use / public use)
- Estimated / metered water consumption volume
- Payment conditions of tariff (performance of payment, payment amount, etc.)

2) GIS application for water supply management

The GIS system can be utilized for efficient operation and maintenance of the water supply system. It is proposed to develop GIS system for the water supply management. The GIS system will contribute to the following tasks:

- Maintenance of the network pipes
- Leakage control
- Estimation of water consumption
- Water distribution (water flow) management
- Customer registration data storage

(3) Measures for Ensuring Adequate Budget for O&M

It is recommended that the financial management be improved for ensuring adequate budget for O&M. The following measures shall be taken by BWD.

1) Improvement of tariff collection system

The current ratio of tariff collection is estimated to be only 30-35% due mainly to an insufficient billing system and inadequate tariff collection system. The following measures are recommended to

increase tariff collection:

Table 12.16 Recommended Measures for Tariff Collection System

Causes of Low Tariff Collection	Recommended Measures	Target
• Unfair tariff charge	• Introduction of metering system	BWD
• No incentives system for collectors	• Introduction of incentives system (bonus system) for collectors	Collectors
• Illegal connections	• Introduction of strict penalty	Customers
• Lack of awareness campaigns on importance of duties for payment	• Implementation of awareness campaign	BWD staff

2) Establishment of Audit Committee (AC)

The audit system for financial statement of BWD shall be established to ensure transparency and accountability. The Audit Committee (AC) is proposed as an auditing unit as shown in Figure 12.12. The members of the committee are preliminarily proposed as follows:

- Director General of BWD
- Director of Technical Department of BWD
- Director of Financial Department of BWD
- Chairman of Governorate Council of Basrah Governorate (BG)
- Governor of Basrah Governorate (BG)
- Representative of Committee Member of Anti-Corruption Unit of Basrah Governorate (BG)

The auditing for financial statement such as annual revenue and expenditure, and revenue from tariff collection should be carried out by the committee periodically.

(4) Customer and Clients Relations / Management and Information and Education Materials

Customers are the primary beneficiaries of the water supply program. They contribute to the revenue of the department to be utilized in the management of facilities. Hence, the relationship between customers and department should be managed so that both groups benefit from each other.

Information and education materials should be designed to provide information (connection procedures, regulatory matters, billing procedure, new water tariffs, etc.) and to educate (proper water habits, methods of water saving, cleaning water facilities, value of free water, etc.) water customers. These materials will have a positive impact on developing an informed group of customers and clients. The result would be the improved management of the supply system including its O&M. It is proposed

that following actions are undertaken:

- Identify important subjects for the preparation of IE materials. Include areas such as the present status of water supply system and the proposed improvements to water supply
- Develop potentially useful education/communication materials (ie. posters, leaflets, brochures, etc.) to provide publicity and to educate stakeholders
- Plan to distribute materials in customer educational program.

12.3.4 Capacity Building Programs

The training needs assessment is the significant tool to assess requirements of the training as well as the facilities available for training within the department. The proper identification of training needs including facilities is a fundamental requirement before the design of a package of training to suit staff at different levels of the department. Hence, the training needs assessment becomes a very high priority in the early phase of the project. The training needs assessment will identify details including what different types of training can be provided in-country vis-a-vis overseas.

The components of the required capacity building programs preliminarily identified in this study together with their objectives are summarized in Table 12.17.

Table 12.17 List of Required Training Programs

No.	Programs	Objectives	Corresponding Strategy
1.	Operation and maintenance (O&M) for water production and distribution	Improve the skills needed for O&M of water supply facilities as follows: • Training on the guidelines and manuals for efficient O&M of the water supply facilities (water treatment plants, pumping stations, reservoirs and network pipes) and its proper operation. • Training on water distribution management. • Training on metering system.	D
2.	NRW control (technical)	Improve skills needed to minimize technical NRW as follows: • Training on leakage control method. • Training on method to reduce the illegal connection.	D&E
3.	NRW control (non technical)	Improve skills needed to minimize non technical NRW as follows: • Training on awareness method to reduce the illegal connection.	E
4.	Customer service relations	Improve the handling of all requests from customers and promote PR.	E
5.	Awareness campaign for tariff collection	Improve the condition of tariff collection. • Training on how to carry out the awareness campaign on significance of payment	E
6.	Sales promotion	Improve the condition of tariff collection. • Training on how to carry out the sales promotion for water.	E
7.	Financial management	Improve the financial management system. • Financial accounting • Managerial accounting • Budget management	E
8.	Computer and GIS training	• Learning basic computer skills for daily work	D&E

12.4 COST ESTIMATION AND IMPLEMENTATION PLAN

12.4.1 Condition of Capital Cost Estimation

(1) Conditions and Assumptions for Cost Estimation

The capital cost was estimated based on the conditions and assumptions as explained in Table 12.18.

Table 12.18 Conditions and Assumptions for Cost Estimation

Item	Conditions and Assumptions
1) Price Level	・ The price level is of June 2006.
2) Foreign Exchange	・ The exchange rate was set as follows. US$ 1.0 = ID1475 = JPY112 as of June 2006.
3) Implementation Schedule	・ 2007-2010 Tender Design, P/Q and Tender ・ 2010-2013 Construction
4) Administration expenses	・ Administration expenses were assumed in proportion to the amount of 10 percent of the direct construction cost. ・ Administration expenses were applied and incorporated into local and foreign currency portions. ・ Security cost for transportation was applied and incorporated into foreign currency portion. ・ Security cost for construction site was applied and incorporated into local currency portion. ・ Insurance for transportation of imported equipment and materials was applied and incorporated into foreign currency portion. Insurance for construction was applied and incorporated into local currency portion.
5) Price contingency	・ Price contingency was provided to cover price escalation in Iraq and foreign countries, where imported equipment and materials are manufactured. ・ 9.0 percent per annum of price contingency was applied for the local currency portion. ・ 1.7 percent per annum of price contingency was applied for the foreign currency portion.
6) Physical contingency	・ Physical contingency was provided to cover minor differences in actual and estimated quantities, omissions of minor items of work incidental, difficulties unforeseeable at the site, possible changes in plan, and other uncertainties. ・ 20 percent of the direct construction cost, administration expenses, and engineering cost was applied for both of the local currency and foreign currency.
7) Tax and Duty	・ Custom Duty 5 percent of CIF Basrah prices of foreign procurements (Pipes, Fittings equipment, electric panel and etc) was incorporated ・ Tax 10 percent of the direct construction cost and administration expenses was applied.
8) Engineering Cost	・ 11 percent of the direct construction cost was applied.

(2) Implementation Schedule of the Priority Project

The priority project is planned to start at selection of consultant in 2007 and to be completed in 2013. The implementation of the project is planned in a manner to ensure the proper execution of the work considering the construction conditions including contractors and suppliers, procurement of materials and labor force, the manner of procurement of materials, and the manner of construction. As a result, the implementation schedule was prepared as shown in Table 12.19.

Table 12.19 Proposed Implementation Schedule for Priority Project

Item	2007		2008		2009		2010		2011		2012		2013	
Loan Arrangement														
Selection of Consultant														
Detailed Design														
Tendering														
Rehabilitation of Distribution Network														
Rehabilitation of WTP														
Construction of Transmission System														
Construction of Water Treatment Plant														
Strengthening of Distribution Network and Zoning														
Construction of RO Plant														

(3) Direct Construction Cost

The direct construction cost of pipeline was estimated by using the same unit cost as WSPCB and the construction cost of water treatment plant and transmission facilities was estimated based on components of facilities planned in the section 12.2.

12.4.2 Estimated Capital Cost

The estimated costs for the proposed project are summarized in Table 12.20.

Table 12.20 Capital Cost Estimation

(US$)

No.	Items	L.C.	F.C.	Total
1.	Direct Construction Cost			
1-1	Rehabilitation of Distribution Network	9,895,000	11,193,000	21,088,000
1-2	Rehabilitation of Water Treatment Plant	995,000	6,360,000	7,355,000
1-3	Construction of Transmission system	24,334,000	54,935,000	79,269,000
1-4	Construction of Water Treatment Plant	23,351,000	34,179,000	57,530,000
1-5	Restructuring Distribution Network and Zoning	3,774,000	7,191,000	10,965,000
1-6	Construction of Reverse Osmosis Plant	5,052,000	89,940,000	94,992,000
	Sub-total (1)	67,401,000	203,798,000	271,199,000
2.	Administration Expenses	15,813,000	31,764,000	47,577,000
	Sub-total (1) + (2)	**83,214,000**	**235,562,000**	**318,776,000**
3.	Tax and Duty	42,068,000	0	42,068,000
4.	Engineering Cost	13,555,000	29,224,000	42,779,000
5.	Price Contingency	54,021,000	24,575,000	78,596,000
6.	Physical Contingency	27,447,000	52,027,000	79,474,000
	Total	**220,305,000**	**341,388,000**	**561,693,000**

Note: L.C. means local currency portion and F.C. means foreign currency portion.

The yearly implementation cost of the project was estimated as given in Table 12.21.

Table 12.21 Yearly Implementation Cost of Priority Project

(Million US$)

Item	2008	2009	2010	2011	2012	2013	Total
(1)+(2) Direct Cost + Administration Expenses	0.0	0.0	16.9	110.9	94.1	96.9	318.8
(3) Tax and Duty	0.0	0.0	2.1	14.6	12.5	12.9	42.1
(4) Engineering	0.8	8.0	8.7	9.0	7.9	8.4	42.8
(5) Price Contingency	0.0	0.0	3.5	23.2	23.2	28.8	78.6
(6) Physical Contingency	0.0	0.0	4.1	26.8	23.4	25.1	79.5
Total	0.8	8.0	35.3	184.5	161.0	172.2	561.7

The percentage of components of the estimated capital cost were analyzed as shown in Figure 12.13 and that of the estimated direct cost in Figure 12.14. The direct construction cost and administration expenses occupy 57 % of the total cost. Thirty-five percent of the direct construction cost is occupied by RO plant, 21 % by water treatment plant and 29 % by construction of transmission system.

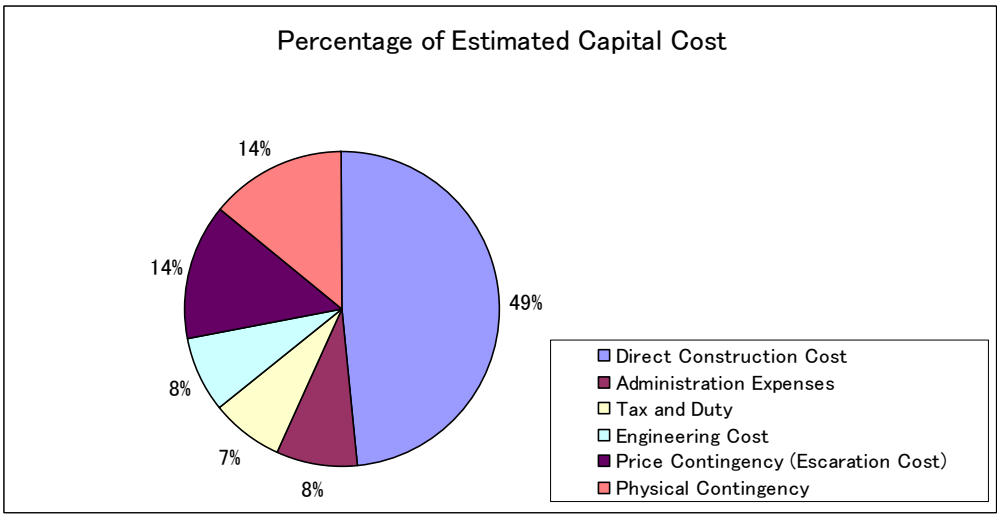


Figure 12.13 Percentage of Components of Capital Cost

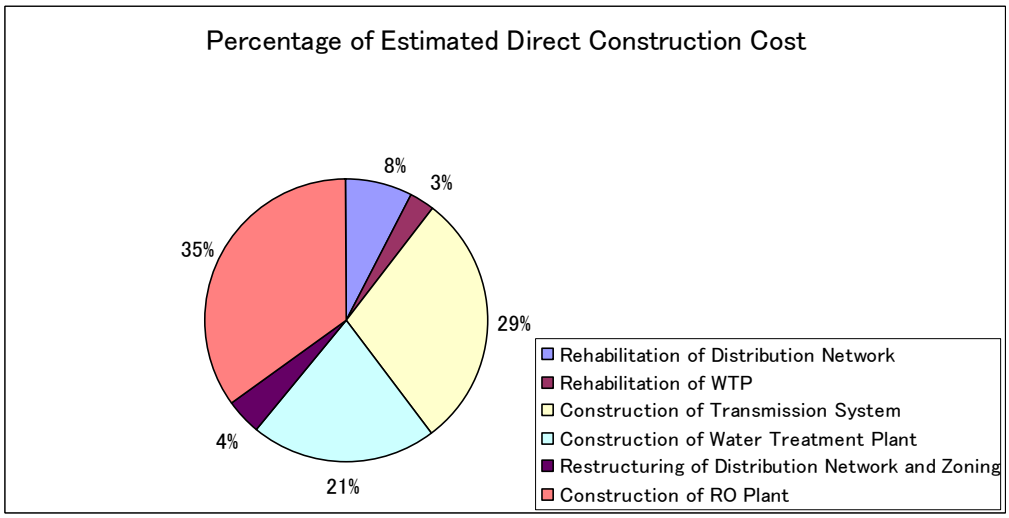


Figure 12.14 Percentage of Components of Direct Construction Cost

12.4.3 Operation and Maintenance Cost of Priority Project

(1) Conditions and Assumptions for Operation and Maintenance Cost Estimation

Based on the same conditions of cost estimation as WSPCB, the annual operation and maintenance cost of BWD for the priority project for 2015 was estimated as shown in Table 12.22. The operation and maintenance costs covering Central Basrah for 2015 as well as the entire Basrah Governorate were estimated.

The current average hours of power supply is 12 hours for water supply facilities in Basrah due to shortage of power. Considering this condition, two cases were prepared for estimation of operation and maintenance cost. It is assumed that the existing condition will continue in future in the case 1 and the power supply conditions will be improved in future in the case 2.

Table 12.22 Operation and Maintenance of BWD after the Implementation of Priority Project

(Million US $)

Item	Entire Basrah Governorate		Central Basrah	
	Case 1	Case 2	Case 1	Case 2
	Generator : 12 hrs use	Generator : No use	Generator : 12 hrs use	Generator : No use
Salary	7,430	7,430	5,040	5,040
Operating budget	543	543	429	429
Electricity	11,801	505	11,704	418
Consumable (Chemicals for WTP)	1,505	1,505	1,177	1,177
Consumable (Chemicals for RO)	2,105	2,105	2,105	2,105
Consumable (Membrane)	5,541	5,541	5,541	5,541
Other consumables(Maintenance)	3,269	3,269	2,583	2,583
Others	74	74	48	48
Total (Million ID/year)	32,268	20,972	28,637	17,341
Total (Million UD$/year)	21.5	14.0	19.1	11.6

Note:
Other consumables indicate purchases for fuel, electricity, spare parts and stationary
No price escalation is considered.
Others indicate purchase of machinery, vehicles, furniture

12.4.4 Capacity Development Program Cost

The capacity development programs are essential components to ensure the sustainability of the water supply bodies and the sustainable implementation of the priority project. The required program components were identified in the previous chapter. To implement these programs, the training schedule and required input are proposed as shown in Table 12.23 and Table 12.24. The required total man-months are 252 for the foreign consultants and 504 for the local consultants.

Table 12.23 Proposed Implementation Schedule for Capacity Building Programs

No.	Program	2008	2009	2010	2011	2012	2013
1	O&M for water production and distribution						
2	NRW control (technical)						
3	NRW control (non technical)						
4	Customer service relations						
5	Awareness campaign						
6	Sales promotion						
7	Financial management						
8	Computer and GIS training						

Table 12.24 Necessary Training Periods and Input of Foreign and Local Consultants

No.	Programs	Necessary Training Periods	Foreign Consultants (MM)	Local Consultants (MM)
1.	O&M for water production and distribution	3 years	78	156
2.	NRW control (technical)	3 years	48	96
3.	NRW control (non technical)	3 years	30	60
4.	Customer service relations	1 years	12	24
5.	Awareness campaign	6 years	24	48
6.	Sales promotion	2 years	24	48
7.	Financial management	1 years	12	24
8.	Computer and GIS training	2 years	24	48
	Total		**252**	**504**

To implement the capacity development programs, the following equipment is required.

- Computer sets and GIS software
- Leakage equipment
- New computer billing system

Based on the required man-month inputs and equipment, the capacity development costs are estimated as given in Table 12.25 with an yearly cost schedule. The total required cost is 13.6 million US$.

Table 12.25 Estimated Cost for Institutional Capacity Building

(Million US$)

Item	Total			2008		2009		2010		2011		2012		2013	
	total	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
Inst. Cap. Bdg.	12.6	5.0	7.6	1.3	1.9	1.7	2.5	1.2	1.8	0.1	0.1	0.1	0.1	0.7	1.1
Computers and GIS	0.30	0	0.3			0.3									
Leakage equipment set	0.70	0	0.7			0.7									
Equipment total	1.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	13.6	5.0	8.6	1.3	1.9	2.7	2.5	1.2	1.8	0.1	0.1	0.1	0.1	0.7	1.1

Note: Estimation conditions:
Foreign component: 30,000 US$ per man-month
Local component: 10,000 US$ per man-month
Computers and GIS: Lump Sum
Leakage detection equipment: 220,000 US$/set

12.5 PROJECT EVALUATION

12.5.1 Benefits and Costs of the Project

(1) Project Benefits

The following table summarizes the issues of the existing water supply, existing conditions of the water supply and the project benefits.

Table 12.26 Benefits of the Proposed Projects

Issue	Existing Conditions (Without Project)	Benefits (With Project)
Inadequate water supply quantity (Low pressure)	・The current actual water consumption is very low due to leakage and insufficient water treatment capacity ・The average service pressure is negative to about 5 m, depending on the area.	・Per capita water consumption of 300 l/ca/day for Basrah municipality, 260 l/ca/day for Al Hartha center and, 200 l/ca/day for Al Hartha rural is assured. ・Average water demand will be met but in peak demand period minor shortage may occur. ・Service pressure will be at least 15 m in the entire project area.
Inadequate water supply hours	・Less than 6 hr/day for 41 % of the surveyed households and 6 - 12 hr/day for 25 %	・24 hours continuous supply basically, but at peak hour in peak demand period some shortage may occur ・Equitable water transmission for the entire project area by efficient water transmission management.
Problems of water supply quality (Taste or high TDS)	・SWC: 670 mg/l ・SAA: 1,500 mg/l	・Average: 894 mg/l (after mixing) SWC: 670 mg/l SAA: 1,500 mg/l RO water: below 200 mg/l
Problems of water supply quality (Color, turbidity and odor)	・The treated water of most of the treatment plants exceeds the water quality standards in turbidity and color. The treated water of 43 % of the water treatment plants contains E. Coli and is inappropriate for domestic use.	・The water treatment plants will produce the treated water that meets the standards. ・The service pressure will be positive and leakage will be repaired so that contamination in pipes will be eliminated.
Inappropriate maintenance of facilities	・The capability of O&M is low in treatment and leakage control.	・The capability of O&M will be improved.
Insufficient income	・The current level of revenue water ratio is low, resulting in low level of income	・NRW will be reduced and income will be increased.

(2) TDS Improvement

TDS of the supplied water was estimated as shown in Figure 12.15 based on the flow regime, TDS of water sources and RO treated water. The average TDS in the project area is estimated as 894 mg/l.

However, if the per capita water demand is reduced by 10 % and 20 % and the water treatment plants having Shat Al Arab river as water source are not used, the average TDS will be 825 mg/l and 725 mg/l, respectively. In these cases, the water demands after reduction will be 270 and 240 l/ca/day, which are still sufficient water amount for human consumption comparing with that of other countries.

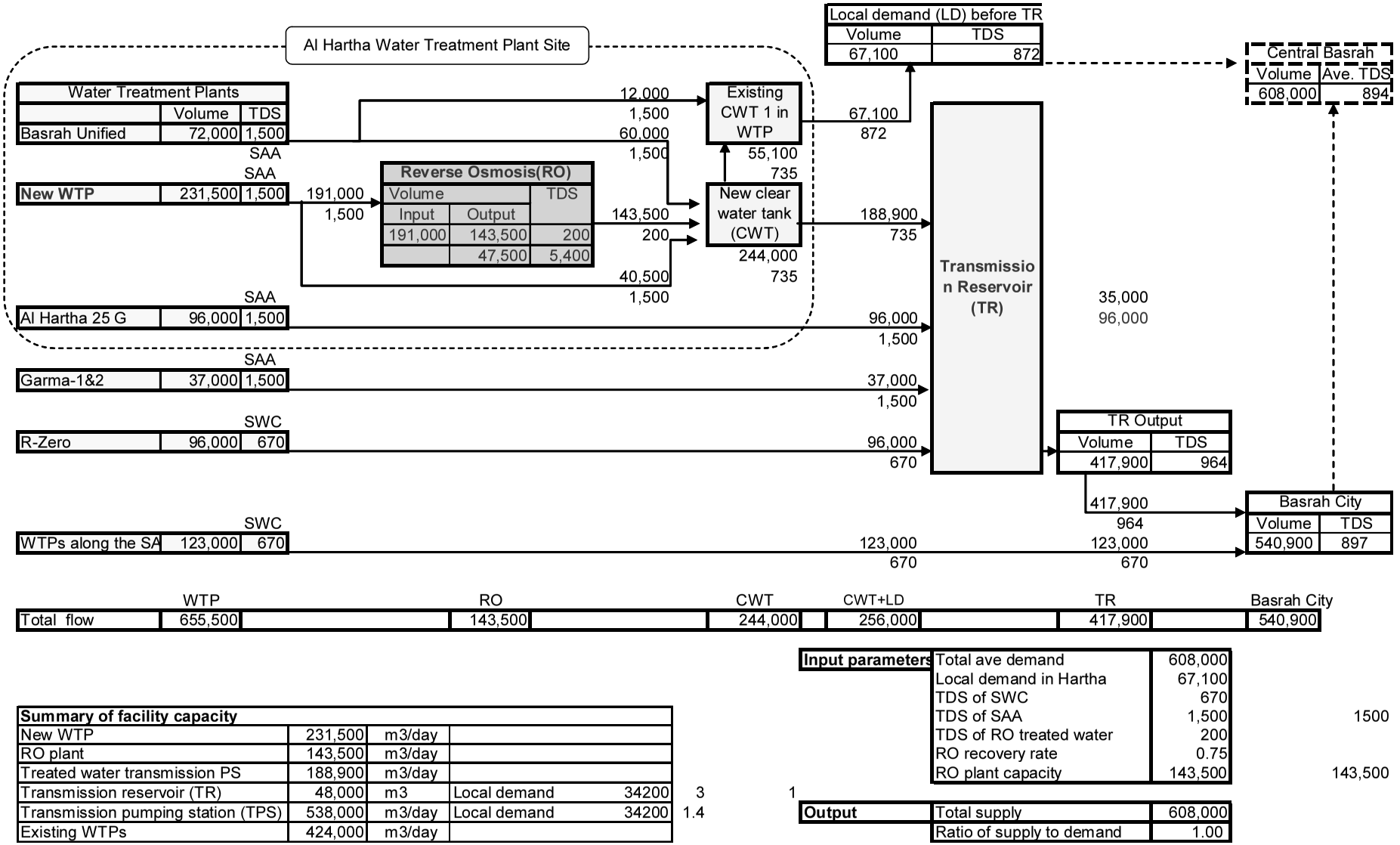


Figure 12.15 Design Flow Balance (m^3/day) in Water Supply System in Basrah District and Estimated TDS Concentrations (mg/l) (Priority Project)

(3) Customer's Satisfaction

Based on the results of socio-economic survey and the concept of satisfaction contribution factors that was introduced in evaluating WSPCB, customer's satisfaction by the priority project are evaluated as shown inTable 12.27. Assuming the improvement degree of this project as shown in the table, total improvement ratio or total customer satisfaction ratio is calculated as 81.3 % for the priority project. It means that if the current satisfaction is zero, this project contributes to increasing customer's satisfaction to 81 %. The customer's satisfaction will reach to 100 % if the stage 5 of the WSPCB is implemented.

Table 12.27 Calculation of Customers' Satisfaction by Priority Project

Service Item	The ratio of respondents who complained *	Satisfaction contribution factor	Assumed improvement degree by service item (%)	Total improvement (Customer satisfaction) (%)
Amount /pressure	94 %	21.8%	80	17.4
Service hours	67 %	15.5%	80	12.4
Turbidity	89 %	20.6%	100	20.6
Taste (salinity)	97 %	22.5%	50	11.2
Smell	85 %	19.7%	100	19.7
Total	-	100.0%	-	**81.3**

* JICA study team socio-economic survey

(4) Project Cost Base

The total project cost in terms of yearly implementation is given in the following table and the operation and maintenance costs are summarized in Table 12.22.

Table 12.28 Cost Basis of the Priority Projects

(Million US$)

Item	2008	2009	2010	2011	2012	2013	Total
Construction works							
Direct Cost + Administration Expense	0.0	0.0	16.9	110.9	94.1	96.9	318.8
Tax and Duty	0.0	0.0	2.1	14.6	12.5	12.9	42.1
Engineering	0.8	8.0	8.7	9.0	7.9	8.4	42.8
Price Contingency	0.0	0.0	3.5	23.2	23.2	28.8	78.6
Physical Contingency	0.0	0.0	4.1	26.8	23.4	25.1	79.5
Total for Construction	0.8	8.0	35.3	184.5	161.0	172.2	561.7
Capacity building program	3.2	5.2	3.0	0.2	0.2	1.8	13.6

12.5.2 Financial Evaluation

(1) Calculation conditions and cases for analysis

The same analysis conditions as WSPCB were adopted for financial analysis for the priority project. In the analysis, following options regarding input of subsidy to the project in addition to the generator use option are considered with following grounds:

<table>
<tr><td>Input of Subsidy</td><td>• The northern and central parts of Iraq do not suffer from high TDS.
• Only the southern part of Iraq suffers from high TDS water supply.
• The TDS increase in the rivers is caused by discharge of salinity contents at the upstream area, i.e., northern and central part of Iraq.
• As national policy concerns, or considering the equity of the entire Iraqi citizens, measures to decrease TDS to the equitable level should be undertaken by the central government.
• Therefore, the study team recommends that the costs relating to reverse osmosis (RO), a TDS reduction measure, should be covered by government subsidy in line with national policy.
• Following options are considered in analysis.
Option 1: Without government subsidy for the costs related to RO
Option 2: With government subsidy for the costs related to RO</td></tr>
<tr><td>Generator Use</td><td>• Currently, the normal power supply is carried out only for half a day. Therefore, following two options are considered in analysis.
Option 1: 12 hours of generator use
Option 2: No generator use assuming the power supply condition will be improved in near future</td></tr>
<tr><td>Estimated Subsidy by generator use</td><td>(billion ID/year (million US$/year))
<table><tr><td></td><td>Total O&M cost</td><td>RO O&M cost for subsidy</td><td>Other O&M cost</td></tr><tr><td>With using generator</td><td>28.7 (19.1)</td><td>14.0 (9.3)</td><td>14.7 (9.8)</td></tr><tr><td>Without using generator</td><td>17.4 (11.6)</td><td>7.8 (5.2)</td><td>9.6 (6.4)</td></tr></table></td></tr>
</table>

Table 12.29 shows the cases that were evaluated. Case 3 and Case 4, in which the capital and operation & maintenance cost for RO are covered by subsidy, were evaluated. Table 12.30 shows the calculation conditions. The detailed calculation sheets by case are attached in Appendix J.

Table 12.29 Cases to be Evaluated

Item	Case 1	Case 2	Case 3	Case 4
(1) Subsidy for Reverse Osmosis (Capital & OM cost)	Without		With	
(2) Hours of generator use	12 hours	0 hours	12 hours	0 hours

Table 12.30 Conditions of Financial Evaluation

Item	Value/explanation/formulation
Project life	40 years
Feasible FIRR criteria	More than 10 % is preferable
Discount rate for NPV and B/C ratio	10 %
Unit of water tariff	It is assumed that water meters will be installed for all customers by 2015 and the water will be sold by the volume consumed. Therefore, the unit of water tariff in the calculation should be ID/m^3, not ID/household, which is the current unit of tariff.
Water tariff level	The current water tariff level by revenue water volume was calculated based on the estimated total revenue water volume and the current total revenue from the tariff. The estimated volume tariff value is 11.1 ID/revenued-m^3, or 0.0074 US$/revenued-$m^3$. Assuming 360 l/day for per capita consumption, The current water tariff level is 0.12 % of the average household income.
Tariff collection rate	The tariff collection rate will improve from the current 35 % to 60 % in 2015 and 75 % in 2025 and after.
Project revenue	0.0074 US$ x additional revenue water volume (revenued-m^3) by the project
Project capital cost	Direct construction cost, Administration expenses, tax & duty and Engineering cost
Project O&M cost	Additional O&M cost
Project replacement cost	This cost will be spent every 15 years after the completion of the construction of Project

(2) Financial analysis for full cost recovery (capital and operation and maintenance costs)

Financial indicators were calculated assuming the total project costs comprised of capital and operation & maintenance costs should be recovered from water charge collection only. The results of calculation of financial indicators are summarized in Table 12.31.

The estimated water tariffs which return more than 10 % of FIRR vary from 4.0 % to 6.9% of the average household income. For the lowest, in the case 4, to obtain 10 % of FIRR, 4.0 % of the household income should be spent for water service. This is not feasible to realize the project.

In the case of existing tariff level, the FIRRs of two options become negative and the projects are judged as financially unfeasible. To make the project feasible, or to obtain more than 10 % of FIRR, the water tariff or the average expense for water supply service of household should be 4.0 – 6.9 %. Since the estimated tariff level is higher than the feasible water tariff level, the projects are judged unfeasible considering appropriate water tariff level (2-3 % of household income).

Table 12.31 Calculation Results of Financial Indicators (Full cost recovery)

Case	Water tariff (US$/ revenue-$m^3$)	Net Present value (M US$)	FIRR	B/C ratio	Required tariff level	
					multiple of the current tariff level	% of the household income
Case 1 Without subsidy and with generator	0.0074	-369	-	0.016	1	0.11 %
	0.372	-76	6.9%	0.798	50	5.5%
	0.468	2	**10.1%**	1.005	63	6.9%
	0.743	223	17.3%	1.596	100	11.0 %
Case 2 Without subsidy and without gen.	0.0074	-328	-	0.018	1	0.11 %
	0.372	-35	8.6%	0.895	50	5.5%
	0.416	1	**10.0%**	1.002	56	6.2%
	0.743	215	16.1%	1.560	100	11.0 %
Case 3 With subsidy and with gen.	0.0074	-227	-	0.026	1	0.11 %
	0.290	0	**10.0%**	0.999	39	4.3%
	0.372	66	13.4%	1.281	50	5.5%
	0.743	365	25.4%	2.561	100	11.0 %
Case 4 With subsidy and without gen.	0.0074	-209	-	0.028	1	0.11 %
	0.267	0	**10.0%**	1.001	36	4.0%
	0.372	84	14.3%	1.390	50	5.5%
	0.743	383	26.1%	2.780	100	11.0 %

(3) Financial analysis for cost recovery of operation and maintenance cost

In Iraq, as the water supply bodies are heavily subsidized from the central and local governments and the water tariff is set at a very low level, the water supply bodies have not been able to cover their operation and maintenance costs by the revenue collected from water charge.

As shown in the results of the calculation above, the projects were judge unfeasible if both the capital and operation & maintenance costs should be recovered by the revenue collected from the water charge. In this section, therefore, financial analysis is carried out to estimate water tariff level from which operation and maintenance cost is recovered. In the analysis, the following 2 options of generator use are used considering the current water supply conditions stated in previous chapter. In this case, FIRR is not calculated since there is no capital investment. The results of calculation are shown in Table 12.32. In the analysis, 4 cases, the same cases as shown in Table 12.29, were evaluated.

Table 12.32 Results of Financial Indicators (O&M cost recovery)

Case	Description	Water tariff (US$/ revenue-$m^3$)	Required tariff level	
			multiple of the current tariff level	% of the household income
Case 1	Without subsidy and with generator	0.126	17	1.9%
Case 2	Without subsidy and without generator	0.104	14	1.5%
Case 3	With subsidy and with generator	0.067	9	1.0%
Case 4	With subsidy and without generator	0.059	8	0.9%

As commonly understood, feasible tariff level for sanitation service including water supply and wastewater disposal is less than about 2 -3 %. This priority project deals with only improvement of water supply service. Therefore, 1- 2 % of the household income may be feasible for water tariff. The case 3 and case 4, in which the operation & maintenance costs of reverse osmosis are covered by subsidy, are preferable condition for the implementation of the project considering the current low tariff level. These tariff levels are equivalent to 8 - 9 times of the current tariff and are almost same as the willingness to pay for the improved service obtained from the socio-economic survey results by the study team.

12.5.3 Economic Evaluation

Based on the same analysis condition as in WSPCB, economic analysis was carried out and the results are summarized in Table 12.33 and the detailed calculation sheets by case are attached in APPENDIX J. The EIRR of the priority project is calculated as 5.5 % if the willingness to pay for the improved water supply service is 3 % of the average household income. As the EIRR is more than 5 %, the priority project is judged economically viable although the EIRR is not at preferable level (more than 10 %).

Table 12.33 Results of Economic Evaluation

Cases	Value (US$/capita/month)	EIRR
1. Willingness to pay for the improved service (1 % of the household income)*	0.73	Negative
2. Willingness to accept the compensation (2 % of the household income)	1.41	Negative
3. Willingness to accept the compensation (3 % of the household income)	2.11	5.5 %

Note: * the result of JICA socio-economic survey.

12.5.4 Conclusions and Recommendations

These findings conclude that the implementation of the project is financially not feasible in condition of the full cost recovery including the capital and operation & maintenance cost. Therefore, it is recommended that the central and local governments subsidize capital cost until the water supply service of BWD is well developed. As a national water supply policy, or considering the equity of entire Iraqi citizen with respect to salinity in supplied water, operation & maintenance cost related to the reverse osmosis plant should preferably be covered by subsidy.

The economic analysis identified that the project may be economically viable in case that the willingness to pay for improved service is equivalent to the 3 % of the household income.

The current willingness to pay for improved water supply service is 1 % of the household income. The willingness to pay would probably improve depending on the awareness or understanding of customers on the water supply service. To make the project more viable, therefore, the awareness and the willingness to pay should be enhanced by information, education and communication (IEC) activities by BWD.

Also there is possibility that other unmeasured economic benefits or indirect benefits such as health condition improvement are not included in this analysis. If these benefits are included, the project will become more viable.

12.5.5 Technical Evaluation on Priority Project

In the components of the priority project, reverse osmosis (RO) requires advanced and special technology for operation and maintenance and the other components use ordinary technology of water supply. Therefore, a technical evaluation is made focusing on RO technology. The following table describes the results of the technical evaluation and recommendations made to follow up the results.

Table 12.34 Results of Technical Evaluation

Item	Evaluation result	Recommendations
Selection of RO treatment process	RO plant requires pre-treatment such as multi-layer filters, activated carbon process or ultra-filtration. Furthermore, appropriate membrane type and the number of banks of RO should be decided according to the raw water quality.	The detailed process and capacity of RO should be decided through detailed investigation of water quality of the Shat Al Arab and a pilot project for 1 year is recommended.
RO operation and maintenance	RO plant needs high expertise in O&M. BWD does not have enough expertise on RO treatment process. Therefore, currently, the operation and maintenance of many small RO plants in Basrah is contracted out to private companies.	Introduction of RO should meet the following conditions: ・Appropriate operation of conventional water treatment plants to produce RO feed water. ・Acquiring of required operation and maintenance technology of RO. ・Securing of operation and maintenance budget for RO plant. These shall be brought about through the institutional capacity building programs.
		Contracting out of operation and maintenance of a large scale RO plant should also be considered as an option.
Cost of RO water	RO plant produces expensive water and cannot be operated at the current level of budget including subsidy and revenue from water charge.	・The budget level of BWD shall be improved through appropriate water charge collection, etc. ・Non-revenue water shall be reduced through reduction of leakage and illegal connection, etc. ・RO water shall be priced appropriately. ・Water demand shall be reduced through installing customer meters and appropriate pricing.
TDS concentration of supplied water	There is a concern about the improved TDS level, or 894 mg/l on average in the project area, whether or not the customers will be satisfied with this level of TDS for drinking and cooking.	To start the project, customer's satisfaction in terms of TDS concentration should be explained.

12.5.6 Initial Environmental Evaluation for Priority Project

According to the Environmental Guideline for Infrastructure Projects (JICA, 2004), potential environmental impacts by the implementation of the priority project were identified based on the results of screening, field surveys and data collection at the sites which were carried out by a local subcontractor.

(1) Components of Priority Project

The proposed components for the priority project are described in sections 12.1 and 12.2 and the

locations of the proposed facilities are shown in Figure 12.1.

(2) Identification of Potential Environmental Impacts

The potential environmental impacts of the priority project are evaluated using the checklist, in which 34 social, natural and pollution aspects are included. The results are shown in Table 12.35 and the following possible impacts are preliminarily identified.

1) Resettlement of residents may be required in case of land acquisition of the project sites. Land use and economic activities in the surrounding area of project site may be affected.
2) The existence of cultural heritages should be checked.
3) The project sites are located in the urban area of Basrah. The construction vehicles and machinery may affect traffic, and cause noise, vibration and dust in the surrounding areas of project sites and roads during the construction period.
4) When the existing pipe is replaced, it may cause health hazard of workers during cutting, transporting and disposing of asbestos cement pipe (ACP).
5) The wastewater discharged from RO plant may cause pollution of the river environment.

Table 12.35 Preliminary Screening Check List

No	Item	Evaluation	Comments
1	Involuntary resettlement	**B**	Project site is planned in urban area of Basrah.
2	Local economy such as employment and livelihood etc.	**N**	Positive impact on local employment.
3	Land use and utilization of local resources	**B**	Land use and economic activities in the surrounding area of project site may be affected.
4	Social institutions such as social infrastructure and local decision-making institutions	**N**	
5	Existing social infrastructures and service	**N**	
6	The poor, indigenous of ethnic people	**C**	Increase of water rate is required.
7	Misdistribution of benefit and damage	**N**	
8	Local conflict of interests	**N**	
9	Gender	**N**	
10	Children's rights	**N**	
11	Cultural heritage	**C**	It is necessary to check about the existence of a cultural heritage, because the project site is unutilized land.
12	Infectious diseases such as HIV/AIDS etc.	**C**	In the replacement of the existing pipe, it may cause works of cutting, transport and disposal of Asbestos Cement Pipe.
13	Air pollution	**B**	The construction vehicles and machinery may affect traffic, noise, vibration and dust in the circumference of project site and roads during construction period.
14	Water Pollution	**B**	Wastewater from treatment plant (backwashing of filtration) is expected.
15	Soil Contamination	**N**	
16	Waste	**B**	Sludge from treatment plant is expected.
17	Noise and Vibration	**B**	Same as "Air pollution"
18	Ground subsidence	**N**	
19	Offensive Odor	**N**	
20	Geographical features	**N**	
21	Bottom sediment	**N**	
22	Biota and ecosystem	**N**	
23	Water usage	**N**	
24	Accidents	**B**	Leakage of chlorine gas in the treatment plant is considered.
25	Global warming	**B**	Increase of electricity consumption is expected.
26	Others	**N**	
27	National park, protected area designated by the government (coast line, wetlands, reserved area for ethnic or indigenous people, cultural heritage), and areas being considered for national parks or protected areas	**N**	
28	Virgin forests, tropical forests	**N**	
29	Ecological important habitat areas (coral reef, mangrove wetland, tidal flats)	**N**	
30	Habitat of valuable species protected by domestic laws or international treaties	**N**	
31	Likely salts cumulus or soil erosion areas on a massive scale	**N**	
32	Remarkable desertification trend areas	**N**	
33	Archaeological, historical or cultural valuable areas	**C**	Same as "Cultural heritage"
34	Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or special socially valuable areas	**N**	

A – Serious impact is expected
B – Some impact is expected
C – Extent of impact is unknown and examination is needed. Impacts may become clear
N – No impact is expected

(3) Potential Environmental Impacts by Proposed Components

The potential environmental impacts by the proposed component are identified and their significance is preliminarily evaluated as below.

1) Rehabilitation and Restructuring of Distribution Network and Zoning

The potential environmental impacts of rehabilitation of distribution network are as follows:

- Traffic congestion accident during construction stage
- Noise, vibration and dust during construction stage
- Degradation of the living environment by the above-mentioned activities
- Health effect by replacement works and disposal of the existing asbestos cement pipes

Since the rehabilitation work is conducted along roads including community roads, it is possible to disturb the living environment of the residents. The following procedures should be carried out at the detail planning and construction stages with careful examination.

- Sufficient explanation and discussion with residents and community
- Assignment of complaint officers
- Assignment of traffic control staff
- Implementation of an adequate implementation scheme
- Consideration of working hours and construction method, if required

About 15 % of the distribution pipes are asbestos cement pipe (ACP) in the Basrah District and the replacement works of ACP will be required in the rehabilitation of distribution network. It is possible that the scattering of asbestoses causes health hazard to the workers. Therefore, the scattering in the air and exposures to the workers should be minimized as much as possible during the rehabilitation works. The following are the countermeasures for asbestoses health hazard during pipe replacement work.

- The asbestoses affect mostly on respiratory organs but asbestos intake by oral ingestion causes less affect on health. Therefore, the cutting work of ASP that scatters the asbestos should be minimized. When unavoidable, the cutting work should be done in a wet condition spraying water to avoid scattering, and workers should wear a protection mask.
- USAID proposed in the Bagdad water supply project that the aged ACP should not be touched but left buried, and new pipelines should be installed.
- Disposal method of ACP should be further examined and appropriate methods should be determined based on the policy of the relevant environment department.

2) Rehabilitation of the Existing Water Treatment Plants

The rehabilitation work of the existing water treatment plants is carried out within the water treatment

sites. The potential environmental impacts of rehabilitation of the existing water treatment plants are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- Noise, vibration and dust during the construction period
- Degradation of the living environment by the above-mentioned items

Basically, the impacts during the construction work are the same as the rehabilitation of distribution network. Unlike health hazard by replacement of ASP, however, there is no significant potential environmental impact during the construction stage. Also no significant negative impact is expected during the operation of water treatment plants after the rehabilitation work.

3) Construction of Transmission System

a) Transmission Reservoir and Pumping Station

The potential environmental impacts of the constructions of transmission reservoir and pumping stations are as follows:

- Traffic congestion during construction stage
- Noise, vibration and dust during construction stage
- Noise and vibration from pump and generator during operation stage
- Degradation of the living environment by the above-mentioned items
- Damage of cultural heritages and important natural environment

From the results of field survey, it was confirmed that the proposed site is a public land located near the highway intersection (coordinate: 30°32' 16.75''N, 47° 44' 02.06''E) in vacant lots in the desert area (see Appendix K1). Also there is no resident lot and no economic activity in the proposed sites. Therefore, it could be concluded that there will be no impact during the construction work.

The noise and vibration from pump and generator facilities in operation works can be reduced by arrangement of buffer zone and plantation surrounding the buildings.

The locations of cultural heritage in Basrah are shown in Appendix K2. There is no cultural heritage in this area.

b) Transmission Ring Mains

The potential environmental impacts of the construction of the ring mains are as follows:

- Traffic congestion during construction stage
- Noise, vibration and dust during construction stage
- Degradation of the living environment by the above-mentioned items

- Damage of cultural heritages and important natural environment

The degree of these impacts depends on the location of road, or the conditions of roads and the neighborhood along the proposed ring mains. The degree of impacts is evaluated based on the results of field surveys.

The proposed route of the ring mains is shown in Appendix K3. The route was classified into 8 sections according to the conditions of road and the surrounding areas. The characteristics of sections in the ring main are explained in Table 12.36. It was confirmed by site survey that there was basically sufficient space for construction work, and it may not be required to control the traffic during the construction period. The surrounding areas of the route from point-1 to point-4 shown in Appendix K3 are commercial zone, and it may be required that suitable implementation scheme along these route be considered.

As shown in Appendix K2, there is no cultural heritage on the route of the ring mains. Moreover, the construction would be done in the existing roads and any cultural heritage would not be expected.

Table 12.36 Road Conditions along the Route of Ring Mains

Section No.*	Paved / unpaved	Road width	Existence of frontage road	Building density	Remarks
Section-A	unpaved road	1	No	5	The road situation is poor.
Section-B	paved road	4	Yes	3	Trunk road There is bus terminal (Point-4*)
Section-C	paved road	2	Yes	1	Major thoroughfare-community road There are 2 commercial area (Point-1,2*)
Section-D	paved road	1 - 2	No	2	Community road
Section-E	paved road	3	Yes	1	Major thoroughfare
Section-F	unknown			-	There is no road
Section-G	paved road	2 - 3	Yes	1	City major thoroughfare-trunk road
Section-H	paved road	3	Yes	1	City major thoroughfare-trunk road There is commercial area. (Point-3*)
Road width (including frontage road, road maintenance area and parking space) 1 less than 10 m 2 from 10 to 15 m 3 from 15 m to 30 m 4 more than 30 m					
Building density along road 1 Building density is distributed continuously 2 Continuous in general (between 1 and 2) 3 Dispersive 4 Sparse 5 Almost no building					

Note: *: refer to Appendix K3

4) Construction of New Water Treatment Plant

The potential environmental impacts of the construction of new water treatment plant near the Al Hartha 25 MG and Basrah Unified plants are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- Noise, vibration and dust during construction stage
- Noise, vibration and others during operation stage
- Degradation of the living environment by the above-mentioned items
- Water pollution by discharge of settled sludge of coagulation process
- Leakage accidents of chlorine gas

Based on the results of field surveys, the lands on the north, south and west sides of the existing water treatment plants are private properties. However, the land between Al Hartha 25 MG and Basrah Unified plants is a public land, and this area is recommended as the proposed project site from the field survey (see Appendix K5 and Appendix K6).

Basically, the impacts during the construction work are the same as the rehabilitation of distribution network and it is minor impacts.

The potential environmental impacts during the operation are the same as two existing water treatment plants. Currently, there is no house surrounding the construction sites and the impact is not foreseen. However, the noise and vibration from pump and generator facilities during operation stage can be reduced by arrangement of buffer zone and plantation surrounding the buildings.

The sludge removed from sedimentation basins are discharged to the Shat Al Arab. The contents of wastewater and sludge are the same as the river water but include aluminum sulfate during the coagulation process. Aluminum sulfate is not a harmful substance and therefore, the discharge of the sludge does not affect river environment. However, the discharge will be done once in a half year so that the flux of the sludge one time is large. To reduce the impact to the human activities along the river bank as much as possible, the discharge point should be located to the center of the river.

In water treatment plant, chlorine is used for disinfection of water. If chlorine leaks occur, the workers in water treatment plant and the residents living in the surrounding area would be affected. Adequate safety measures should be considered at planning and operation stages and the emergency plan for accident should be prepared.

5) Construction of RO Treatment Plant

The potential environmental impacts of the construction of RO treatment plant near the Al Hartha 25

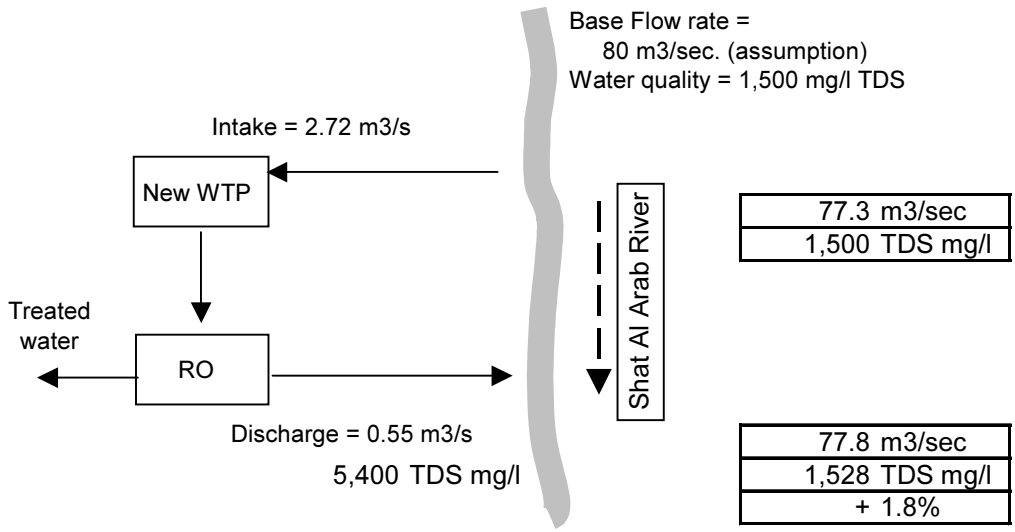
MG and Basrah Unified WTP are as follows:

- Traffic congestion at the time of carrying in and out of construction materials
- Noise, vibration and dust in a construction work period
- Noise, vibration and others in operation works
- Degradation of the living environment by the above-mentioned items
- Damage of cultural heritages
- Water pollution by discharge of wastewater during desalinization process

The RO plant will be located at the same site of the new water treatment plant. Therefore, consideration of the potential environmental impacts during construction works and operation works are same as those for water treatment plant.

The brine from desalination process in RO plant is discharged to the Shat Al Arab. This wastewater contains high salinity (TDS of 5,400 mg/l) which may cause significant impact on the river environment. The increase of TDS concentration was calculated as follows and it was confirmed that the increase (from 1,500 mg/l to 1,528 mg/l) would not give significant impact. Also there is no discharge of sludge from this treatment plant.

Estimation of TDS of the Shat AL Arab after Discharge of RO brine wastewater	
Wastewater from desalination process: TDS concentration: Water volume:	 5,400 mg/l-TDS 0.55 m^3/s
Receiving water body: TDS concentration: Water flow:	Shat Al Arab river 1,500 mg/l-TDS 80 m^3/s (water flow at Amara, 80 – 150 m^3/s as monthly average from 1975 to 2003)
Increase of TDS concentration of the SAA after discharge of wastewater:	less than 1.8 % (1,528 mg/l-TDS)



(4) Conclusions and Recommendations

As a result of the field surveys conducted by the local subcontractor and evaluation carried out by the study team, no significant impact of the priority project was identified but some minor impacts were identified, which is summarized in following table with their mitigation measures.

Table 12.37 Summary of Minor Impacts and Mitigation Measures

Facility	Possible Impact	Mitigation Measures
1. Rehabilitation of network	・ About 15 % of the distribution pipes are asbestos cement pipe in the project area and the replacement works of ACP will be required for the rehabilitation of the distribution network. It is possible that the scattering of asbestoses causes health hazard to the workers.	・ The scattering in the air and exposures to the workers should be minimized as much as possible during the rehabilitation works. ・ The aged ACP should not be touched but left buried, and new pipelines should be installed.
2. Rehabilitation of water treatment plant	・ No significant impact	-
3. Construction of transmission system	・ No significant impact	
4. Construction of new water treatment plant	・ The sludge removed from sedimentation basins are discharged to the Shat Al Arab once in a half year so that the flux of the sludge at a time is large. The contents of the sludge discharged do not affect river environment but the large flux of the discharge may affect the human activities along the river bank downstream.	・ To reduce the impact to the human activities along the river bank as much as possible, the discharge point should be located at the center of the river. ・ The drainage should be carried out in many days.
5. Construction of RO plant	・ The increased TDS concentration by discharge of high concentrated brine water from RO is less than 2 % in the Shat Al Arab and does not affect the river environment.	-
6. Strengthening of distribution mains and zoning	・ No significant impact	-

For smooth implementation of the projects, public and all stakeholders should be involved in the project through stakeholder meetings and public hearings, where the information on the proposed project should be disclosed, stakeholders' opinions should be collected, and consultation with the stakeholders should be carried out.

CHAPTER 13

CONCLUSIONS AND RECOMMENDATIONS ON PRIORITY PROJECT

CHAPTER 13 CONCLUSIONS AND RECOMMENDATIONS ON PRIORITY PROJECT

13.1 CONCLUSIONS

1. The stage 2-4 of the Water Supply Plan for Central Basrah (WSPCB) was selected as the priority project for feasibility study and the proposed facilities were designed with the following estimated capacity:

Facilities	Capacity/Quantity
1. Rehabilitation of network	Dia.110 mm - 700 mm, 285 km
2. Rehabilitation of water treatment plant (WTP)	13 plants in Basrah District
3. Transmission system	
(1) Transmission reservoir (TR)	48,000 m^3
(2) Transmission pumping station (TPS)	538,000 m^3/day x 60 m head
(3) Ring mains and connections	Dia. 600 mm - 2000 mm, 35,200 m
4. New water treatment plant	
(1) Treatment plant	245,000 m^3/day
(2) Treated water pumping station	192,000 m^3/day x 40 m head
5. RO plant	145,000 m^3/day (output)
6. Strengthening of distribution mains and 13 zoning	Dia. 200 mm- 700 mm, 25,100 m

2. In addition, institutional capacity building programs including non-revenue water control programs were selected for priority project to develop the required capacity of Basrah Water Directorate (BWD) to ensure the project sustainability.

3. The target area of the priority project is the same area as in WSPCB and includes the central Basrah comprising Al Basrah district center, Al Hartha center and rural area with the population of 1,257,000 and the average day water demand of 608,000 m^3/day in 2015.

4. The total project cost of the priority project was estimated at 561.7 million US$, and comprised of 318.9 million US$ as direct construction cost and the rest as indirect cost.

5. The current cost of operation and maintenance for the Basrah water supply system is 5 billion ID/annum, out of which only 14 % or 0.7 billion ID was recovered from the water charge. The total project requires 21 billion ID for annual operation and maintenance with normal power supply conditions, and 32 billion ID using onsite generators in the existing power supply conditions.

6. The following project benefits are identified:
   - Satisfaction of the day average water demand (300 l/ca/day for Basra city)
   - Improved service water pressure (15 m at tap)
   - In principle, 24 hours water supply
   - Even water distribution through the entire project area
   - Improvement of water quality except TDS and supply of hygienic water
   - Improvement of total dissolved solid (TDS) concentration of supplied water (on average 894 mg/l from the current 1,500 mg/l of Shat Al Arab river)
   - Improved technical management capacity, financial conditions and customer service of Basrah Water Directorate

7. As a result of financial evaluation of the project, the implementation of the project is financially not feasible in condition of the full cost recovery including the capital and operation & maintenance cost. Therefore, it is recommended that the central and local governments subsidize capital costs until the water supply service of BWD is well developed.

8. As a result of economic evaluation, the implementation of the priority project gives 5.5 % of EIRR in case that the willingness to pay for improved service is equivalent to 3 % of the household income. This value indicates that the project may be economically viable. The project would be more viable if other unmeasured economic benefits or indirect benefits such as improvement of health conditions are also included while considering benefits.

9. According to initial environmental examination, no significant negative impact of the proposed project was identified.

13.2 RECOMMENDATIONS

Based on the conclusions made in the feasibility study, the followings are recommended to increase feasibility of the priority project.

1. The study team could not carry out any site survey in Basrah due to security reasons and the scope of the priority project was prepared under such conditions. Therefore, the result of this study contains some unconfirmed factors. At the detailed design stage, detailed investigation should be carried out to make the project components more reliable.

2. The study team recommends that BWD adopt water demand management policy by means of the installation of water meters with establishment of proper tariff system, leakage control and encouragement of water saving. The demand control policy could give the following additional

benefits to the project.

- Efficient use of water by reducing wastage or in-house loss.
- Reduction of the operation and maintenance costs of water treatment and distribution by reducing the required amount of the treated water and distribution.
- Enabling of the early abandonment of the existing water treatment plants by reducing the required amount of the treated water.
- Further improvement of TDS by abandoning the operation of the water treatment plants that receives high TDS raw water from the Shat Al Arab.

3. The study team recommends that introducing RO plant, which produces expensive water and needs high expertise for O&M, meet the following conditions.
    - Appropriate operation of conventional water treatment plants to produce RO feed water.
    - Acquiring of required operation and maintenance method.
    - Improved power supply conditions for water supply facilities.
    - Improved budget level of BWD; appropriate water charge collection.
    - Controlled non-revenue water; reduced leakage and illegal connection.
    - Appropriate pricing of RO water.
    - Reduction of water demand through installing customer meters and appropriate pricing.

4. Based on limited water quality data, the process of RO was designed. Therefore, the study team recommends that the detailed process be decided through detailed investigation of water quality of the Shat Al Arab by implementing a pilot project.

5. The TDS improvement by this project was estimated at 894 mg/l, while WHO recommends TDS less than 600 mg/l is preferable for human consumption. Therefore, the study team recommends BWD confirm whether the improved TDS level can satisfy the users' requirement.

6. Currently, the operation and maintenance of many small RO plants owned by BWD is outsourced to private companies since BWD does not have enough technical expertise on RO treatment process. Therefore, the study team recommends that outsourcing of operation and maintenance of the proposed RO plant also be considered.

7. The southern part of Iraq, which are located downstream of the country's river system, suffers from high TDS water supply. A major cause of higher TDS in the rivers is assumed to be from discharge of high salinity contents in the upstream areas. Therefore, the southern areas receive disadvantage caused by the economic activities of the upstream areas. In this line, the study team recommends the central government of Iraq seek for measures such as subsidy to the required cost for RO plant operation in order to compensate the geopolitical disadvantage of the project area.

8. The current willingness to pay for the improved water supply service is 1 % of the household income. The willingness to pay would improve depending on the increased awareness to the water supply service. The study team recommends that BWD promote awareness campaigns to increase the people's awareness and the willingness to pay for water supply service, which would result in enhancement of the economic and financial feasibility of the project.