to the town of Anguruwatote and some noise disturbance could be caused to it's residents. It is inevitable that the pipeline route will pass close to a number of institutions but, with careful planning, the noise disturbance should be of short duration.

It is important that all engines have effective silencing to minimize their noise output, regardless of their location.

The severity of vibrations caused by the movement of heavy plant and vehicles will depend on the ground conditions. As there are no concentrations of population close enough to any of the construction sites to feel such effects, no problems are anticipated from this source. The exception to this may be during the time when plant and equipment are delivered to site. Care must be taken to avoid towns and villages as much as possible when planning the delivery routes.

The greatest disturbances due to vibrations are caused by piling operations. It is unlikely however, that piling will be required at any of the three sites. Even if piling were to be necessary, there are no structures close enough to the sites to be endangered, though the noise caused by such operations will carry for some distance.

(22) Ground Subsidence

The prime cause of ground subsidence is generally the excessive abstraction of groundwater. No such abstraction will take place during construction.

(23) Noxious Odors

Exhaust fumes, the burning of plastic and rubber etc. and rotting waste are the only potential generators of noxious odors during the construction phase of the project. In reality, the exhaust fumes will be rapidly dispersed and should never reach concentration levels likely to cause a nuisance. The type of rubbish that may be burned can be controlled and thereby prevent problems from that source. Rotting waste can also be avoided by ensuring that such material is collected and removed from site to a designated disposal tip.

16.3.4 Operation Phase

(1) Resettlement

The operation of the treatment plant will not require the resettlement of any further people.

(2) Economic Activities

There should be no effect on economic activities when the treatment plant is in operation, though it may be argued that the increased provision of water could indirectly enhance economic growth in the supply areas.

(3) Transportation and Daily Life

Some traffic will be generated by the existence of the intake and the treatment plant, mainly vehicles delivering chemicals. It will however be minimal and should not affect the movement of local vehicles.

In the future, pipeline maintenance may give rise to temporary traffic problems, if and when it becomes necessary to excavate roadways to find and mend leaks.

(4) Interruption to the Community

No interruption to the community will result from the operation of the intake or the treatment plant.

(5) Cultural Assets and Archaeology

There will be no effect on cultural assets or archaeology.

(6) Common Rights

No common rights should be infringed when the treatment plant is in operation.

(7) Sanitation and Health

No direct sanitation or health risks will be associated with the components of the project when they are in use.

Indirectly, sanitation and health may suffer as a consequence of providing significantly greater quantities of water to the distribution areas. With the exception of a relatively small area of Colombo, there are no other sewerage systems and the majority of the inhabitants of the intended distribution areas have inadequate or non existent toilet facilities. The increase in the supply of potable water will lead to an equivalent increase in waste water production, with no acceptable means of disposal. Inevitably this will lead to greater pollution of the surface and groundwaters in certain areas and the probability of an increase in water borne diseases.

(8) Waste

The only waste generated in any significant quantity in the operation phase will be sludge from the treatment processes. The treatment of the liquid sludge is dealt with in detail in sub-section 16.3.3.19).

The end result of the sludge treatment will be a solid sludge cake which will periodically be dug out of the drying beds for disposal off-site. The final disposal of this sludge presents a significant problem, it has no commercial value and, in general, cannot be used as fill material as it has poor load bearing properties. On average some 16 m^3 per day will be produced and the NWSDB must acquire a suitable acceptable disposal site at the earliest opportunity.

Solid waste in the form of empty chemical sacks may require disposal, though these may be recycled. This is not considered to be a significant problem provided it is recognized and accommodated for before the plant is put into operation.

(9) Dangers

The transportation and storage of chlorine at the treatment plant will constitute the main danger. The transportation danger can be reduced by selecting a delivery route which avoids main population centers. By careful design of the chlorine storage and dosing facilities, the threat posed by these installations can be minimized and any leaks contained.

No other hazardous chemicals will be used or stored on site with the exception of aluminum sulphate (alum). A solution of alum is acidic and safety showers should be provided in the chemical house in case workers get splashed.

(10) Topography and Geology

This aspect is not relevant to the operation of the treatment plant.

(11) Soil Erosion

Adequate means for disposing of overflows from the treatment plant and the high-level reservoir should be provided as the possibility of soil erosion could occur if the potentially large flows are not conducted safely to a suitable watercourse. A reasonably large stream flows in the vicinity of the treatment plant site which should prove satisfactory. No such stream flows close to the reservoir site and the problem should be addressed in detail at the earliest opportunity.

(12) Groundwater

No effects will be caused to the groundwater by the operation of the intake or treatment plant.

(13) Lakes Marshes and Rivers

The nominal output of the proposed new treatment plant will be 18,2000 m^3/d. From published data (Hydrological Annual 1991/92, Hydrology Division, Irrigation Department, Sri Lanka) the minimum average monthly flow at Putupaula is 200 million m^3, equivalent to a daily flow of some 6,670,000 m^3/d. Thus, under these conditions, the treatment plant will take only about 2.7 percent of the rivers flow. Not a significant amount.

The months of January to March 1991 were exceptional drought months and the river flow was reduced to 518,400 m^3/d near Horana. Under this situation the water treatment plant abstraction would account for about 35 percent or the river flow. It may be anticipated that this would enhance saline intrusion and increase the threat to the Kalutara intake.

The simplest countermeasure that could be employed at times of abnormally low river would be to reduce the abstraction rate to the treatment plant. A theoretical possibility would be to provide a raw water storage reservoir from which the plant would draw at times of low river flow. Clearly such a reservoir would have to be very large indeed an may have to be formed by building a dam across the river. There are a considerable number of practical and financial difficulties associated with this approach and it cannot be recommended

Some concern has been expressed by the NWSDB that the abstractions for the treatment plant during low flow periods in the Kalu Ganga might affect the Bolgoda Lakes. This possibility has been assessed, as well as other potential environmental effects on the lakes, and is discussed in detail in Supporting Report (Volume III). No effects related to river flow are expected.

(14) Coastline and Sea

The operation of the treatment plant is not relevant to this item.

(15) Flora and Fauna

No effects will be caused to the flora and fauna by the operation of the intake, treatment plant, reservoir or the transmission pipelines.

(16) Weather

The weather will not be affected.

(17) View

The effect on the view is as detailed in sub-section 16.3.3.17).

(18) Air Pollution

The only possible cause of air pollution would be an escape of chlorine gas. The careful design of the chlorine storage and dosing facilities will minimize this risk.

(19) Water Pollution

1) Intake

The intake design includes the provision of grit chambers which will require cleaning from time to time. The highest load will be deposited at times of high river flow and it may be expected that it will consist of a significant quantity of sandy material. Whatever the composition of the material, it will be naturally occurring and not constitute pollution if it is returned to the river. If however the grit chambers have not been cleaned for some considerable period of time, caution should be exercised to ensure that the deposits have not turned anaerobic. If this is found to have occurred, it would be unwise to return them to the river as chemical changes can take place, generating toxins which could harm fish etc.

2) Treatment Plant

In general, between 5 percent and 8 percent of the flow entering a treatment plant will be discharged as wastewater from the sedimentation and filtration stages. The exact amount will depend on the design and efficiency of the settled sludge removal system, the frequency of filter washing and the quantity of water needed for each wash.

The design proposed for the new treatment plant incorporates a washwater return system to the plant inlet, thereby recycling a significant proportion of the wastewater. The solids content of the washwater will then be removed by the sedimentation stage.

Sludge discharges from the sedimentation basins will flow to batch thickening tanks, the thickened sludge then being discharged to a set of sludge drying beds. The supernatant water from the thickening tanks will be withdrawn for disposal to the small stream that passes to the east of the site. Sludge solids will be retained on the beds but a proportion of the water fraction will filter through to a series of underdrains. From the underdrains the filtrate will flow to a collection chamber and from there to the small stream. The water remaining in the sludge will be evaporated by the action of wind and sun, leaving a dry sludge cake which has to be removed periodically for disposal off-site.

The worst situation will occur should the drying beds be bypassed for any reason. Under these circumstances the sludge from the sedimentation basins will flow directly to the stream causing a highly noticeable discharge. During the dry season, when the flow in the stream is at it's lowest, the majority of the suspended particles may be expected to settle on the stream bed and along it's sides before reaching the Kalu Ganga.

Such a discharge would be contrary to the discharge standards contained in the Sri Lankan "National Environmental (Protection and Quality) Regulation, No 1, 1990". The standards set a limit for suspended solids of 50 mg/l with a minimum dilution of 8:1. Should the dilution be less than this figure, then the permissible level of suspended solids is reduced in proportion to the dilution factor. Unsettled sludge will have a suspended solids load in the region of 2,000 mg/l (0.2%) and the dilution factor during the dry season could be as low as 4:1.

Overflows will be provided from various points in the treatment process and these will also flow to the stream, via the filtrate collection chamber of the drying beds. It is unclear as to the effect that a flow of up to 190,000 m^3/d would have on the stream and it's surroundings, though it is unlikely to be in excess of the natural flow in the stream during periods of heavy rain. The suspended solids load in such a discharge would be small and generally no worse than the Kalu Ganga river water. Quite how the discharge standards would be interpreted under such circumstances, particularly with respect to the dilution factor, is a matter for debate.

Drains and overflows from the chemical house are a potential source of water pollution. An interceptor tank should be provided to collect all such discharges for eventual removal, via a tanker, to an acceptable disposal site.

(20) Soil Pollution

None of the operations at the intake, treatment plant or high-level reservoir will lead to soil pollution.

(21) Noise and Vibration

The only significant noise generation will be from the pumps at the intake and the transmission pumps at the treatment plant. These will be enclosed in buildings and will not be close enough to any residential areas or institutions to cause a nuisance.

No vibrations will be caused other than minimal ones from the pump sets. These should not be felt outside of the pump houses.

(22) Ground Subsidence

This item is not relevant to the operation of the scheme.

(23) Noxious Odors

No noxious odors will be produced.

16.3.5 Conclusions

From the foregoing it may be concluded that:

1) During the Construction Phase

   1. Major environmental impacts:

      - None

   2. Minor environmental impacts:

      - Resettlement
      - Transportation and daily life
      - Disruption to the community
      - Water pollution
      - Noise and vibration

   3. Uncertain environmental impacts:

      - Economic activities
      - Sanitation
      - Soil pollution

2) During the Operation Phase

   1. Major environmental impacts:

      - None

   2. Minor environmental impacts:

      - River flow
      - Water pollution

   3. Uncertain environmental impacts:

      - None

The environmental impacts associated with the construction phase will be of limited duration with the exception of the resettlement requirements. None of them are judged to be serious.

The two factors highlighted for the operation phase of the project will be present for the life of the treatment plant. It should be recognized however that the river flow problem is only likely to occur on rare occasions and can be contained if necessary by reducing the output of the plant. The water pollution problem should also occur very infrequently and, at worst, will only significantly affect the small stream which runs close to the treatment plant site. This stream has no known abstractions and any sludge deposits will be scoured away during the high flows of the rainy season into the Kalu Ganga. No noticeable deterioration is expected in the river water quality at such times as the river will also be in flood.

Provided practical countermeasures are taken, the overall conclusion of the EIA is that the effects of both the construction and operation phases will cause no significant or lasting harm to the environment and should not rule against the implementation of the project.

CHAPTER 17

CONCLUSION AND RECOMMENDATION

17. CONCLUSION AND RECOMMENDATIONS

17.1 Conclusion

The financial viability of the Kalu Ganga Water Supply Project is much dependent on the tariff rate. The current tariff rate is regarded to be under the proper level in terms of the affordability and in comparison with other public utility charges. The results of the case study with a parameter of incremental rate of tariff, taking into account the current depressed tariff structure, indicates that the Project will be viable if the tariff rate is allowed to be increased at 8 - 10 percent per annum.

Further, the implementation of the Project will provide the Greater Colombo Water Supply System with two major water sources which will ensure more reliability for water supply in emergency or severe drought cases.

17.2 Recommendations

Recommendations towards the implementation of the Project are summarized in accordance with their importance and priorities as follows:

1) Taking necessary measures for ensuring the feasibility and financial viability of the Project

For the debt service management along with the implementation of the proposed projects and for clearing up the accumulated deficit by the year 2000, the routine efforts in the water supply management such as reduction in NRW, and implementation of the cost containment strategy will not be sufficient. The present depressed water tariff system will therefore need to be reviewed to set up a higher level of tariff structure at reasonable level considering the affordability of the consumers in the Greater Colombo Area. The viability of the proposed Kalu Ganga Project will then be assured with such measures to be taken.

In this connection, it is strongly recommended to establish in the NWSDB a financial management unit which will be fully in charge of debt service management, current and fixed assets management, cost containment strategy, future investment programming, etc.

2) Improvement of Non-Revenue Water (NRW)

Reduction in the amount of non-revenue water (unaccounted-for water) is a major subject to tackle in the management of the Greater Colombo Water Supply System. It will, if successfully implemented, result in increase in the revenue and reduction in the operation cost.

Most efficient and economical measures for reduction in NRW may be recommended as follows:

1. Provision of water meters to every consumer, repairing the defective water meters, and calibration of reading error.
2. Conducting efficient meter reading and billing collection
3. Controlling the illegal connection
4. Provision or repair of the bulk flow meters to monitor the amount of supply.

Reduction in the physical water loss will need more operational efforts and actual cost compared with the measures above but will much contribute to the system life. It will give an allowance in the production and transmission capacity of the existing and newly constructed facilities. The more allowance the water supply system will be given, the longer the expansion in future will be deferred. An alternative scenario for the case of smaller water loss in 5 percent is presented in Section 15.3 in Chapter 15. It shows a considerable reduction in project size and therefore the project cost.

3) Protection of Water Source

It is necessary for the government to establish a policy for protection of the water source in terms of quality and quantity of the raw water. For water quality, in particular, the following possible sources of contamination must be paid attention:

1. Discharge of a large amount of domestic sewage from large cities or communities upstream of the intake.
2. Toxic or harmful wastewater discharge from industries in the catchment area at upstream.

For quantity of the raw water, a comprehensive water utilization plan for the Kalu Ganga, including water supply, irrigation, power generation, flood control, industry etc., must be established as well as an organizational arrangement of controlling the water right.

4) Role of the Greater Colombo Regional Support Center

The Greater Colombo Regional Support Center of the NWSDB is considered as the obvious and most appropriate agency that will be in charge of the Project during and after its implementation. However, the RSC (GC) which is now the largest RSC in terms of the number of service connections and share of revenues in the NWSDB still remains one of the weakest centers in terms of organizational and managerial capability because it has not received due attention in the earlier institutional development activities. After implementation of the Project, water supply capacity in the Greater Colombo Area will be doubled and the RSC (GC) should be geared to fully meet the increased roles, functions and activities it will be charged with. The involvement of the RSC (GC), therefore, from the initial stage of the planning and design of the Project is quite significant to reflect the real needs and problems experienced by the RSC (GC).

5) Conduct of detailed analysis on salinity intrusion

The salinity intrusion analysis conducted in this study is based on the presently available data and information. If a study on the salinity barrier is to be conducted in future, it is recommended that the analysis be conducted by one-dimensional, two-layer, unsteady flow hydraulic model analysis based on the detailed river bed profiles and cross sections and the actual hourly changes in salinity.

6) Establishment of salinity intrusion monitoring system

The salinity intrusion analysis in this report shows that the salinity wedge might reach the proposed intake point under some circumstances. However, such a situation will be foreseeable to some extent by checking the water level of the Kalu Ganga if the saline water monitoring will be added to the water quality monitoring program. The key location to identify the salinity wedge is the area with shallow river bed immediately downstream of Narthupana bridge which act as a natural barrier for the salinity intrusion. When the salinity wedge goes upstream over this point, there will be a possibility that it will reach the intake point. Although the proposed structure of the intake mouth is carefully designed to enable the intake from the surface layer which will be free from saline water, it is recommended to monitor salinity at different depths at Narthupana bridge so that it will be possible to foresee the level of the saline water.

7) Timely Review of the Feasibility Study Prior to the Implementation

This Feasibility Study is prepared on the basis of the presently available data and information and most reasonable projection made from such information. In future, there may be more development or changes in socio-economic or natural conditions in the project area which are now unforeseeable but might affect, if they occur, the recommendations presented in the study. It is therefore recommended that the Feasibility Study be timely reviewed in future to take into account the situation at the time of the implementation of the Project.

8) Establishment of water quality monitoring system for the Kalu Ganga

There is unlikely any serious pollutant sources which discharge the hazardous or toxic wastewater for health upstream of the proposed intake point. However, the future development in the upper reach of the Kalu Gang is unforeseenable; or there will be a possibility that some factory might discharges wastewater into the river. Those who are concerned with water supply operation should therefore be required to carefully monitor the water quality of the source. It is recommended to establish the water quality monitoring system strategically connecting some points allotted in the river stretch downstream of the confluence of major tributaries, factory-concentrated area , problematic factory-located area, etc.

The purpose of the water quality monitoring is to predict the abnormality in the raw water quality before it will reach the intake point, and to identify the discharging source. For this purpose, the testing system should be highly upgraded including both the instrument and staff. In addition, it is necessary to collect the information on the location of existing and new factories and the movement of projects developed in the upper reach of the Kalu Ganga in cooperation with the agencies concerned such as the Central Environmental Authority.

9) Kalutara Water Supply System in Future

The existing Kalutara intake station has experienced the saline water during the 1991 drought. By a large intake from the Kalu Ganga for Greater Colombo upstream of the Kalutara intake station, it will be expected to be placed on the severer situation as for the salinity intrusion as described in Chapter 6 which also suggests that there is few proper place even though moving the Kalutara intake station upstream. One solution will be the integration of the Kalutara Water Supply System which presently covers a part of Panadura P.S. across the Kalu Ganga to the Kalu Ganga Water Supply System.

10) Provision of Sewerage Services

The expansion of the water supply capacity will bring the increase in the sewage to be discharged in the service area. At present, a sewer system is provided in C.M.C. and only the northern coastal part of Dehiwala but not in service. According to the "Wastewater and Sanitation Master Plan for Greater Colombo" prepared in 1993, Dehiwala-Mt.Lavinia M.C. and a northern part of Moratuwa U.C. will be covered by a sewer system by 2000 and only the remainder of Moratuwa U.C. and Panadura U.C. will be added to them at last in the high development scenario by 2020. Other remaining areas are expected to be served by the on-site facilities which mainly treat excreta and do not treat other wastewater. The pollutant load to be discharged into watercourses will accordingly increase in the unserved area steadily. In addition, although the maintenance of those facilities is left to the responsibility of owners, their neglect of proper maintenance of those facilities will lead to the pollution of the surface water and groundwater. The high priority should be given to the provision of a sewer system within the service area by water supply.

ANNEX A COMPUTATION OF FIRR AND ROE

FEASIBILITY ANALYSIS FOR KALU GANGA PROJECT

(BASE CASE)

Row	PROJECT COST CASE-1	at 1994 price ('000 US$)	Stage 1	Stage 2	TOTAL		CASE-2	('000 US$)
86	Construction Cost (Direct cost)		114,697	72,580	187,277	1		187,277
87	Engineering Services		12,617	7,984	20,600	2		20,600
88	Physical Contingency		13,443	8,461	21,904	3		21,904
89	Others(Board administration,land,etc.)		7,117	4,049	11,165	4		11,165
90	TOTAL		147,873	93,074	240,947		TOTAL	240,947
91			61%	39%				

Sensitivity Analysis 0% increase in percentage of Construction Cost

Form of Government Financing for Water Supply Projects

	Foreign Component Grant	Foreign Component Loan	Local Component	
Rural	85%	15%	Grant	100%
Urban	50%	50%	Grant	100%

FINANCIAL MECHANISM OF EXTERNAL LOAN

			TOTAL	Grant Component
Project Cost	100%			
Government Grant (L/C)	15%		15.0%	
External Loan (F/C)	85%			57.5%
Government Grant		50%	42.5%	
NWSDB		50%	42.5%	

PHASE I : TARGET YEAR 2010

Stage 1		Stage 2	
Capital Expenditures	147,873 US$'000 (1994 fixed price)	Capital Expenditures	93,074 US$'000 (1994 fixed price)
	49 Rs./US$ as of 1994.3		49 Rs./US$ as of 1994.3
	7,245,795 Rs.'000		4,560,611 Rs.'000

	Capital Allocation		Interest		Capital Allocation		Interest
Capital Grant from Government	57.5%	4,166,332		Capital Grant from Government	57.5%	2,622,351	
Capital Grant fr. Foreign Agencies	0.0%	0		Capital Grant from Foreign Agencies	0.0%	0	
Foreign Loan through Treasury	42.5%	3,079,463	12%	Foreign Loan through Treasury	42.5%	1,938,260	12%

	A B C D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
124	**Disbursement & Repayment Schedule**																		
125		1994	Fixed Price ('000 Rs.)			1	2	3	4	5	6	7	8	9	10	11	12	Total	
126	**Funds Sources**		Total		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008		
127	Capital Grant from Government		6,788,683	57.5%	154,211	76,007	1,517,240	1,161,766	893,070	488,109	961,986	737,042	512,098	287,154	0	0	0	6,788,683	
128	Capital Grant from Foreign Agencies		0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
129	Foreign Loan through Treasury	Stage 1	3,079,463	42.5%	113,982	56,179	1,121,438	858,696	595,955	333,213	0	0	0	0	0	0	0	3,079,463	
130	Foreign Loan through Treasury	Stage 2	1,938,260	42.5%	0	0	0	0	64,141	27,563	711,033	544,770	378,507	212,245	0	0	0	1,938,260	
131			11,806,405		268,193	132,186	2,638,677	2,020,462	1,553,166	848,885	1,673,019	1,281,813	890,606	499,399	0	0	0	11,806,405	
132	**Disbursement Schedule (Current Price)**																		
133	Price Escalation Rate=		5%		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total	
134	Capital Grant from Government		9,358,549		170,018	87,987	1,844,214	1,482,740	1,196,800	686,818	1,421,292	1,143,394	834,154	491,131	0			9,358,549	
135	Capital Grant from Foreign Agencies		0		0	0	0	0	0	0	0	0	0	0	0			0	
136																			
137	Debt outstandings(beg.)				0	125,665	190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,554,178	6,917,188				
138	Foreign Loan through Treasury	Stage 1	3,917,253		125,665	65,034	1,363,115	1,095,938	798,636	468,864	0	0	0	0	0			3,917,253	
139	Foreign Loan through Treasury	Stage 2	2,999,935		0	0	0	0	85,955	38,784	1,050,520	845,118	616,549	363,010	0			2,999,935	
140	Debt outstandings(end)				125,665	190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,554,178	6,917,188	6,917,188				
141	Interest during construction	Interest=	12%		7,540	18,982	104,671	252,214	371,046	454,580	548,070	661,808	749,508	808,282	830,063			4,806,764	
142	(IDC is not capitalized.)	**Capital Expenditures**			295,683	153,021	3,207,329	2,578,678	2,081,391	1,194,466	2,471,812	1,988,512	1,450,703	854,142	0			16,275,737	
143	**Repayment Schedule**					1	2	3	4	5	6	7	8	9	10	11	12	13	14
144	**Stage 1**				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
145	Debt outstandings(beg.)				0	125,665	190,699	1,553,814	2,649,752	3,448,389	3,917,253	3,917,253	3,917,253	3,739,196	3,561,139	3,383,082	3,205,025	3,026,968	2,848,911
146	Foreign Loan through Treasury	3,917,253			125,665	65,034	1,363,115	1,095,938	798,636	468,864									
147	Repayment	178,057											178,057	178,057	178,057	178,057	178,057	178,057	178,057
148	Debt outstandings(end)				125,665	190,699	1,553,814	2,649,752	3,448,389	3,917,253	3,917,253	3,917,253	3,739,196	3,561,139	3,383,082	3,205,025	3,026,968	2,848,911	2,670,854
149	Interest	Interest=	12%		7,540	18,982	104,671	252,214	365,888	441,938	470,070	470,070	470,070	448,703	427,337	405,970	384,603	363,236	341,869
150	**Stage 2**				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
151	Debt outstandings(beg.)							0	0	85,955	124,739	1,175,259	2,020,376	2,636,925	2,999,935	2,999,935	2,999,935	2,863,575	2,727,214
152	Foreign Loan through Treasury	2,999,935						0	85,955	38,784	1,050,520	845,118	616,549	363,010					
153	Repayment	136,361															136,361	136,361	136,361
154	Debt outstandings(end)							0	85,955	124,739	1,175,259	2,020,376	2,636,925	2,999,935	2,999,935	2,999,935	2,863,575	2,727,214	2,590,853
155	Interest	Interest=	12%					0	5,157	12,642	78,000	191,738	279,438	338,212	359,992	359,992	359,992	343,629	327,266
156																			
157	**TOTAL**				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
158	Debt outstandings(beg.)				0	125,665	190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,376,121	6,561,074	6,383,017	6,204,960	5,890,543	5,576,125
159	Foreign Loan through Treasury	6,917,188			125,665	65,034	1,363,115	1,095,938	884,591	507,648	1,050,520	845,118	616,549	363,010	0	0	0	0	0
160	Repayment												178,057	178,057	178,057	178,057	314,418	314,418	314,418
161	Debt outstandings(end)				125,665	190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,376,121	6,561,074	6,383,017	6,204,960	5,890,543	5,576,125	5,261,707
162	Interest				7,540	18,982	104,671	252,214	371,046	454,580	548,070	661,808	749,508	786,915	787,329	765,962	744,595	706,865	669,135
163																			
164	Debt Services				7,540	18,982	104,671	252,214	371,046	454,580	548,070	661,808	927,565	964,972	965,386	944,019	1,059,013	1,021,283	983,553
165	2																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
180			REVENUES & EXPENSES PROJECTION																			
181								1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
183		Additional Production Capacity (m3/day)												26,800	33,500	46,900	67,000	91,000	109,200	136,500	163,800	182,000
184		Water served (m3/day)		100% of full capacity									0	2,116	20,867	39,617	58,368	78,338	98,308	118,278	138,247	158,261
185		Additional Water sold (m3/day)											0	1,438	14,176	26,914	39,653	53,220	66,787	80,354	93,920	107,517
186			Domestic	60.0%	000 m3/year								0	315	3,105	5,894	8,684	11,655	14,626	17,598	20,569	23,546
187			Non-domestic	35.0%	000 m3/year								0	184	1,811	3,438	5,066	6,799	8,532	10,265	11,998	13,735
188			Others(Industries)	5.0%	000 m3/year								0	26	259	491	724	971	1,219	1,466	1,714	1,962
189		Water sold / production capacity												5%	42%	57%	59%	58%	61%	59%	57%	59%
190		Additional Water Sold ('000 m3/year)											0	525	5,174	9,824	14,473	19,425	24,377	29,329	34,281	39,244
192							Tariff Incremental		FIRR	ROE												
193					1993 price	2000 price	Rate		10.0%	9.6%		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
194		Tariff	Domestic Rs./m3		4.4	6.5	8.0%					6.5	7.1	7.6	8.2	8.9	9.6	10.4	11.2	12.1	13.1	14.1
195			Non-domestic Rs./m3		20.2	33.3	8.0%					33.3	35.9	38.8	41.9	45.3	48.9	52.8	57.0	61.6	66.5	71.8
196			Others(Industries) Rs./m3		29.2	56.8	8.0%					56.8	61.4	66.3	71.6	77.3	83.5	90.2	97.4	105.2	113.6	122.7
197	Revenues		Domestic ('000 Rs.)										0	2,398	25,538	52,365	83,321	120,775	163,688	212,694	268,491	331,949
198			Non-domestic										0	7,127	75,901	155,630	247,634	358,948	486,488	632,137	797,970	986,570
199			Others(Industries)										0	1,739	18,525	37,984	60,439	87,606	118,734	154,282	194,755	240,786
201			Revenue Total										0	11,264	119,964	245,978	391,394	567,329	768,909	999,112	1,261,216	1,559,305
202			Operating Cost Rs./m3		3.0		5% (=Incremental rate of Cost)						4.4	4.7	4.9	5.1	5.4	5.7	5.9	6.2	6.5	6.9
203			O & M Expenses ('000 Rs.)										0	3,594	37,219	74,196	114,778	161,751	213,134	269,251	330,445	397,197
204			Gross Profit ('000 Rs.)										0	7,669	82,745	171,783	276,615	405,578	555,775	729,861	930,772	1,162,109
205			Accum. Profit ('000 Rs.)										0	7,669	90,414	262,197	538,812	944,390	1,500,165	2,230,026	3,160,797	4,322,906
206																						
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COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	A	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
222		**DEBT SERVICES PROJECTION**																			
223							1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
224			**Stage 1**																		
225			Debt outstandings(beg.)				0	125,665	190,699	1,553,814	2,649,752	3,448,389	3,917,253	3,917,253	3,917,253	3,739,196	3,561,139	3,383,082	3,205,025	3,026,968	2,848,911
226			Foreign Loan through Treasury	3,917,253			125,665	65,034	1,363,115	1,095,938	798,636	468,864	0	0	0	0	0	0	0	0	0
227			Repayment	178,057			0	0	0	0	0	0	0	0	178,057	178,057	178,057	178,057	178,057	178,057	178,057
228			Debt outstandings(end)				125,665	190,699	1,553,814	2,649,752	3,448,389	3,917,253	3,917,253	3,917,253	3,739,196	3,561,139	3,383,082	3,205,025	3,026,968	2,848,911	2,670,854
229			Interest	Interest=	12%		7,540	18,982	104,671	252,214	365,888	441,938	470,070	470,070	470,070	448,703	427,337	405,970	384,603	363,236	341,869
230			**Stage 2**																		
231			Debt outstandings(beg.)				0	0	0	0	0	85,955	124,739	1,175,259	2,020,376	2,636,925	2,999,935	2,999,935	2,999,935	2,863,575	2,727,214
232			Foreign Loan through Treasury	2,999,935			0	0	0	0	85,955	38,784	1,050,520	845,118	616,549	363,010	0	0	0	0	0
233			Repayment	136,361			0	0	0	0	0	0	0	0	0	0	0	0	136,361	136,361	136,361
234			Debt outstandings(end)				0	0	0	0	85,955	124,739	1,175,259	2,020,376	2,636,925	2,999,935	2,999,935	2,999,935	2,863,575	2,727,214	2,590,853
235			Interest	Interest=	12%		0	0	0	0	5,157	12,642	78,000	191,738	279,438	338,212	359,992	359,992	359,992	343,629	327,266
236			**TOTAL**																		
237			Debt outstandings(beg.)				0	125,665	190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,376,121	6,561,074	6,383,017	6,204,960	5,890,543	5,576,125
238			Foreign Loan through Treasury	6,917,188			125,665	65,034	1,363,115	1,095,938	884,591	507,648	1,050,520	845,118	616,549	363,010	0	0	0	0	0
239			Repayment				0	0	0	0	0	0	0	0	178,057	178,057	178,057	178,057	314,418	314,418	314,418
240			Debt outstandings(end)				125,665	190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,376,121	6,561,074	6,383,017	6,204,960	5,890,543	5,576,125	5,261,707
241			Interest				7,540	18,982	104,671	252,214	371,046	454,580	548,070	661,808	749,508	786,915	787,329	765,962	744,595	706,865	669,135
242																					
243		**CASHFLOW PROJECTION for FIRR Calculation**					**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
244			Capital Expenditures				295,683	153,021	3,207,329	2,578,678	2,081,391	1,194,466	2,471,812	1,988,512	1,450,703	854,142	0				
245			Revenues before Interest & Repayment				0	0	0	0	0	0	7,669	82,745	171,783	276,615	405,578	555,775	729,861	930,772	1,162,109
246			Net Cashflow				-295,683	-153,021	-3,207,329	-2,578,678	-2,081,391	-1,194,466	-2,464,142	-1,905,767	-1,278,920	-577,527	405,578	555,775	729,861	930,772	1,162,109
247			FIRR =	10.0%																	
248																					
249								1	2	3	4	5	6	7	8	9	10	11	12	13	14
250		**DEBT SERVICES SCHEDULE**						1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
251						Debt outstandings(end)		190,699	1,553,814	2,649,752	3,534,343	4,041,992	5,092,512	5,937,629	6,376,121	6,561,074	6,383,017	6,204,960	5,890,543	5,576,125	5,261,707
252						Interest		18,982	104,671	252,214	371,046	454,580	548,070	661,808	749,508	786,915	787,329	765,962	744,595	706,865	669,135
253						Repayment		0	0	0	0	0	0	0	178,057	178,057	178,057	178,057	314,418	314,418	314,418
254						Debt Services		18,982	104,671	252,214	371,046	454,580	548,070	661,808	927,565	964,972	965,386	944,019	1,059,013	1,021,283	983,553
255		Disbursed Amount	Depreciation			Profit before depreciation & interest		0	0	0	0	0	7,669	82,745	171,783	276,615	405,578	555,775	729,861	930,772	1,162,109
256	Stage 1	9,385,830	469,291			Depreciation (1)						0	469,291	469,291	469,291	469,291	469,291	469,291	469,291	469,291	469,291
257	Stage 2	6,889,907	344,495			Depreciation (2)											344,495	344,495	344,495	344,495	344,495
258	Total	16,275,737				Profit after depreciation & interest		-18,982	-104,671	-252,214	-371,046	-454,580	-1,009,692	-1,048,355	-1,047,017	-979,592	-1,195,538	-1,023,974	-828,521	-589,880	-320,813
259						Accu. surplus/deficit		-18,982	-123,653	-375,867	-746,912	-1,201,493	-2,211,185	-3,259,540	-4,306,557	-5,286,149	-6,481,687	-7,505,660	-8,334,182	-8,924,062	-9,244,875
260						Return on Investment		-0.1%	-0.6%	-1.5%	-2.3%	-2.8%	-6.2%	-6.4%	-6.4%	-6.0%	-7.3%	-6.3%	-5.1%	-3.6%	-2.0%
261								1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
262						Marginal Profit		0	0	0	0	0	7,669	82,745	171,783	276,615	405,578	555,775	729,861	930,772	1,162,109
263						Debt Services		18,982	104,671	252,214	371,046	454,580	548,070	661,808	927,565	964,972	965,386	944,019	1,059,013	1,021,283	983,553
264	4					Debt Service Coverage		0.00	0.00	0.00	0.00	0.00	0.01	0.13	0.19	0.29	0.42	0.59	0.69	0.91	1.18

COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	A B C D E F G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
265	**INCOME STATEMENTS**		1	2	3	4	5	6	7	8	9	10	11	12	13	14
266		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
267	Revenues	0	0	0	0	0	0	11.264	119.964	245.978	391.394	567.329	768.909	999.112	1.261.216	1.559.305
268							0	3.594	37.219	74.196	114.778	161.751	213.134	269.251	330.445	397.197
269	Gross Profit	0	0	0	0	0	0	7.669	82.745	171.783	276.615	405.578	555.775	729.861	930.772	1.162.109
270	Depreciation	0	0	0	0	0	0	469.291	469.291	469.291	469.291	813.787	813.787	813.787	813.787	813.787
271	Interest	7.540	18.982	104.671	252.214	371.046	454.580	548.070	661.808	749.508	786.915	787.329	765.962	744.595	706.865	669.135
272	Profit after interest & depreciation	-7.540	-18.982	-104.671	-252.214	-371.046	-454.580	-1.009.692	-1.048.355	-1.047.017	-979.592	-1.195.538	-1.023.974	-828.521	-589.880	-320.813
273	Accu. Profit	-7.540	-26.522	-131.193	-383.407	-754.452	-1.209.032	-2.218.725	-3.267.080	-4.314.097	-5.293.689	-6.489.226	-7.513.200	-8.341.722	-8.931.602	-9.252.415
274																
275	**CASHFLOW STATEMENTS**	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
276	Plus: Depreciation	0	0	0	0	0	0	469.291	469.291	469.291	469.291	813.787	813.787	813.787	813.787	813.787
277	Minus: Repayment	0	0	0	0	0	0	0	0	178.057	178.057	178.057	178.057	314.418	314.418	314.418
278	Minus: Investment	268.193	132.186	2.638.677	2.020.462	1.402.246	784.031	1.673.019	1.281.813	890.606	499.399	0	0	0		
279	Plus: Debt+Equity	268.193	132.186	2.638.677	2.020.462	1.402.246	784.031	1.673.019	1.281.813	890.606	499.399	0	0	0		
280	Plus: **Working Capital** (**Board's own funds**)	7.540	18.982	104.671	252.214	371.046	454.580	535.211	573.421	748.192	680.444	551.815	380.428	320.381	82.052	0
282																
283	Net Cashflow	0	0	0	0	0	0	-5.190	-5.643	-7.591	-7.913	-7.993	-7.816	-8.771	-8.459	178.556
284	Accumulated Net Cashflow	0	0	0	0	0	0	-5.190	-10.832	-18.423	-26.336	-34.329	-42.145	-50.916	-59.375	119.181
285																
286	Mobilized Funds															
287	Capital Grant from Government	170.018	87.987	1.844.214	1.482.740	1.196.800	686.818	1.421.292	1.143.394	834.154	491.131	0	0	0		
288	Capital Grant from Foreign Agency	0	0	0	0	0	0	0	0	0	0	0	0	0		
289	< Working Capital >	7.540	18.982	104.671	252.214	371.046	454.580	535.211	573.421	748.192	680.444	551.815	380.428	320.381	82.052	0
290	Total	177.558	106.969	1.948.885	1.734.954	1.567.846	1.141.398	1.956.503	1.716.815	1.582.346	1.171.575	551.815	380.428	320.381	82.052	0
291																
292	**ROE CALCULATION**	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
293	EQUITY (exclu. Capital Grant from Foreign Agency)	-177.558	-106.969	-1.948.885	-1.734.954	-1.567.846	-1.141.398	-1.956.503	-1.716.815	-1.582.346	-1.171.575	-551.815	-380.428	-320.381	-82.052	0
294	ROE= **9.6%** CASH GENERATION	0	0	0	0	0	0	-5.190	-5.643	-7.591	-7.913	-7.993	-7.816	-8.771	-8.459	178.556
295	(At the year of 1997)															
296	(Working Capital included)	-177.558	-106.969	-1.948.885	-1.734.954	-1.567.846	-1.141.398	-1.961.693	-1.722.458	-1.589.937	-1.179.489	-559.808	-388.244	-329.152	-90.511	178.556
297																
298	EQUITY PORTION	170.018	87.987	1.844.214	1.482.740	1.196.800	686.818	1.421.292	1.143.394	834.154	491.131	0	0			
299	LOAN PORTION	125.665	65.034	1.363.115	1.095.938	884.591	507.648	1.050.520	845.118	616.549	363.010	0	0	0	0	0
300	Debt Outstandings(end of year)	125.665	190.699	1.553.814	2.649.752	3.534.343	4.041.992	5.092.512	5.937.629	6.376.121	6.561.074	6.383.017	6.204.960	5.890.543	5.576.125	5.261.707
301	Repayment	0	0	0	0	0	0	0	0	178.057	178.057	178.057	178.057	314.418	314.418	314.418
302	WORK IN PROGRESS	295.683	153.021	3.207.329	2.578.678	2.081.391	1.194.466	2.471.812	1.988.512	1.450.703	854.142	0	0			
303	Accu. Work in Progress	295.683	153.021	3.360.350	5.939.028	8.020.419	9.214.886	2.471.812	4.460.324	5.911.027	6.765.168	6.765.168				
304	NET FIXED ASSETS						9.214.886	8.745.594	8.276.303	7.807.011	7.337.720	13.633.596	12.819.810	12.006.023	11.192.236	10.378.449
305	Depreciation	0	0	0	0	0	0	469.291	469.291	469.291	469.291	813.787	813.787	813.787	813.787	813.787
306																
307																
308	5															

	A–E		F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
309	PROJECT COST SCHEDULE						(Unit:'000)			TARGET YEAR 2010								
310	A. Cost allocation Schedule at 1994 price					Stage I					Stage II							
311	Project Cost (1994 price)				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL
312	100 Direct Construction Cost		100%															
313	Stage 1	F/C (Yen)	7,974,934		0	0	3,189,974	2,392,480	1,594,987	797,493								7,974,934
314		L/C	1,933,616		0	0	773,446	580,085	386,723	193,362								1,933,616
315	Stage 2	F/C (Yen)	4,832,539								1,933,016	1,449,762	966,508	483,254				4,832,539
316		L/C	1,322,516								529,006	396,755	264,503	132,252				1,322,516
317	200 Land Acquisition																	
318	Stage 1	F/C (Yen)	0															0
319		L/C	58,686		29,343	29,343												58,686
320	300 Board's Administrative Expenses																	
321	Stage 1	F/C (Yen)	0															0
322		L/C	290,042		29,004	29,004	58,008	58,008	58,008	58,008								290,042
323	Stage 2	F/C (Yen)	0															0
324		L/C	198,377						19,838	19,838	39,675	39,675	39,675	39,675				198,377
325	400 Engineering Services		11%															
326	Stage 1	F/C (Yen)	1,069,892		320,967	106,989	160,484	160,484	160,484	160,484								1,069,892
327		L/C	123,643		37,093	12,364	18,546	18,546	18,546	18,546								123,643
328	Stage 2	F/C (Yen)	677,027						203,108	67,703	101,554	101,554	101,554	101,554				677,027
329		L/C	78,241						23,472	7,824	11,736	11,736	11,736	11,736				78,241
330	Exchange rate		49.00 Rs./US$ in 1994															
331			106.00 Yen/US$															
332	Total Base Cost at 1994 price				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
333	Stage 1	F/C (Yen)	9,044,826		320,967	106,989	3,350,457	2,552,964	1,755,471	957,977	0	0	0	0				9,044,826
334		L/C	2,405,988		95,440	70,712	850,001	656,640	463,278	269,917	0	0	0	0				2,405,988
335	Stage 2	F/C (Yen)	5,509,566		0	0	0	0	203,108	67,703	2,034,570	1,551,316	1,068,062	584,808				5,509,566
336		L/C	1,599,135		0	0	0	0	43,310	27,662	580,418	448,166	315,915	183,663				1,599,135
337	Sub-Total (US$)																	0
338	Stage 1	F/C (US$)	85,329	63.5%	3,028	1,009	31,608	24,085	16,561	9,038	0	0	0	0				85,329
339		L/C (US$)	49,102	36.5%	1,948	1,443	17,347	13,401	9,455	5,509	0	0	0	0				49,102
340	Stage 2	F/C (US$)	51,977	61.4%	0	0	0	0	1,916	639	19,194	14,635	10,076	5,517				51,977
341		L/C (US$)	32,635	38.6%	0	0	0	0	884	565	11,845	9,146	6,447	3,748				32,635
342			219,043		4,976	2,452	48,955	37,485	28,816	15,749	31,039	23,781	16,523	9,265				
343																		
344	Total Base Cost at Current Price				1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
349																		
350	6																	

	A-D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
351	500 Physical Contingency		% of Base Cost		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008		
352	Stage 1	F/C (Yen)	904.483	10%	32.097	10.699	335.046	255.296	175.547	95.798								904.483	
353		L/C	240.599	10%	9.544	7.071	85.000	65.664	46.328	26.992								240.599	
354	Stage 2	F/C (Yen)	550.957	10%					20.311	6.770	203.457	155.132	106.806	58.481				550.957	
355		L/C	159.913	10%					4.331	2.766	58.042	44.817	31.591	18.366				159.913	
356																			
357	Total Contingencies(US$)		21.904		498	245	4.896	3.749	2.882	1.575	3.104	2.378	1.652	927				21.904	
358	Stage 1	F/C (US$)	8.533		303	101	3.161	2.408	1.656	904	0	0	0	0				8.533	
359		L/C (US$)	4.910		195	144	1.735	1.340	945	551	0	0	0	0				4.910	
360	Stage 2	F/C (US$)	5.198		0	0	0	0	192	64	1.919	1.464	1.008	552				5.198	
361		L/C (US$)	3.264		0	0	0	0	88	56	1.185	915	645	375				3.264	
362																			
363	GRAND TOTAL (1994 price)																		
364	Stage 1	F/C (US$)	93.861		3.331	1.110	34.769	26.493	18.217	9.941	0	0	0	0				93.861	
365		L/C (US$)	54.012		2.143	1.587	19.082	14.741	10.400	6.059	0	0	0	0				54.012	
366	% of Stage 1		147.873		3.7%	1.8%	36.4%	27.9%	19.4%	10.8%								100%	
367	Stage 2	F/C (US$)	57.175		0	0	0	0	2.108	703	21.113	16.099	11.084	6.069				57.175	
368		L/C (US$)	35.899		0	0	0	0	972	621	13.030	10.061	7.092	4.123				35.899	
369	% of Stage 2		93.074		0.0%	0.0%	0.0%	0.0%	3.3%	1.4%	36.7%	28.1%	19.5%	11.0%				100%	
370		Total	240.947		5.473	2.698	53.851	41.234	31.697	17.324	34.143	26.159	18.176	10.192				240.947	
371	**B. Disbursement Schedule**		(1994 price)		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008		
372	(Funds to be Required)	Stage 1	147.873		5.473	2.698	53.851	41.234	28.617	16.001	0	0	0	0	0	0	0	147.873	
373		Stage 2	93.074		0	0	0	0	3.080	1.324	34.143	26.159	18.176	10.192				93.074	
374		Total (US$)	240.947		5.473	2.698	53.851	41.234	31.697	17.324	34.143	26.159	18.176	10.192				240.947	
375		Stage 1	7.245.795		268.193	132.186	2.638.677	2.020.462	1.402.246	784.031	0	0	0	0	0			7.245.795	
376		Stage 2	4.560.611		0	0	0	0	150.920	64.854	1.673.019	1.281.813	890.606	499.399	0			4.560.611	
377		Total ('000Rs.)	11.806.405		268.193	132.186	2.638.677	2.020.462	1.553.166	848.885	1.673.019	1.281.813	890.606	499.399	0			11.806.405	

	Inflation Rate		Direct Cost	Estimated Direct Cost Import Duties	Direct Cost ex.Import Duties	Allocation		
380								
381	Foreign	3%	85.329	14.221	85.329	71%		
382	Local	10%	49.102		34.880	29%	Average inflation rate=	5.0%

	STAGE 1 (1994 price)	('000 US$)
100	Direct Construction Cost	114.697
200	Land Acquisition	1.198
300	Board's Administrative Expenses	5.919
400	Engineering Services	12.617
500	Physical Contingency	13.443
600	Price escalation	
	Total	147.873

	STAGE 2 (1994 price)	('000 US$)
100	Direct Construction Cost	72.580
200	Land Acquisition	0
300	Board's Administrative Expenses	4.049
400	Engineering Services	7.984
500	Physical Contingency	8.461
600	Price escalation	
	Total	93.074

COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	BA	BB	BC	BD	BE	BG	BH
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COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	BA	BB	BC	BD	BE	BG	BH
124																		
125																		
126																		
127																		
128																		
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139																		
140																		
141																		
142																		
143	15	16	17	18	19	20	21	22	23	24	25							
144	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021						Total	
145	2,670.854	2,492.797	2,314.740	2,136.683	1,958.626	1,780.569	1,602.512	1,424.456	1,246.399	1,068.342	890.285							
146																	3,917.253	
147	178.057	178.057	178.057	178.057	178.057	178.057	178.057	178.057	178.057	178.057	178.057						3,917.253	
148	2,492.797	2,314.740	2,136.683	1,958.626	1,780.569	1,602.512	1,424.456	1,246.399	1,068.342	890.285	712.228							
149	320.502	299.136	277.769	256.402	235.035	213.668	192.301	170.935	149.568	128.201	106.834						7,529.643	
150	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021							
151	2,590.853	2,454.493	2,318.132	2,181.771	2,045.411	1,909.050	1,772.689	1,636.328	1,499.968	1,363.607	1,227.246							
152																	2,999.935	
153	136.361	136.361	136.361	136.361	136.361	136.361	136.361	136.361	136.361	136.361	136.361						2,999.935	
154	2,454.493	2,318.132	2,181.771	2,045.411	1,909.050	1,772.689	1,636.328	1,499.968	1,363.607	1,227.246	1,090.886							
155	310.902	294.539	278.176	261.813	245.449	229.086	212.723	196.359	179.996	163.633	147.270						5,765.082	
156																		
157	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021							
158	5,261.707	4,947.290	4,632.872	4,318.455	4,004.037	3,689.619	3,375.202	3,060.784	2,746.366	2,431.949	2,117.531							
159	0	0	0	0	0	0	0	0	0	0	0						6,917.188	
160	314.418	314.418	314.418	314.418	314.418	314.418	314.418	314.418	314.418	314.418	314.418						6,917.188	
161	4,947.290	4,632.872	4,318.455	4,004.037	3,689.619	3,375.202	3,060.784	2,746.366	2,431.949	2,117.531	1,803.113							
162	631.405	593.675	555.945	518.215	480.484	442.754	405.024	367.294	329.564	291.834	254.104						13,302.265	
163																		
164	945.823	908.092	870.362	832.632	794.902	757.172	719.442	681.712	643.982	606.251	568.521						20,219.453	
165																	20,219.453	

COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	BA	BB	BC	BD	BE	BG	BH
180																		
181	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
183	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000	182.000		
184	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261	158.261		
185	107.517	107.517	107.517	107.517	107.517	107.517	107.517	107.517	107.517	114.876	114.876	114.876	114.876	114.876	114.876	114.876		
186	23.546	23.546	23.546	23.546	23.546	23.546	23.546	23.546	23.546	25.158	25.158	25.158	25.158	25.158	25.158	25.158		
187	13.735	13.735	13.735	13.735	13.735	13.735	13.735	13.735	13.735	14.675	14.675	14.675	14.675	14.675	14.675	14.675		
188	1.962	1.962	1.962	1.962	1.962	1.962	1.962	1.962	1.962	2.096	2.096	2.096	2.096	2.096	2.096	2.096		
189	59%	59%	59%	59%	59%	59%	59%	59%	59%	63%	63%	63%	63%	63%	63%	63%		
190	39.244	39.244	39.244	39.244	39.244	39.244	39.244	39.244	39.244	41.930	41.930	41.930	41.930	41.930	41.930	41.930		
192																		
193	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
194	15.2	16.4	17.8	19.2	20.7	22.4	24.2	26.1	28.2	30.4	32.9	153.2	165.5	178.7	193.0	208.4		
195	77.6	83.8	90.5	97.7	105.5	114.0	123.1	132.9	143.6	155.1	167.5	780.6	843.0	910.5	983.3	1062.0		
196	132.5	143.1	154.6	167.0	180.3	194.7	210.3	227.1	245.3	264.9	286.1	1333.6	1440.3	1555.5	1680.0	1814.4		
197	358.505	387.185	418.160	451.613	487.742	526.762	568.903	614.415	663.568	765.706	826.962	3.854.435	4.162.789	4.495.812	4.855.477	5.243.916	66.959.612	
198	1.065.496	1.150.735	1.242.794	1.342.218	1.449.595	1.565.563	1.690.808	1.826.073	1.972.158	2.275.717	2.457.774	11.455.580	12.372.027	13.361.789	14.430.732	15.585.190	199.007.454	
199	260.049	280.853	303.321	327.587	353.794	382.097	412.665	445.678	481.332	555.420	599.854	2.795.892	3.019.563	3.261.128	3.522.018	3.803.780	48.570.500	
201	1.684.050	1.818.774	1.964.276	2.121.418	2.291.131	2.474.422	2.672.375	2.886.165	3.117.059	3.596.842	3.884.590	18.105.906	19.554.379	21.118.729	22.808.227	24.632.886	314.537.565	
202	7.2	7.6	8.0	8.4	8.8	9.2	9.7	10.2	10.7	11.2	11.8	31.2	32.8	34.4	36.1	37.9		
203	417.057	437.909	459.805	482.795	506.935	532.282	558.896	586.841	616.183	646.992	679.341	1.802.495	1.892.620	1.987.251	2.086.613	2.190.944	39.270.250	
204	1.266.993	1.380.864	1.504.471	1.638.622	1.784.196	1.942.140	2.113.479	2.299.325	2.500.876	2.949.851	3.205.248	16.303.411	17.661.759	19.131.478	20.721.614	22.441.942	275.267.315	
205	5.589.899	6.970.763	8.475.234	10.113.856	11.898.052	13.840.192	15.953.672	18.252.997	20.753.872	23.703.723	26.908.971	195.310.521	212.972.280	232.103.759	252.825.373	275.267.315		
206																		
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COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	BA	BB	BC	BD	BE	BG	BH
222																		
223	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021							
224																		
225	2,670,854	2,492,797	2,314,740	2,136,683	1,958,626	1,780,569	1,602,512	1,424,456	1,246,399	1,068,342	890,285							
226	0	0	0	0	0	0	0	0	0	0	0						3,917,253	
227	178,057	178,057	178,057	178,057	178,057	178,057	178,057	178,057	178,057	178,057	178,057						3,917,253	
228	2,492,797	2,314,740	2,136,683	1,958,626	1,780,569	1,602,512	1,424,456	1,246,399	1,068,342	890,285	712,228							
229	320,502	299,136	277,769	256,402	235,035	213,668	192,301	170,935	149,568	128,201	106,834						7,537,183	
230																	0	
231	2,590,853	2,454,493	2,318,132	2,181,771	2,045,411	1,909,050	1,772,689	1,636,328	1,499,968	1,363,607	1,227,246							
232	0	0	0	0	0	0	0	0	0	0	0						2,999,935	
233	136,361	136,361	136,361	136,361	136,361	136,361	136,361	136,361	136,361	136,361	136,361						2,999,935	
234	2,454,493	2,318,132	2,181,771	2,045,411	1,909,050	1,772,689	1,636,328	1,499,968	1,363,607	1,227,246	1,090,886							
235	310,902	294,539	278,176	261,813	245,449	229,086	212,723	196,359	179,996	163,633	147,270						5,765,082	
236																	0	
237	5,261,707	4,947,290	4,632,872	4,318,455	4,004,037	3,689,619	3,375,202	3,060,784	2,746,366	2,431,949	2,117,531							
238	0	0	0	0	0	0	0	0	0	0	0						6,917,188	
239	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418						6,917,188	
240	4,947,290	4,632,872	4,318,455	4,004,037	3,689,619	3,375,202	3,060,784	2,746,366	2,431,949	2,117,531	1,803,113							
241	631,405	593,675	555,945	518,215	480,484	442,754	405,024	367,294	329,564	291,834	254,104						13,302,265	
242																		
243	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
244																	16,275,737	
245	1,266,993	1,380,864	1,504,471	1,638,622	1,784,196	1,942,140	2,113,479	2,299,325	2,500,876	2,949,851	3,205,248	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	275,267,315	
246	1,266,993	1,380,864	1,504,471	1,638,622	1,784,196	1,942,140	2,113,479	2,299,325	2,500,876	2,949,851	3,205,248	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	258,991,578	
247																		
248																		
249	15	16	17	18	19	20	21	22	23	24	25	45	46	47	48	49		
250	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
251	4,947,290	4,632,872	4,318,455	4,004,037	3,689,619	3,375,202	3,060,784	2,746,366	2,431,949	2,117,531	1,803,113							
252	631,405	593,675	555,945	518,215	480,484	442,754	405,024	367,294	329,564	291,834	254,104						13,294,725	
253	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418						6,917,188	
254	945,823	908,092	870,362	832,632	794,902	757,172	719,442	681,712	643,982	606,251	568,521						20,211,913	
255	1,266,993	1,380,864	1,504,471	1,638,622	1,784,196	1,942,140	2,113,479	2,299,325	2,500,876	2,949,851	3,205,248	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	275,267,315	
256	469,291	469,291	469,291	469,291	469,291	469,291	469,291	469,291	469,291	469,291	469,291						9,385,830	
257	344,495	344,495	344,495	344,495	344,495	344,495	344,495	344,495	344,495	344,495	344,495						6,889,907	
258	-178,199	-26,597	134,739	306,621	489,925	685,599	894,668	1,118,244	1,357,525	1,844,230	2,137,358	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	245,696,853	
259	-9,423,074	-9,449,671	-9,314,932	-9,008,311	-8,518,386	-7,832,787	-6,938,119	-5,819,875	-4,462,350	-2,618,120	-480,762	165,740,059	183,401,819	202,533,297	223,254,911	245,696,853		
260	-1.1%	-0.2%	0.8%	1.9%	3.0%	4.2%	5.5%	6.9%	8.3%	11.3%	13.1%	100.2%	108.5%	117.5%	127.3%	137.9%		
261	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
262	1,266,993	1,380,864	1,504,471	1,638,622	1,784,196	1,942,140	2,113,479	2,299,325	2,500,876	2,949,851	3,205,248	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	71,433,392	
263	945,823	908,092	870,362	832,632	794,902	757,172	719,442	681,712	643,982	606,251	568,521	0	0	0	0	0	20,211,913	
264	1.34	1.52	1.73	1.97	2.24	2.56	2.94	3.37	3.88	4.87	5.64							

COMPUTATION OF FIRR AND ROE FOR THE KALU GANGA PROJECT

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	BA	BB	BC	BD	BE	BG	BH
265	15	16	17	18	19	20	21	22	23	24	25	45	46	47	48	49		
266	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
267	1,684,050	1,818,774	1,964,276	2,121,418	2,291,131	2,474,422	2,672,375	2,886,165	3,117,059	3,596,842	3,884,590	18,105,906	19,554,379	21,118,729	22,808,227	24,632,886	314,537,565	
268	417,057	437,909	459,805	482,795	506,935	532,282	558,896	586,841	616,183	646,992	679,341	1,802,495	1,892,620	1,987,251	2,086,613	2,190,944	39,270,250	
269	1,266,993	1,380,864	1,504,471	1,638,622	1,784,196	1,942,140	2,113,479	2,299,325	2,500,876	2,949,851	3,205,248	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	275,267,315	
270	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	0	0	0	0	0	16,275,737	
271	631,405	593,675	555,945	518,215	480,484	442,754	405,024	367,294	329,564	291,834	254,104	0	0	0	0	0	13,302,265	
272	-178,199	-26,597	134,739	306,621	489,925	685,599	894,668	1,118,244	1,357,525	1,844,230	2,137,358	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	245,689,313	
273	-9,430,614	-9,457,211	-9,322,472	-9,015,851	-8,525,926	-7,840,327	-6,945,659	-5,827,415	-4,469,890	-2,625,660	-488,302	165,732,519	183,394,279	202,525,757	223,247,371	245,689,313		
274																		
275	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
276	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	0	0	0	0	0	16,275,737	
277	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	0	0	0	0	0	6,917,188	
278									0	0	0	0	0	0	0	0	11,590,631	
279																	11,590,631	
280	0	0	0														5,080,976	
282																		
283	321,171	472,772	634,108	805,990	989,294	1,184,968	1,394,038	1,617,613	1,856,894	2,343,599	2,636,727	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	260,128,838	
284	440,351	913,123	1,547,231	2,353,222	3,342,516	4,527,484	5,921,521	7,539,134	9,396,029	11,739,628	14,376,355	180,172,045	197,833,804	216,965,282	237,686,896	260,128,838		
285																		
286																		
287																	9,358,549	
288																	0	
289	0	0	0														5,080,976	
290	0	0	0														14,439,525	
291																	14,439,525	
292	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2041	2042	2043	2044	2045		
293	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-14,439,525	
294	321,171	472,772	634,108	805,990	989,294	1,184,968	1,394,038	1,617,613	1,856,894	2,343,599	2,636,727	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	260,128,838	
295																		
296	321,171	472,772	634,108	805,990	989,294	1,184,968	1,394,038	1,617,613	1,856,894	2,343,599	2,636,727	16,303,411	17,661,759	19,131,478	20,721,614	22,441,942	245,689,313	245,689,313
297															ROE (at the year of 1997) =		9.6%	
298																	9,358,549	
299	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,917,188	
300	4,947,290	4,632,872	4,318,455	4,004,037	3,689,619	3,375,202	3,060,784	2,746,366	2,431,949	2,117,531	1,803,113	0	0	0	0	0		
301	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	314,418	0	0	0	0	0	6,917,188	
302																	16,275,737	
303																		
304	9,564,662	8,750,875	7,937,089	7,123,302	6,309,515	5,495,728	4,681,941	3,868,154	3,054,368	2,240,581	1,426,794							
305	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	813,787	0	0	0	0	0	16,275,737	
306																		
307																		
308																		

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