SECTOR E

CONSTRUCTION PLAN AND COST ESTIMATION

VOLUME 3: SUPPORTING REPORT

SECTOR E: CONSTRUCTION PLAN AND COST ESTIMATION

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SECTOR E CONSTRUCTION PLAN AND COST ESTIMATION

1. GENERAL

The construction plan and cost estimation is prepared for the following structures proposed as the optimum structural flood mitigation scheme:

(1) Community pond in Fatima Jinnah Park;

(2) Flood diversion channel, which includes the river improvement of Kurang River proposed as the outlet channel of the proposed diversion channel; and

(3) Supplementary works for the on-going channel improvement presently made between Chaklala Bridge and Kattarian Bridge by RDA

2. SUMMARY OF CONSTRUCTION WORKS

The construction works of the aforesaid four (4) structures are summarized as below:

2.1 Community Pond

The community pond is scheduled to complete through the urgent project (2004-2005) as described in the following chapter. The major works are broadly divided into the following three (3) portions: (1) Diversion works, (2) Construction of the flood mitigation facilities and (3) Construction of the amenity facilities. The works items and work volumes for these portions are as listed below:

Table R E.1 Major Construction Works of Community Pond

Work Item		Specification	Unit	Quantity
1. Diversion Facilities	1.1 Intake			
	Fixed Weir	H=2.5m	set	1
	Diversion Weir	H=5.2m	set	1
	Wet Stone Pitching		m^2	2,500
	Wet Stone Masonry		m^2	2,800
	1.2 Diversion Channel	L=1,340m、W=8m	set	1
	1.3 Box Culvert, etc.		L.S.	1
2. Flood Control Facilities	2.1 Detention Dam	Mixed type		
	Foundation Excavation		m^3	90,000
	Earth Fill	Homogeneous	m^3	160,000
	Concrete		m^3	31,000
	2.2 Pond Excavation		m^3	2,000,000
3. Amenity Facility	3.1 General Facilities			
	Entrance Gate		set	4
	Car Park		set	4
	Main Road	Asphalted	m	4,700
	3.2 Sports & Recreation			
	Multipurpose Ground		set	2
	Tennis Court		set	6
	Basket Court		set	4
	Other Facilities		set	1
	3.3 Landscape			
	Water-front Open Area		m^2	15,000
	Entrance Open Area		m^2	4,000
	Flower Bed		m^2	75,000
	Forest Park		m^2	417,000

2.2 Flood Diversion Channel

Construction of the flood diversion channel would be made through two (2) phases, namely: the short-term project (2005-2007) and the long-term project (2008-2012) as described in the following chapter. The major works for the construction are also divided into the following four (4) portions: (1) Diversion channel from Bedarawali Kas to Tenawali Kas, (2) Diversion Channel from Tenawali Kas to Saidpur Kas, (3) Diversion channel from Saidpur Kas to Kurang River and (4) Improvement Kurang River. The works items and work volumes for these portions are as listed below:

Table R E.2 Major Construction Works of Diversion Channel

Work Item		Unit	Quantity (Short term)	Quantity (Long term)
1. Diversion Channel (Bedarawali Kas - Tenawali Kas)	1.1 Fixed Weir	place	0	1
	1.2 Diversion Weir	place	0	1
	1.3 Diversion Channel			
	Common Excavation	m^3	0	1,148,000
	Revetment (wet stone masonry, wet stone pitching)	m^2	0	76,200
	Concrete (reinforced concrete & floor concrete)	m^3	0	33,840
	1.4 Bridge	place	0	4
2. Diversion Channel (Tenawali Kas - Saidpur Kas)	2.1 Hydraulic Drop (Tenawali Kas & Kanitawali Kas)	place	2	2
	2.2 Intake Weir (Tenawali Kas)	place	1	1
	2.3 Diversion Weir (Saidpur Kas)	place	1	1
	2.4 Diversion Channel (L=2,150m)			
	Common Excavation	m^3	184,000	443,000
	Dike Embankment	m^3	26,000	47,000
	Revetment	m^2	0	30,400
	Concrete (Floor Concrete)	m^3	0	21,390
	Drainage Outlet	place	40	50
	2.5 Bridge	place	8	8
3. Diversion Channel (Saidpur Kas - Kurang River)	3.1 Hydraulic Drop (Ojhri Kas)	place	2	2
	3.2 Diversion Channel (L=5,126m)			
	Common Excavation	m^3	1,542,000	2,430,000
	Dike Embankment	m^3	49,000	84,000
	Revetment (wet stone masonry, wet stone pitching)	m^2	0	107,300
	Concrete (Floor Concrete)	m^3	0	18,400
	3.3 Hydraulic Drop (Diversion Channel)	place	1	1
	Common Excavation	m^3	9,000	9,000
	Concrete (Mass Concrete)	m^3	11,000	11,000
	Gabion Mattress W 1.0m x B 1.5m x T 0.5m	m^3	11,300	11,300
	3.4 Bridge	place	8	8
4. Improvement of Kurang River	4.1 Excavation and Embankment Works			
	Common Excavation	m^3	82,000	164,000
	Dike Embankment	m^3	82,000	164,000
	4.2 Slope Protection (sodding)	m^2	37,000	74,000
	4.3. Drainage Outlet	place	30	70
5. Compensation	5.1 House Evacuation (for diversion channel)		110	220
	For diversion channel	house	15	20
	For Improvement of Kurang River	house	110	220
	5.2 Land Acquisition (for Improvement of Kurang River	m^2	211,500	348,000

2.3 Supplementary Works for On-going Channel Improvement by RDA

The supplementary works are broadly divided in to the following two (2) portions, namely: (1) river improvement of Lai Nullah below Chaklala Bridge ((RD5+277-RD6+215) and (2) side slope protection works for the on-going channel river section of Lai Nullah from Chaklala Bridge to Kattarian Bridge (RD6+251-RD17+210). The river improvement of Lai Nullah below

Chaklala Bridge of the above item (1) is scheduled to complete through the urgent project (2004-2005), while the side slope protection works of the item (2) is through the short-term project (2005-2007), as described in the following chapter. The works items and work volumes for these portions are as listed below:

Table R E.3 Major Construction Works of Supplementary Works for On-going River Channel Improvement of Lai Nullah

Work Item		Unit	Quantity
1. Downstream River Improvement	1.1 Earth Work (Common Excavation)	m^3	31,000
	1.2 Slope Protection (Wet stone pitching)	m^2	41,000
	1.3. Compensation		
	Land Acquisition	m^2	8,000
	House Evacuation	house	0
2 Slope Protection	2.1 Revetment (Wet Stone Pitching)	m^2	302,000
	2.2 Compensation		
	Land Acquisition	m^2	0
	House Evacuation	House	0

3. CONSTRUCTION PLAN

3.1 Basic Conditions of Construction Plan

3.1.1 Earth Work

The performance of the construction machine is assumed as listed in Table R 7.3.1 taking the most suitable machine combination and the reuse of the excavation soil. Based on the performance of the construction machine, the construction period of earthwork was estimated.

Table R E.4 Performance of Construction Machines

Earthwork	Machine	Performance Capacity	Remarks
Excavation	Bulldozer (32 ton)	146.21 m^3/hr.	
Loading	Backhoe (1.0m^3)	104.00 m^3/hr.	
Carrying	Dump truck (10 ton)	30.86 m^3/hr.	Materials handling distance : 0.5km
	Dump truck (10 ton)	8.00 m^3/hr.	Materials handling distance : 8km
	Dump truck (10 ton)	6.70 m^3/hr.	Materials handling distance : 12km
Grading & compaction	Bulldozer (21 ton)	100.00 m^3/hr.	Disposal Area
Spreading material for fill work	Bulldozer (21 ton)	119.60 m^3/hr.	Dam Work
Spreading material for fill work	Backhoe (0.7m^3)	53.50 m^3/hr.	Dam Work
Compaction of material for fill work	Tamping Roller (20.7 to 34.5 ton)	55.00 m^3/hr.	Dam Work

3.1.2 Mass Concrete Placing Work

The construction period of mass concrete of the dam body is estimated on the basis of the following assumptions:

(1) The daily concrete placing capacity is 225 m^3 (15m in width x 10m in depth x 1.5m in height)

(2) The maximum casting height of 1.5m.

(3) One cycle of the daily concrete placing works will take 8 days, which include 2 days of form fabrication, 5 days for concreting and curing, and 1 day for dismantling.

3.1.3 Available Working Days

Construction works are much influenced by rainfall. The works related to soil materials in particular could be performed in the non-rainy days. Taking these conditions into account, the number of the available construction-days in a month is assumed at by 25 days. It is also assumed that each of the preparation, the temporary work and the clearing works would take 0.5 months.

3.1.4 Dumping Sites

The dumping sites for the excavated materials are provisionally assumed at Block H-12 and F-13 in Islamabad (refer to Fig. E.1).

3.2 Construction Procedure and Method

3.2.1 Community Pond

Fatima Jinnah Park will be developed as a community pond, which will be used as a community area except for flooding time. Proposed facilities are diversion facilities, flood control and landscape facilities.

Diversion facilities will be constructed to take water from the tributary of Bedarawali Kas.

Flood control facilities consist of a detention dam and the wet/dry pond.

The detention dam is composed of central concrete portion for water stop and homogeneous earth fill at abutments. For the foundation excavation of the concrete portion, it is necessary to make sure that the foundation ground retains the required bearing capacity. The concrete will be produced at concrete plants and placed by concrete pump cars. Earth works consist of foundation excavation, earth filling and drain construction. The foundation must have necessary resistance for bearing capacity, shearing force and piping. Earth fill work should be implemented in accordance with the compaction regulations to maintain the strength against settlement, shearing force and piping. Excavated materials at the pond will be used for filling material. Earthwork equipments are bulldozers and backhoes for excavation, dump trucks for transport, and tamping rollers for compaction.

Volume of excavated materials is estimated approximately 2,000,000m^3. 1,700,000 m^3 of that is reused for constructing the dam and landscape facilities, etc. The remaining is transported to the dumping site, graded and compacted. The dumping site will be set after consensus made among the concerned within CDA, according to the discussion with CDA planner. As the site will be selected in the CDA land, no compensation will occur.

Proposed locations for the dumping site are H-12, and H13 as shown in Fig. E.1.

The excavation work is implemented at day during the material is used for filling works at site, but it is done at day and night when the material is thrown to the dumping site. Two-shift work continues for about 7 months.

3.2.2 Flood Diversion Channel

Flood diversion channel is composed three-construction area as following:

(1) Diversion Channel (Bedarawali Kas – Tenawali Kas)

(2) Diversion Channel (Tenawali Kas – Saidpur Kas)

(3) Diversion Channel (Saidpur Kas – Kurang River)

The order of above mentioned channels is an order from the upstream to from downstream part.

Construction works on short-term project include parts of construction of (2) Diversion Channel (Tenawali Kas – Saidpur Kas) and (3) Diversion Channel (Saidpur Kas – Kurang River). In implementation of long-term project, widening and placing floor concrete of two channel aforesaid and construction of (1) Diversion Channel (Bedarawali Kas – Tenawali Kas) will be executed. The whole construction period will be expected eight (8) years.

As for this construction, Progress of construction is influenced by earthwork. The whole excavated materials become about 4,000,000 m^3.

Excavated materials from the diversion channel will be transported to the dumping site, CDA land locating within 12 km away, and graded and compacted. The site will be selected by CDA before the commencement of work. No land compensation occurs because it is located in CDA land. The proposed locations for the dumping site are H-12 and H-13 as shown in Fig. E.1. This earthwork will be implemented at day and night.

This canal will be lined with reinforced concrete, wet stone masonry and wet stone pitching. The reinforced concrete will be placed on channel bed. The wet stone masonry and the wet stone pitching is used for revetment of dike. In constructing this concrete-lined channel, covering depth of its concrete must be thick enough to resist absolution.

About Kurang River improvement, the major job is the earthwork including excavation and earth fill works. Excavated soil will be re-used for dike embankment work at site. Earth fill work should be implemented in accordance to the compaction regulations to maintain the strength against settlement, shearing force and piping.

3.2.3 Supplementary Works for On-going Channel Improvement by RDA

Surface of existing river dikes is protected by stone masonry to prevent erosion. In carrying materials for this work at the site, it is necessary to pay attention to safety measures because the sate located near densely populated area.

Excavated materials are transported to a dumping site, which is designated by TMA, 25 km away, then graded and compacted.

3.3 Construction Schedule

In accordance with the phased program, the entire construction period for the major work components of the optimum structural plan was assumed as shown in Table R E.5. The detailed construction schedule was further prepared based on the aforesaid work volumes and basic conditions for construction as shown in Tables E.1 and E.2.

Table R E.5 Entire Construction Period of Major Works

Work Item		Construction Period
1. Community Pond		Urgent (2004-2005)
2. Diversion Channel	2.1 Channel (Tenawali Kas-Kurang River, Qmax= 470 m^3/s)	Short-term (2005-2007)
	2.2 Channel (Bedarawali Kas-Kurang River, Qmax=1,790m^3/s)	Long-term (2008-2012)
	2.3 Improvement of Kurang River	Short/Long-term (2005-2012)
3. Supplementary Works for River Improvement of Lai Nullah	3.1 River improvement below Chaklala Bridge	Short-term (2004-2005)
	3.2 Side slope protection of the on-going improvement section	Short-term (2005-2007)

4. COST ESTIMATION

The preliminary cost estimate is an accurate measurement of costs derived from all construction tasks shown on figures with an overall completion status during the Master Plan stage. This estimate is used for the project evaluation and served as a baseline for cost studies prior to the cost estimate during the Feasibility Study stage.

4.1 Constitution of Project Cost

Project cost is composed of such costs as construction base cost, compensation cost, consultancy service cost, administration cost, price contingency, physical contingency and tax. All costs expressed in the Study based on the average prevailing market prices in 2002, and the exchange rate of currency of US$ 1.0 =120.06 yen (Japanese currency) = Rs. 58.0.

The constitution of the project cost is given a below:

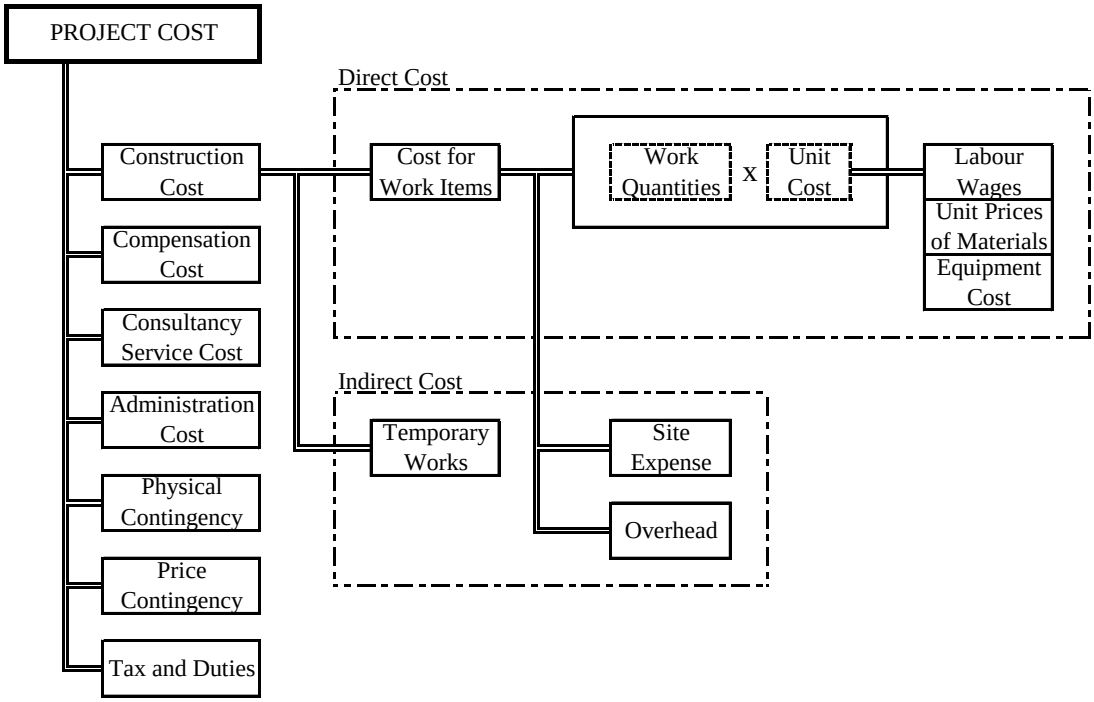

Fig. R E.1 Constitution of Project Cost

Administration cost, physical contingency, price contingency and tax are calculated by ratios which are expressed in percentage to other cost items. The explanation of each cost item is described below.

(1) Construction Cost : Construction cost is composed of direct cost estimated based on the work quantities multiplied by unit cost, and indirect cost which is estimated in percentage.

(2) Compensation Cost : Compensation cost consists of the land acquisition and house evacuation costs.

Item	States	Unit Price
Land Acquisition	Urban Area	Rs. 5,500 to 11, 000/m^2
	Rural Area	Rs. 1,600 to 2, 000/m^2
	Forest	Rs.500/m^2
House Evacuation	Urban Area	Rs.8,000,000/house
	Rural Area	Rs.50,000 to 100,000/house

(3) Consultancy Service Cost : Consultancy service cost is entirely expended for the construction supervision and detailed design services of consultants. It is estimated based on the status of the project (ease or difficulty), the time of year, number of required engineers and other expenses. Ten (10) % of the sum of the construction cost is adopted.

(4) Administration Cost : This cost is Project Owner's expenditures for the proper project management to execute the project implementation

smoothly. One (1) % of the sum of the construction cost and the compensation cost is adopted.

(5) Physical Contingency : Five (5) % of the sum of the construction base cost, the compensation cost, the administration cost and the engineering service cost is considered for contingent expenses for the incidental construction tasks.

(6) Price Contingency : This contingency is the cost for the price escalation. From the economical point of view, two (4) % per annum is adopted. The general price change rates of the monthly statistical bulletin (97-02) were referred for calculation of the inflation rate.

(7) Tax and Duties : 6.4 % of the sum of the construction cost, the consultancy service cost and contingencies shall be considered.

4.2 Construction Cost

The construction cost is estimated as the sum of the direct cost and the indirect cost.

4.2.1 Direct Cost

The estimate for direct costs is performed based on the quantities of all construction tasks shown on figures and described in the project requirements. The direct cost includes all of countable element due to the type, size, design, construction procedures and quality of the intended structure, which are taken into account when deriving the cost for each work item. The costs are estimated on the unit cost basis as shown below:

Direct Cost = Sigma (Unit Cost for a Payment Item x Work Quantity for a Payment Item).

The unit cost can be estimated based on the basic costs such as labor wage, unit prices of materials and equipment cost (refer to Tables E.3 to E.6).

4.2.2 Indirect Cost

The indirect cost on the project is an integral part of each estimate. “Temporary works”, “Site expense” and “Overhead” are considered as the indirect cost.

“Temporary works” includes items such as mobilization and demobilization, temporary buildings, electrical facilities, water supply system, access road construction and maintenance, and temporary utilities. 5 % of the sum of the direct cost is adopted.

"Site expense" includes the cost items such as salary and allowance of the Contractor's employee, job office expenses, consumables, small tools and insurance at site. 10 % of the cost for the direct cost and "Temporary works" is adopted.

"Overhead" is the expense for the main and branch office support of the Contractor composed of director's remuneration, retirement allowances, communication fee, advertising, research activities, social expense, profit and insurance. 8 % of the sum of the direct cost, "temporary works" and "site expense is adopted.

4.3 Project Cost

Based on the above assumptions, the project cost estimated for the optimum structural flood mitigation plan is estimated at Rs. 7,615 million in total, which is divided into (1) Rs. 1,137 million for the community pond, (2) Rs. 5,605 million for the flood diversion and (3) Rs. 873 million for the supplementary works for the on-going channel improvement of Lai Nullah. The project cost is also divided into (1) Rs. 1,267 million for the urgent project, (2) Rs. 2,857 million for the short-term project and (3) Rs. 3,492 million for the long-term project. As for the flood forecasting and warning system proposed as the non-structural flood mitigation plan, the project cost is estimated at Rs. 302 million, which would be invested during the term of the urgent project cost. The breakdown of the project cost is given in Tables E.7 to E.28, and as tabulated below:

Table R E.6 Project Cost for the Proposed Structural and Non-structural Flood Mitigation Plan

(Unit: Rs. million)

Work Item			Urgent Project	Short-term Project	Long-term Project	Total
Structural	Community Pond		1,137	-	-	1,137
	Diversion Channel	Channel (Tenawali Kas-Kurang River)	-	2,059	-	2,059
		Channel (Bedarawali Kas-Kurang River)	-	-	3,433	3,433
		Improvement of Kurang River	-	55	59	114
		Sub-total	-	2,113	3,492	5,605
	Supplementary Works for Lai Nullah	River improvement below Chaklala Br.	130	-	-	130
		Side slope protection of the river channel	-	743	-	743
		Sub-total	130	743	-	873
	Grand Total of Structural Plan		**1,267**	**2,857**	**3,492**	**7,615**
Non-structural	Flood Forecasting and Warning System	Equipment Cost	248	-	-	248
		Installation Cost	28	-	-	28
		Cost for Civil Works	10	-	-	10
		Materials/ other miscellaneous	16	-	-	16
	Grand-total of Non-structural Plan		**302**	**-**	**-**	**302**

4.4 Operation and Maintenance Cost

The operation and maintenance cost is assumed to consist of (1) the machine operation cost, (2) the machine maintenance cost, (3) the cost for the administrative and logistic support, (4) cost for repair of the structures and office running cost, and (5) the miscellaneous expenses. Based on the assumptions for these items as mentioned in the following items (1) to (3), the annual operation and maintenance cost is estimated at Rs. 3,256 thousand upon completion of the urgent project, Rs. 4,784 thousand upon completion of the short-term project and Rs. 5,373 thousand upon completion of the long-term project as listed in Table R E.7.

Table R E.7 Annual Operation and Maintenance Cost for the Components of the Structural Plan

(Unit: Rs. Thousand)

Item	Upon Completion of Urgent Project	Upon Completion of Short-term Project	Upon Completion of Long-term Project
(1) Machine operation cost	696	1,006	1,006
(2) Machine maintenance cost*	1,404	1,404	1,404
(3) Cost for administrative and logistic support	542	1,160	1,160
(4) Cost for repair of the structures and office running cost	460	986	1,547
(5) Miscellaneous expenses**	155	228	256
Total	3,256	4,784	5,373

*: Includes cost for regular maintenance, repair of the machineries, supply of spare parts
**: Assuming 5% of the items (1) to (4)

As for the flood forecasting and warning system, the necessary annual operation and maintenance cost is estimated at about Rs. 3 million, which is composed of Rs. 2.3 million for maintenance of equipment and Rs. 0.7 million for administrative/logistic support as listed in Table R E.8. This operation and maintenance cost would accrue immediately after completion of the urgent project in 2005.

Table R E.8 Annual Operation and Maintenance Cost for the Flood Forecasting and Warning System in the Non-structural Plan

(Unit: Rs. Thousand)

Item	Cost
Maintenance cost for equipment, office running cost, etc.	2,258*
Cost for administrative and logistic support	700
Total	2,958

*: 1% of procurement & installation cost of the equipment, civil works and other miscellanies direct cost.

Details of operation and maintenance cost for the structural plan are given in Tables E.29 and E.30. The necessary annual budget of the task force proposed in FFC should be squeezed out from both operation and maintenance costs (refer to Table E.31).

For future reference, necessary equipment during implementation as well as operation and maintenance is listed in Table E.32.

4.5 Cost for Alternative Study

4.5.1 Alternative Routes of Flood Diversion Channel

Three alternative routes to divert flood discharge to Kurang River are studied. Construction cost and compensation cost are given as follows (refer to Tables E.33 to E.35):

Table R E.9 Cost for Alternative Routes of Flood Diversion Channel

(Unit: Rs. million)

Alternative Routes	Construction Cost	Compensation Cost	Total
Route 1	4,383	366	4,750
Route 2	3,219	486	3,705
Route 3	3,308	2,188	5,496

4.5.2 Alternative Flood Mitigation Schemes for Long-term Project

The optimum flood mitigation scheme is determined through comparison of the alternative schemes. The project cost of each alternative is given as follows (refer to Table E.36):

Table R E.10 Project Cost of Alternative Flood Mitigation Schemes for Long-term Project

(Unit: Rs. million)

Alt. No.	Measure to reduce the peak flood discharge		Measures to increase the flood flow capacity		Supplementary to On-going River Improvement*	Total
	Community Pond	Flood Mitigation Dam	River Improvement (Deepening of Channel)	Flood Diversion		
Alt. 1	851	2,792	1,948	4,239	873	10,702
Alt. 2	851	-	1,948	4,901	873	8,573
Alt. 3	-	2,792	1,948	4,486	873	10,099
Alt. 4	851	2,792	-	4,803	873	9,319
Alt. 5	-	-	1,948	5,178	873	7,999
Alt. 6	851	-	-	5,605	873	7,330
Alt. 7	-	2,792	-	5,068	873	8,733
Alt. 8	-	-	-	6,574	873	7,448