DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MAHAWELI AUTHORITY OF SRI LANKA (MASL)

PREPARATORY SURVEY
ON
MORAGAHAKANDA DEVELOPMENT PROJECT

FINAL REPORT

VOLUME II
APPENDIX (1/2)

JULY 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

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APPENDIX A GEOLOGY REPORT

1. Introduction

Geological Investigations for Moragahakanda dam were commenced by USOM in 1959, and core drilling surveys were subsequently done by UNDP/FAO and Irrigation Department of Sri Lanka in 1967/1968 and 1977/1978 respectively. A full-scale geological investigation including core drilling, seismic prospecting, work adit, in-situ rock shear test, construction material survey and test grouting was carried out for the feasibility study by JICA in 1979 (hereinafter referred to FS (1979)).

Almost twenty years had past after FS (1979), additional feasibility study including 34 drill holes was carried out by Lahmeyer International Associates in 2000/2001 (hereinafter referred to FS (2001)). Subsequently, supplemental geological investigations including core drilling, electric resistivity survey and laboratory tests for rock materials were done by MASL in 2007.

FS (2001) concentrated almost on leakage risk of 'calcareous gneiss' at dam site and its reservoir which might cause serious problem for the project, and mentioned excavation depth of the dam site and foundation treatment, however, no mention of dam foundation rock or construction materials, and few necessary drawings to for detailed design were prepared. Therefore, it should be noted that a comprehensive geological study to close examine the results of the previous geological investigations is necessary in the early stage of the detailed design.

The scopes of the geological study in this SPROF are to, especially considering geological issues which might cause serious problems to the project, 1) review FS (2001) report, 2) summarize the related geological data of the project, and 3) propose necessary geological investigations based on the results of this study.

For the above purpose, the site reconnaissance of the project area was carried out from January 15th -24th , 2010. During this site reconnaissance, calcareous gneiss outcrops on the cut slope of the diversion road and DN-series drill cores (37 holes in total) were observed and analyzed. The geological condition and springs between the right bank of the dam site and the narrow ridge about 2 km upstream of the dam site was also surveyed to assess water tightness of the dam reservoir.

This report was prepared based on the results of the site reconnaissance and the report reviewing mentioned above.

2. Previous Geological Investigation

2.1 Data Availability

Available previous geological investigation reports are listed as below.

- Feasibility Report on The Moragahakanda Agricultural Development Project prepared by JICA in 1979
- Final report on Feasibility study of Moragahakanda Development Project prepared by Lahmeyer International associates in 2001
- Some Geological Aspects in the Area around Moragahakanda Dam site by H.A. Dharmagunawardhane, Department of Geology, University of Peradeniya, Oct, 2000
- Geological Mapping around Elahara-Moragahakanda Area by A. Pitawala and H.A. Dharmagunawardhane, Department of Geology, University of Peradeniya, Nov, 2000
- Some hydrogeological observations in Proposed Moragahakanada Reservoir Area by H.A. Dharmagunawardhane, Department of Geology, University of Peradeniya, Dec, 2000
- Feasibility Study of Moragahakanda Development Project, Geotechnical Investigations, Section 3 Photographs of Core Samples DN-01-DN-15, Section 5 Photographs of Core Samples DN 13, DN15 to DN34 by Central Engineering Consultancy Bureau (CECB), 2000
- Geotechnical Investigations of Moragahakanda Reservoir-Saddle Dam 01 Reservoir Area & Quarry Site, volume-I Borehole Logs, Photographs of Core Samples & Laboratory Test Results, volume-II Daily Drilling Records & Water Pressure Test Results, and volume-III Resistivity Imaging Survey prepared by CECB in 2007

2.2 Quantities of Previous Geological Investigation

Geological investigations of Moragahakanda dam site have been carried out in the several phase as mentioned above. Quantities of previous geological investigations are summarized in Table 2.1. Core boxes of DN-series were stored in MASL site office. However, ones of DH, DM, DW, and GH-series were not available.

Table 2.1 Previous Geological Investigations

Period	Carried out by	Geological Investigations	
1959-1961	USOM	- Core Drillings: 24 holes (DH-1 to DH-24)	more than 1500 m in total 9 test pits Geophysical survey (details unknown)
1967-1968	UNDP/FAO/ID	- Core Drillings: 16 holes (DH-108 to DH-128)	
1977-1978	Irrigation Department	- Core Drillings: 29 holes, 902.1 m in total, (DM-1 to DM-28)	
1979	JICA	- Core Drillings: 14 holes, 713.15 m in total, (DM-29 to DM-41, DW-1 to DW-2) - Grouting tests: 6 holes, 175.50 m in total, (GH-1 to GH-6) - Seismic Prospecting: 12 lines, 5305 m in total - Adit survey: 8 adits, 133.4 m in total - In-situ test (Block shear tests) - Laboratory tests - Construction material survey	
2000-2001	Lahmeyer International and Associates	- Core drillings: 34 holes, 1390 m in total, (DN-1 to DN-34) - Test pitting: 1 pit - Groundwater monitoring of drill holes	
2007	MASL	- Core Drillings: 8 holes (DN-36, DN-37, DN-38 and DN-40, MQ-01 to MQ-04), 343.12 m in total - Electric resistivity sounding at SD-1: 6 lines (EP 50 –EP-55), 2120 m in total	

Source of data: FS2001 report

3. General Geology

The general geology of the project has been described in the previous feasibility report by JICA (1979) and it is cited here:

"Geologically, the island of Ceylon is a part of the very old and stable continental mass of the South Indian Shield, consisting of highly crystalline metamorphic rocks [See ANNEX 1.1].

The most part of the island is composed of the pre-Cambrian Highland Series and Cambrian Vijayan Series; the former exposed in a belt with 50 to 100 km of width stretching in the direction of north-northeast to south-southwest through the middle part of the island and the latter forming about 50 km wide belts on both sides of it. Miocene sedimentary rocks are located in the northwestern coastal region. Besides these there is a very local patch of Mesozoic rocks in the northwestern part. Quaternary deposits are composed of unconsolidated material of various grain sizes, from clay to gravels, of which some are flood and terrace deposits formed along rivers, some are residual soil scree or talus on hill slopes and others are marine and lacustrine.

Geological history of Sri Lanka starts in the pre-Cambrian era with thick sedimentation in a geosyncline, which underwent regional metamorphism to produce metamorphic rocks of the Highland Series. In Cambrian period, another metamorphism exerting a part of the above metamorphic rocks resulted in poly metamorphosed Vijayan Series. From the late Palaeozoic to the late Mesozoic, it was a part of Gondwana Land which covered the southern hemisphere

extensively. During this period, the tectonic activity in Sri Lanka was predominantly upheaval and erosion, but for a very partial sedimentation occurred in Jurassic. The subsequent periods after disappearance of the Gondwana Land up to the recent age have still kept on seeing upheaval and erosion in the most parts of the island, except in the northwestern part where marine transgression occurred in Miocene. The outstanding development of the peneplains was also due to these activities.

Foldings are observed in these metamorphic rock beds of the Highland Series and the Vijayan Series. Trend of the folding axes shows north-south in general and northwestsoutheast in the southwestern part of the area of the Highland Series. In the area of the Vijayan Series, those axes are more varying in direction and less continuous. Faults show main trends of northeast-southwest and northwest-southeast.

The irrigation area of the Project develops in an extensive lower peneplain on the west bank of the lower Mahaweli Ganga and the Amban Ganga in the downstream reaches from the proposed dam site, about 4 km southwest from Elahera. From geological viewpoint the project area is situated for the most part in the zone of the pre-Cambrian Highland Series and partially in the transition zone from the Cambrian Vijayan Series expos ed on the eastern side of the Mahaweli main stream, all of which are composed of highly crystalline metamorphic rocks.

The Highland Series comprises three groups of rocks, that is, Khondalite group, charnockite and Kadugannawa gneisses, which occur in alternating thin strata and not in regionally separate formations. Rocks of the Highland Series are characterized by such contained minerals as garnet, sillimanite, graphite, cordierite and hypersthene, which are very rare of lacked in the polymetamorphic Vijayan Series. Quaternary unconsolidated deposits covering these rocks are within a few meters in thickness generally in the project area.

4. Geology of Moragahakanda Dam Sites

4.1 Topography

The general land level of the project area ranges from about 130 m to 150 m above sea level. The topography of the region is characterized by the low relief upland (ridge) and valley landscape, expect for isolated monad nockes or erosional remnants, which stand 30 to 100 meters or more above the general land level. The land slopes area of the order of about 4% to 8% and on such landscapes catenary of soils is observed from the ridge to the floor of the valley (FS (2001)).

4.2 Geology

4.2.1 Geological setting

The project site is underlain by Precambrian metamorphic crystalline rocks of Highland series and Cambrian metamorphic rocks of Vijayan series.

According to FS (2001) report, the foundation rocks of Moragahakanda dam site are composed of charnokites, quartz and Limestone-Calc gneiss, and other Gneiss (garnet-biotite-gneiss, garnetifeous gneiss or garnet gneiss).

Two rock types of calcareous (calc) gneiss (massive type and alternate layer type) are identified through the observation of new out crops and drill core in this study, and calc gneiss is possibly divided into some layers. This report, however, follows rock types proposed by FS (2001) basically, since the rock boundary of the two calc gneiss types and their stratigraphical sequence are not clear. Photographs of typical rock types are shown in Table 4.1.

Table 4.1 Typical Rock Type Photographs

Rock type	Photograph
Calc gneiss	<u>Massive type</u> Mineral constituent: calcite, quartz, biotite etc. <u>Alternate layer type</u> Remaining sedimentary structures Mineral constituent: calcite, quartz, biotite etc.
Garnet-biotite gneiss	Mineral constituent: quartz, feldspar, garnet, biotite etc. in various ratio
Charnockites	Mineral constituent: quartz, feldspar, pyroxene? Hard, massive
Quartz	Hard, but relatively brittle due to latent discontinuities

4.2.2 Stratigraphy

There are difficulties to establish the stratigraphy because the foundation rocks are subjected to repeated metamorphism and tectonic movements. In FS (2001) report, the following stratigraphical sequence was proposed from the results of drill survey, while the details were still remained unknown.

- upper calc gneiss
- garnet gneiss. locally including charnockites, charnockitic gneiss, quartz and quite rarely metamorphic limestone
- lower calc gneiss locally including garnet gneiss

In this study, outcrops of calc gneiss at both abutments of Saddle dam No.2, which is now under construction, were found as shown in Figure 4.1. Considering theses new findings and existing adjacent drill holes data (DH-11, DH-19 and DM-36), one calc gneiss layer model can explain the structures of the dam site better than two calc gneiss layers model as shown in Figure 4.2. Results of comparison of stratigraphical sequence are summarized in Table 4.2.

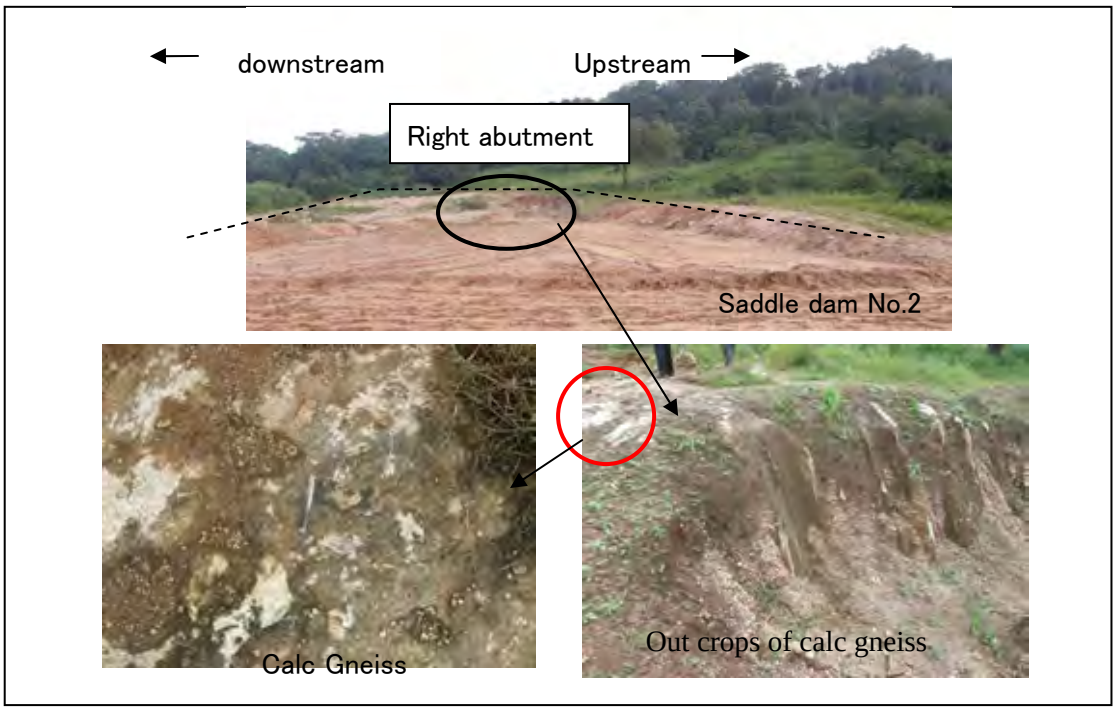


Fig. 4.1 Outcrops of Calc gneiss on the right abutment of Saddle Dam Bo.2

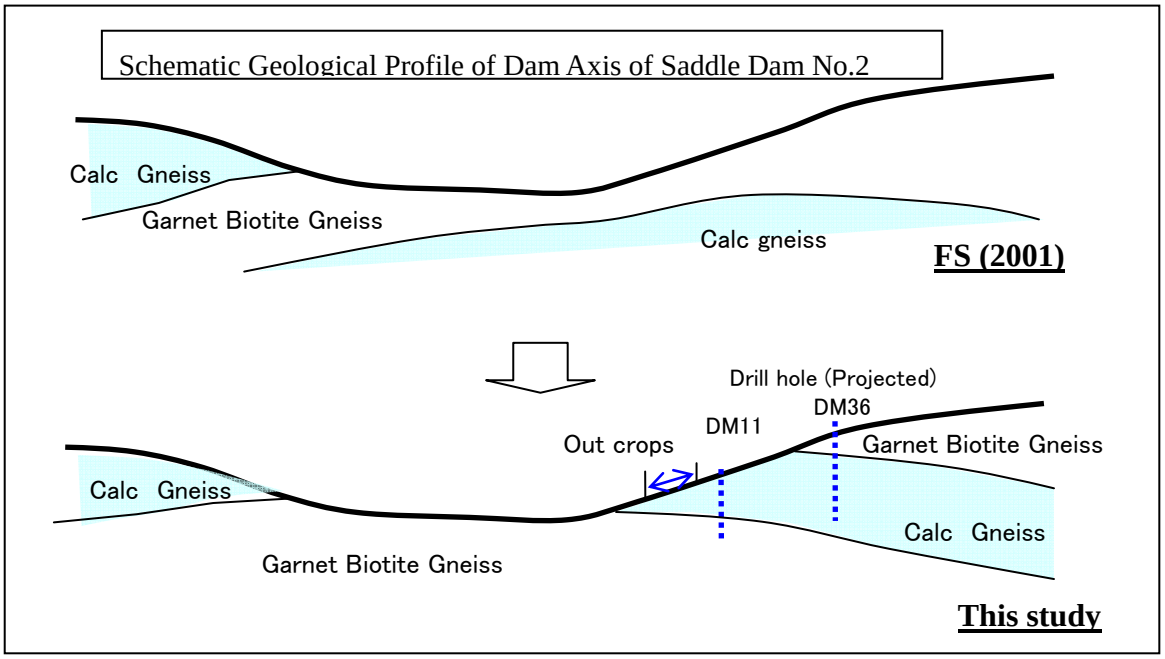


Fig. 4.2 Comparison of Stratigraphical Sequence Models in FS (2001) and this Study

Table 4.2 Stratigraphic Coolum of Foundation rock of Moragahakanda Project area

JICA (1979)		FS (2001)	This Study (2009)
Crystalline limestone Composed of calcite, often containing quartz and mica, massive solid		**Upper calc gneiss**	**Garnet-biotite gneiss/Charnockite/Quartzite**
Calc gneiss Composed of calcite, with quartz and/or mica in high proportion. Foliated bud solid			
Gneiss Generally siliceous and hard. Some including much garnet. Partly granulitic		**Garnet gneiss** (locally including charnockites, charnockitic gneiss, quartz and quite rarely, metamorphic limestone	**Calc gneiss (2 type)** - Alternation layers (3-5 cm thick) of calcareous gneiss with quartz in high proportion and biotite-rich calcareous gneiss - Massive, composed of calcite with quartz and mica in high proportion, and containing many fragments of biotite gneiss etc.
Charnockite Black or dark blue, massive and solid without foliation			
Quartzite Composed of quartz, some including garnet. Irregularly intercalating. Generally hard and cracky			
		Lower calc gneiss locally including garnet gneiss	**Garnet-biotite gneiss**

4.2.3 Structure

The technical structure is simple: the strata form a flat folding with gently inclined limbs. This structure is probably not really a fold but most likely a flat domical structure. Narrow foldings are non-existent (FS 2001).

4.2.4 Fault/Joint

Fault

Several NE-SW striking faults mainly with downthrown displacements up to several tens of meters are anticipated based on results of core drilling survey.

Gneiss and calc gneiss are in contact with fault at right abutment of saddle dam No.2.

Joint

Two sets of steep joints dominated the joint pattern, with strike directions parallel and perpendicular to the beddings; further sets exist with locally differing directions (FS 2001).

4.2.5 Fold

Between the right slope of the main valley and the left slope the left slope of saddle No.2 there exists a flat folding consisting of an anticline and a syncline. Their strike varies between NE-SW and NNE-SSW. The exact position of their axes is unknown (FS 2001).

4.2.6 Weathering

The depth of overburden varies considerably. In some places overburden soil does not exceed a few decimeters while in other places, it often reaches 15 m and more.

4.2.7 Karst

(1) General Condition of Cal gneiss

No general karstifications of the calc gneiss were found except for some karstic features at fault zone (Solution of fault zone is mentioned in next clause). Probably impure mineral constituent (containing much quartz and mica minerals) and crystalline cal gneiss is not susceptible to dissolution. Thickness of decomposed cal gneiss by weathering is 3 m-5 m in general.

Photographs of cal gneiss outcrops on the cut slope of diversion road at the left bank of the dam site and left bank of Saddle dam No.2 are shown in Figure 4.3.

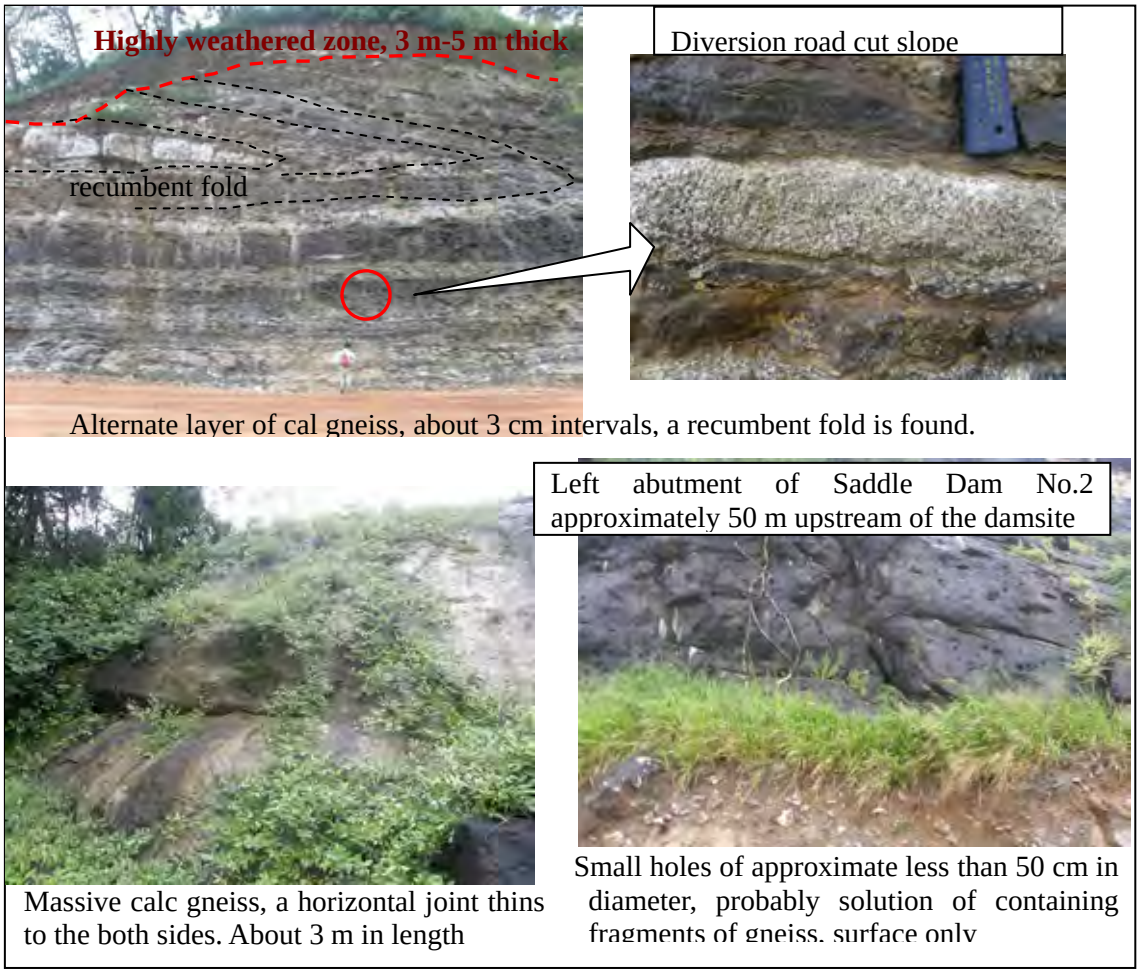


Fig. 4.3 Photographs of Cal gneiss Outcrops on the Cut Slope of Diversion Road at the Left Bank of the Damsite and Left Bank of Saddle dam No.2

(2) Solution and Cavity at Fault zone

Solution of fractured cal gneiss and small cavity were found on the cut slope of diversion road about 1 km upstream of damsite. A small cavity of 10 cm in width was found in an almost vertical NE-SW striking fault of 70 cm in width (See Figure 4.4).

Some karstic features are to be expected along certain fault zones, e.g. the zone along the right abutment of saddle No.1.

Fig. 4.4 Photographs of Solution and Cavity at Fault zone on the Cut Slope of Diversion Road at the Left Bank of the Damsite

4.2.7 Cenozoic Decomposed Deposits

River deposits, poor in gravel size materials, composed mainly of silt to coarse sand, occur along the river course in the vicinity of Main dam site. Thickness of river sand is about eight meters at the dam site. However, bed rocks are exposed on the river floor of the bridge about 4 km upstream of the dam site. Most of river sands are probably accumulated after the construction of the weir (ancient anicut) about 1.5 km downstream of the dam site.

River sand materials

5. Dam Foundation Engineering

5.1 Rock Condition

5.1.1 Strength of Dam Foundation

(1) Rock Classification

According to FS (1979), rock mass was classified based on weathering of rock mass and results of seismic prospecting as shown in Table 5.1.

Table 5.1 Rock classification of the dam site in FS (1979)

Rock classification	Velocity (Primary wave) km/s	Geological condition
Intensively weathered zone	0.6-1.0	Mostly decomposed by weathering, looks like sediment of sandy silt. Containing big fresh boulder (sometimes 2 m to 3 m in diameter)
Moderately weathered zone	1.2-1.5 (partly 1.5-1.7)	Partly decomposed by weathering, having wide open cracks (sometimes 1 m in width) filled by weathered sandy silt and clay
Slightly weathered zone	2.0-2.7 (partly 1.7-2.0)	Mostly fresh rock, with rare cracks. Cracks are strained by weathering, sometimes containing weathered clay (1 cm to 10 cm in width)
Fresh rock	5.5-6.0 (partly 4.4)	Massive and solid rock, with rare cracks. Cracks are closed tightly.

Rock mass of this study was classified based on Rock mass classification prepared by Central Research Institute of Electric Power Industry (CRIEPI), Japan (Tanaka 1964). Criteria of rock classification of CRIEPI are shown in Table 5.2.

Table 5.2 Rock Mass Classification: CRIEPI

Grade	Description
A	The rock mass is very fresh, and the rock forming minerals and grains undergo neither weathering nor alternation. Joints are extremely tight and their surfaces have no visible sign of weathering. Sound by hammer blow is clear.
B	The rock mass is fresh and solid. There is no open joint and crack. But rock forming minerals and grains undergo a little weathering and alteration partly. Sound by hammer blow is clear.
CH	The rock mass is slightly weathered and relatively solid. The rock forming minerals and grains undergo weathering except for quartz. The rock is contaminated by limonite, etc. The cohesion of Joints and cracks is slightly decreased and rock blocks are separated by firm hammer blow along joints. Clay minerals remain on the separation surface. Sound hammer blow is a little dim.
CM	The rock mass is moderately weathered and somewhat softened by weathering, except for quartz. The cohesion of Joints and cracks is somewhat decreased and rock blocks are separated by ordinary hammer blow along the joints. Clay materials remain on the separation surface. Sound by hammer blow is somewhat dim.
CL	The rock mass is highly weathered and soft. The rock forming minerals and grains are softened by weathering. The cohesion of Joints and cracks is decreased and rock blocks are separated by soft hammer blow along the joints. Clay materials remain on the separation surface. Sound by hammer blow is dim.
D	The rock mass is completely weathered and decomposed, and remarkably soft. The rock forming minerals and grains are softened by weathering. The cohesion of joints and cracks is almost absent. The rock mass collapses by light hammer blow. Clay materials remain on the separation surface. Sound by hammer blow is remarkably dim.

Note: Central Research Institute of Electric Power Industry (CRIEPI).

The correlation between the rock mass classification of FS (1979) and the classification of CRIEPI is estimated to be as follows:

This Study		**F/S (1979)**
Rock Class		**Rock Class**
B+		Fresh rock
CH-CM		Slightly weathered zone
CL		Moderately weathered zone
D		Intensively weathered zone

(2) Strength of dam foundation

According in-situ rock tests on shear strength and elasticity, performed in slightly weathered charnockites in the adit No.5 on the left abutment of main dam site (FS 1979), the following results were obtained.

Shear Strength	Cohesion 36 kgf/cm^2
	Internal friction angle 53 degrees
Modulus of elasticity	84,000 – 90,000 kgf/cm^2
Modulus of deformation	51,000 kgf/cm^2

FS (1979) report suggested the use of some lower moderate value for design, because the rock condition was apparently almost similar to the fresh rock and the value obtained for shear strength was somewhat higher than the standard values of slightly weathered rock.

Enormous laboratory and in-situ tests data have been accumulated and analyzed based on the CRIEPI Rock classification in Japan. Physico-mechanical properties of rock masses for the dam foundation can be rather accurately estimated based on the CRIEPI Rock classification accordingly.

Mechanical properties assumed based on the CRIEPI Rock class of solid rock mass as shown in Table 5.2. Considering results of seismic prospecting, in-situ test and rock condition observation of adit No.5 in this study, slightly weathered rock of the dam site will fall around the upper part of CM class in the rock grade range in Table 5.2.

Slightly weathered rock zone and fresh rock zone are competent enough in strength for dam foundation of 60 m class concrete gravity dam as well as impervious core of 50 m class rock fill dam.

Table 5.2 Rock Mass Classification and Rock Parameters by K. Kikuchi, et al.

Rock Grade	Uniaxial compress. strength (kgf/cm^2)	Static modulus of elasticity (kgf/cm^2)	Modulus of Deformation (kgf/cm^2)	Cohesion (kgf/cm^2)	Internal friction angle (deg.)	Velocity of elastic wave (km/sec)
B	800 or more	80,000 or more	50,000 or more	40 or more	55-65	3.7 or more
CH	800-400	80,000-40,000	50,000-20,000	40-20	40-55	3.7-3.0
CM	400-200	40,000-15,000	20,000-5,000	20-10	30-45	3.0-1.5
CL-D	200 or less	15,000 or less	5,000 or less	10 or less	15-38	1.5 or less

Source of data: Dr.K.Kikuchi, Mr.K.Saito & Mr.K.Kusunoki, ICOLD, May,1982

5.1.2 Expected excavation depth

The surface of slightly weathered rock zone is to be expected for dam foundation of concrete gravity dam and impervious core of rock fill dam.

Review results of expected excavation depth except for fault zone along the dam axis proposed in FS (2001) is shown in Table 5.3 and Appendix Figure 1 to Figure 5. Fault zone should be properly treated by concrete replacements etc. according to the rock condition of the dam foundation, if necessary.

This report tentatively designates the dam axis proposed in FS (2001) as the dam axis.

It should be noted that the most suitable dam axis is generally determined through comparison examination considering construction costs based on excavation volume, condition of dam foundation, foundation treatment and workability etc.

Rock conditions along the dam axis are:

- Overburden varies from less than 1 m to 10 m in depth.
- The surface of slightly weathered rock of right bank is likely deeper than one of left bank especially in Main dam and Saddle dam No.2.
- A fault zone with along the right abutment of saddle No.1 found in drilling core of DN-3, DN-33 and DN-16.
- A fault zone along the river course at main dam site is inferred from geological incongruency between drill holeDM-30 and DM-31.

Table 5.3 Expected Excavation Depth along the Dam Axis (G-G' Section and K-K' Section) proposed in FS (2001)

Location	Expected Excavation Depth (m)		
	Left bank	River floor	Right bank
Main dam	5-10	about 10	10-20
Saddle dam No.1	13-14	about 11	9-18
Saddle dam No.2	2-5	about 8	8-10

Note:

1. These excavation lines were estimated by use of drilling survey data carried out by 2001.
2. Excavation works of saddle dam No.2 was completed in 2009. Excavation depth of saddle dam No.2 should be used as reference.

5.2 Hydrogeological Condition of dam sites

5.2.1 Permeability of Dam Foundation

Expected impervious zone of the foundation rocks along the dam axis proposed in FS (2001) is summarized in Table 5.3. In this study, target Lugeon values of foundation treatment are estimated at less than 2 Lu for concrete dam and less 5 Lu for fill dam from experiences of dams in Japan dams. Lugeon maps along the dam axis are shown in Appendix Figure 6 to Figure 9.

Hydrogeological conditions of the damsite are:

- Most of impervious zone at the dam site is 10 m to 30 m in depth from the ground surface.
- Fault affected areas located at the right abutment of saddle No.1and river floor of main dam show pervious along the fault zones, and the depth of impervious zone is unknown.
- Since Lugeon values of the foundation rocks are not so high, the foundation rocks are possibly groutable accordingly, while their groutability is necessary to be ensured by in-situ tests.

Table 5.3 Expected Impervious Zone of Foundation Rocks along the Dam Axis (G-G' Section and K-K' Section) proposed in FS (2001)

Location	Expected Depth of the Surface of Impervious zone (m)			Target Lu value for Impervious zone
	Left bank	River floor	Right bank	
Main dam	5-15	about 55	11-25	less than 2 Lu for concrete dam
Saddle dam No.1	13-33	14-31	18-32	less than 5 Lu for fill dam
Saddle dam No.2	about 14	about 15	about 20	less than 5 Lu for fill dam

1. These impervious zone was estimated by use of drilling survey data carried out by 2001.
2. Foundation treatment of saddle dam No.2 was done in 2009. The results of foundation treatments need to be assessed.

5.2.2 Groundwater level

According to FS (2001), PVC pipes were installed in all drill holes carried out in 2000/2001 (DN-series) for groundwater monitoring after the survey. However, the monitoring works had not been carried out after then. Therefore, groundwater levels in the some important drill holes at the dam site were measured on 16 Jan -17 Jan, 2010 by the Study team to confirm stable groundwater level at dam site. Results of the measurement of ground water level are shown in Table 5.4.

(1) Right bank of main dam

According to FS (2001) report, groundwater level above FSL (185 m) was found during groundwater observation. However, the drill hole DN-28 is not available now, and DN-27 is too short to guarantee stable groundwater level.

(2) The hill between Main dam and saddle dam No.1

Groundwater level of the hill between main dam and saddle dam is below FSL (185 m)

(3) The hill between saddle dam No.1 and saddle dam No.2.

According to FS (2001) report, groundwater level above FSL (185 m) was found during groundwater observation. However, the drill hole DN-23 is not available now, and DN-24 is too short to guarantee stable groundwater level. There are also not negligible risks of groundwater downing in the drill hole section where near the boundary gneiss and calc gneiss as show in Figure 5.1.

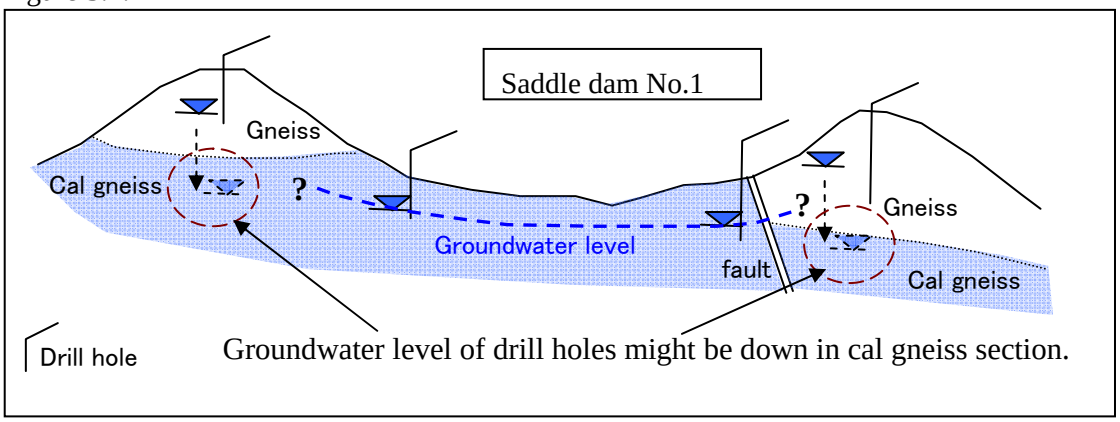


Table 5.1 Geology and Groundwater Image of Saddle dam No.1

(3) Left bank of saddle dam No.2

According to FS (2001) report, groundwater level above FSL (185 m) was found during groundwater observation. Although drill hole DN-10 was not available in this study for monitoring groundwater level, water flow was found above FSL just downstream of saddle dam No.2.

Ground water level is an important factor to assess the water tightness of damsite and determine the grouting area. This study was carried out just after wet season. Groundwater level and water flow of the both abutments measured in this study does not directly ensure stable groundwater level accordingly. Long-term monitoring of groundwater including dry season is necessary.
Furthermore, groundwater level of the hills between main dam and saddle dam No.1 is below FSL as mentioned above. It should be noted that foundation treatment to ensure water tightness of three dams (main dam, saddle dam No.1 and saddle dam No.2) should be designed in whole.

Table 5.4 Expected Impervious Layer of Foundation Rocks along the Dam Axis (G-G' Section and K-K' Section) proposed in FS (2001)

Hole No.	Location	Groundwater level		Remarks
		depth (m)	Elevation (m)	
DN-10	Saddle dam 2 (L.B)			Not available
DN-17	Saddle dam 1 (R.B)	10.8	166.45	16/01/2010
DN-18	Saddle dam 1 (L.B)			Not available
DN-26	Saddle dam 2 (R.B)			Not available
DN-27	Main dam (R.B)	16.2	224.61	16/01/2010 The bottom of the hole was 16.50 m in depth. Less reliable data
DN-32	Main dam (R.B)	10.4	160.17	16/01/2010
DN-33	Saddle dam 1 (R.B)			Not available
DN-34	Saddle dam 1 (L.B)			Not available

5.3 Water Tightness of Reservoir Area

Water tightness of from right bank of dam site to southeastward extending ridge was studied in FS (2001), because:

- Right bank of dam site and southeastward extending ridge is relatively narrow.
- Two NW-SE extending faults are inferred approximately 2 km and 4 km upstream of dam site by aerial photo interpretation

FS (2001) report concluded that the assumed faults will not cause water leakage according to the distribution of cal gneiss in existing geological map and ground water data.
However, site reconnaissance of this study reveals cal gneiss rocks extend to around the assumed fault approximately 2 km upstream of dam site as shown in Figure 5.2. It is accordingly necessary for ensuring water tightness to survey the distribution of cal gneiss considering FSL, and to monitor water flow especially in dry season. If permanent water flow is confirmed above FSL, the assumed fault will not cause water leakage.

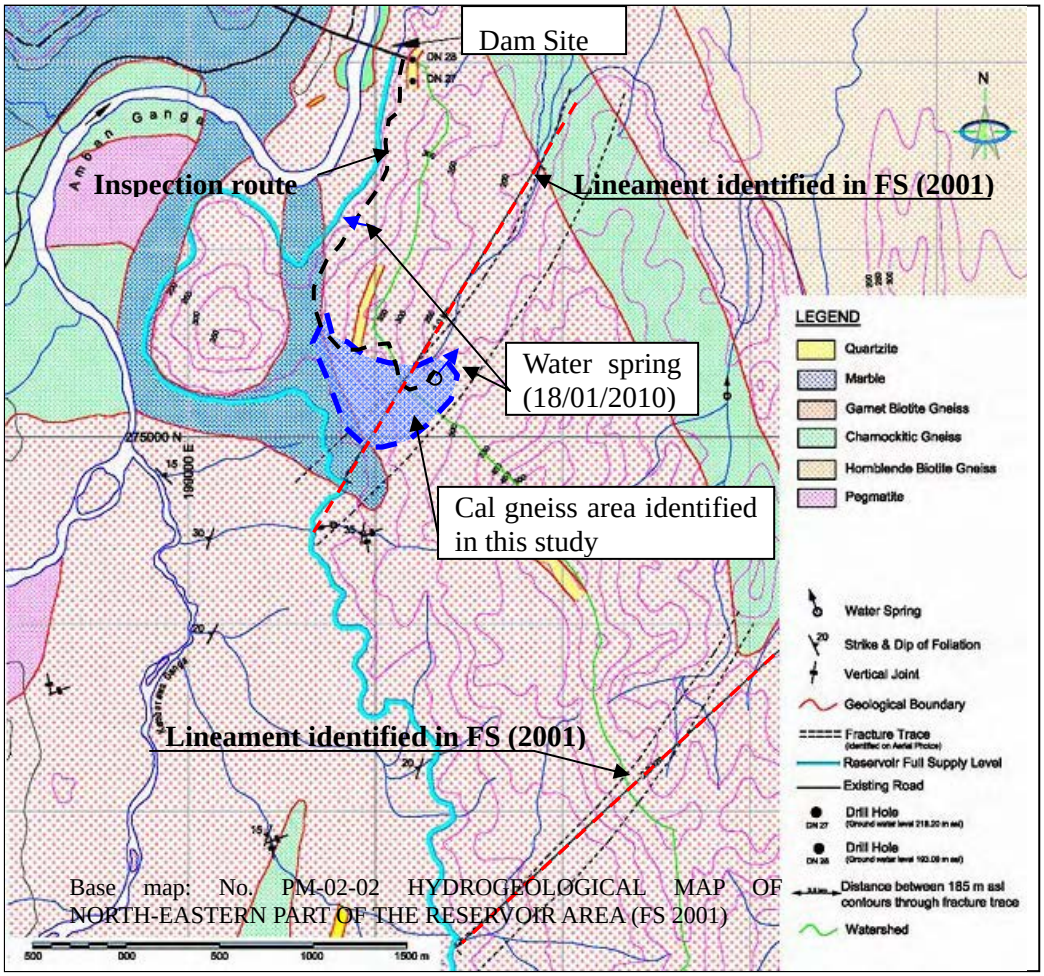


Fig. 5.2 Hydrogeological Condition of Reservoir Area

6. Construction Materials

6.1 Data Availability

Construction material surveys for Moragahakanda dam were conducted at four stages from 1961 to 1979 as shown in Table 6.1. All available data of the construction material surveys were analyzed in FS (1979). Supplemental rock material survey including four drill holes and laboratory tests was carried out by CECB in 2007. There are no descriptions of construction materials in FS (2001), a comprehensive study for construction materials are necessary for the detailed design accordingly. The following descriptions are review results of FS (1979) report based on the site inspection in this study.

Table 6.1 List of Available data on Previous Soil Survey in FS (1979)

No.	Available Data
1.	Map of Dam Site and Vicinity with Location of Soil Survey (Scale= 1:10,000)
2.	Report on the Preliminary Soil Investigation for Moragahakanda Reservoir Project, Oct 1960 - Location map of auger holes - Field notes and summarized data on logs of auger holes; 31 holes. - Summary of laboratory test results
3.	Report on the Investigation of Earth Materials for the Moragahakanda Reservoir Scheme, 1961 - Location map of test pits; 49 pits - Summary of laboratory test results
4.	Report on the Subsoil Investigation of Moragahakanda Reservoir, 1966 - Location map of auger holes and test pits - Logs of upstream test pits: 4 pits - Logs of upstream auger holes: 29 holes - Logs of downstream test pits: 9 pits - Logs of downstream auger holes: 97 holes
5.	Moragahakanda Dam Axis Soil Investigation, May 1978 - Logs of auger holes: 25 holes
6.	Moragahakanda Borrow Area Soil Investigation, Jul.-Nov. 1978 - Sketch of the location of test pits - Logs of test pits: 44 pits - Results of laboratory tests - Summary of laboratory test results - Results of the investigation of riverbed material
7.	FS (1979) - For soil materials; 4 test pits and 28 auger holes - For filter materials and fine concrete aggregates; 6 pits - For rock materials and coarse concrete aggregates; 4 drill holes (DM-29, DM-39, DM-40 and DM-41) and 2 blasting points - Laboratory tests - Large scale shearing test of rock materials using as adit in the damsite
8.	Geotechnical Investigations of Moragahakanda Reservoir-Saddle Dam 01 Reservoir Area & Quarry Site (2007) - For rock materials; 4 drill holes (MQ-1 to MQ-4) - Laboratory tests

Source of data:

- Feasibility Report on The Moragahakanda Agricultural Development Project prepared by JICA in 1979
- Geotechnical Investigations of Moragahakanda Reservoir-Saddle Dam 01 Reservoir Area & Quarry Site, volume-I Borehole Logs, Photographs of Core Samples & Laboratory Test Results prepared by CECB in 2007

6.2 Soil materials

(1) Location of borrow area

Borrow areas of impervious core materials are planned in wide plain area both of upstream and downstream of dam site. The thickness of soil layer is about 1.5-2.5 m and huge borrow area needs to be excavated. Impervious core materials for saddle dam No.2 are obtained at some borrow areas about 2-3 km downstream of the dam site. Soil materials of upstream area can be also expected both in quantity and quality. In respect with the excavation of the upstream of dam site, it should be reminded that the removal of natural blanket in the reservoir basin underlain by limestone possibly leads further leakage of reservoir (Dr. J.B. Auden 1965).

(2) Physical and mechanical properties

Soil materials are classified into SC materials, GS materials and CH, CL materials in Unified Soil Classification System. FS (1979) report has recommended the following design values. Considering the containing relatively weak materials classified into CL or CH, recommendable design criteria are determined in safety side.

Moisture content	21%
Specific gravity of soil particles	2.66
Dry density	1.61 t/m^3
Bulk density	1.95 t/m^3
Cohesion (saturated)	2.0 t/m^2
Cohesion (unsaturated)	4.0 t/m^2
Internal friction angle	17 degrees
Coefficient of permeability	10E-7 cm/s

(3) Suitability as impervious materials

The above SC material, GS material and CH, CL material are available for impervious materials.

GS material is the best quality among them, however, insufficient in quantity. The quality is followed by SC material and CH, CL materials in that order. Since soil materials are distributed only within a small depth, it is difficult to differentiate these three materials.

6.3 Filter materials/Fine Aggregates for Concrete

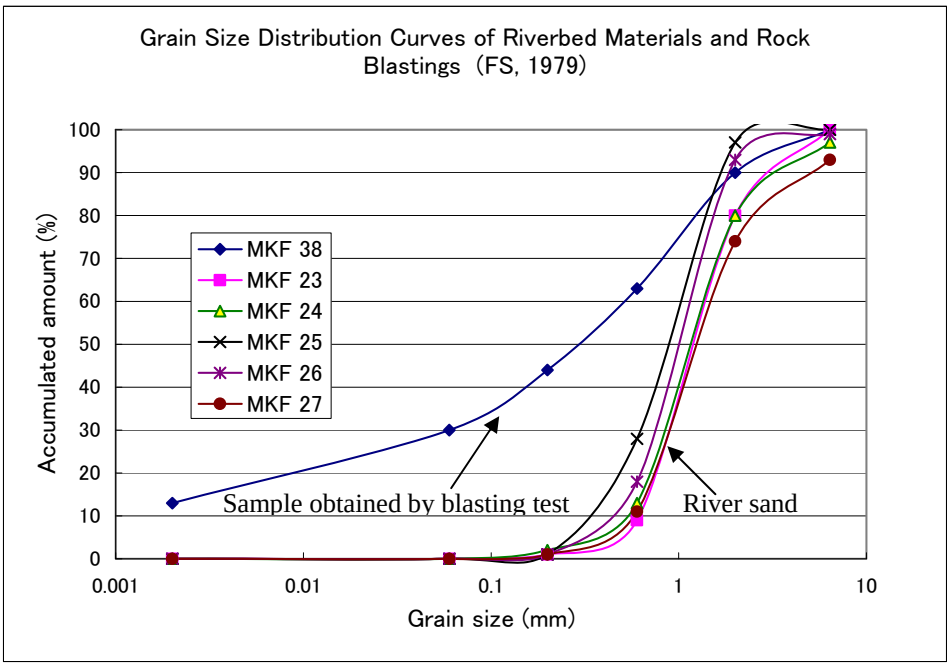
(1) Availability and exploitable quantity

River sand and crushed rocks are available for filter materials in the fill dam and fine aggregates for concrete. River sand deposits are distributed along recent river course from about 4 km upstream of the dam site to probably ancient anicut about 2 km downstream of dam site. These sand materials are likely deposited in the affected area of the dam uping by the ancient anicut. In fact, river bank deposits beside the river course are composed of fine sand to silt. Available amount of river sand is estimated at least 400,000 m^3 based on the results of survey in FS (1979).

(2) Physical properties

River sand materials is very clean (See Figure 6.1), and a fairly coarse sand with average with average uniformity coefficient of 2.64. This sand has a fineness modulus of 3.4 on the average.

Particle size distribution obtained from the adit of calc gneiss by rock blasting tests resulted finer particles was over 30%, which were unsuitable neither for the filter materials nor for fine aggregates. However, availability can not be judged by this one test results. This test sample might be biotite rich gneiss, calc gneiss or weathered rocks. Fresh charnockites and garnetiferous gneiss rocks (poor in biotite) are possibly competent in quality, according to observation of drill core samples and outcrops.



Prepared by the JICA Survey Team

Fig. 6.1 Gain Size Distribution Curves of Riverbed Materials and Rock Blastings

(3) Suitability as filter materials

River sand is available for filter materials. The only shortcoming is that the grain size distribution curve of river sand is not parallel to the one of impervious material but rather steep. Even this would not be problem if the width of the filter is taken lager than 3 m (FS (1979)).

FS (1979) report has recommended the following design values. Parameters of cohesion and internal friction angles were estimated based on general values of sand materials.

Moisture content	6%
Specific gravity of soil particles	2.62
Dry density	1.80 t/m^3
Bulk density	1.80 t/m^3
Cohesion	0 t/m^2
Internal friction angle	30 degrees

(4) Suitability as fine aggregates

River sand is available for filter materials. However, adjustment of grain size of river sand materials will be required by use of fine sand along the river or crushed rock materials to mitigate difficulties with workability, pumping or excessive bleeding due to the uniformity in grain size distribution and lack of particles finer than 0.15 mm.

6.4 Rock materials and Coarse Aggregates for Concrete

(1) Location of quarry site

Locations of Quarry sites in FS (1979) and drill holes MQ-1 to MQ-4 carried out in 2007 are shown in Figure 5.2. Drilling site of MQ-1 seems to be too close to damsite, and also quarry site of MQ-3 and MQ-4 site must be assessed in consideration of damages by blasting vibration and water tightness of the dam reservoir.

In previous study, upstream area underlain by calc gneiss and downstream area underlain by garnetiferous gneiss were considered for rock materials and coarse aggregates for concrete.

(2) Physical and mechanical properties and Suitability as rock materials

Gneiss rocks distributed around the dam site is suitable both in quantity and quality for rock materials (FS 1979).

FS (1979) report has recommended the following design values for rock materials using the results of laboratory tests of calc gneiss samples in Quarry (Q-II).

Moisture content	2%
Specific gravity of soil particles	2.70
Dry density	1.80 t/m^3
Bulk density	1.84 t/m^3

Internal friction angle	40 degrees (assumed)

(3) Physical and mechanical properties and Suitability as coarse aggregates

FS (1979) report judged that materials in Q-I site was suitable for coarse aggregates based on the results of the laboratory tests as shown below.

Average absorption	0.22%-1.0%
Soundness (% loss)	2.2%-10%
Abrasion after 100 rev.	7.4%-10%
Abrasion after 500 rev.	36.1%-40%
Specific gravity	3.02-2.6

However, results of abrasion test are relatively high, although the values satisfy the requirement of JIS standard. Additionally, particle size distribution obtained from the adit of calc gneiss by rock blasting tests is rather fine as mentioned Clause 5.3 (2). Calc gneiss is therefore recommended to be close-examined. Charnockites and garnetiferous gneiss (poor in biotite) is possibly superior to calc gneiss in quality, according to the observation of drill core samples and outcrops.

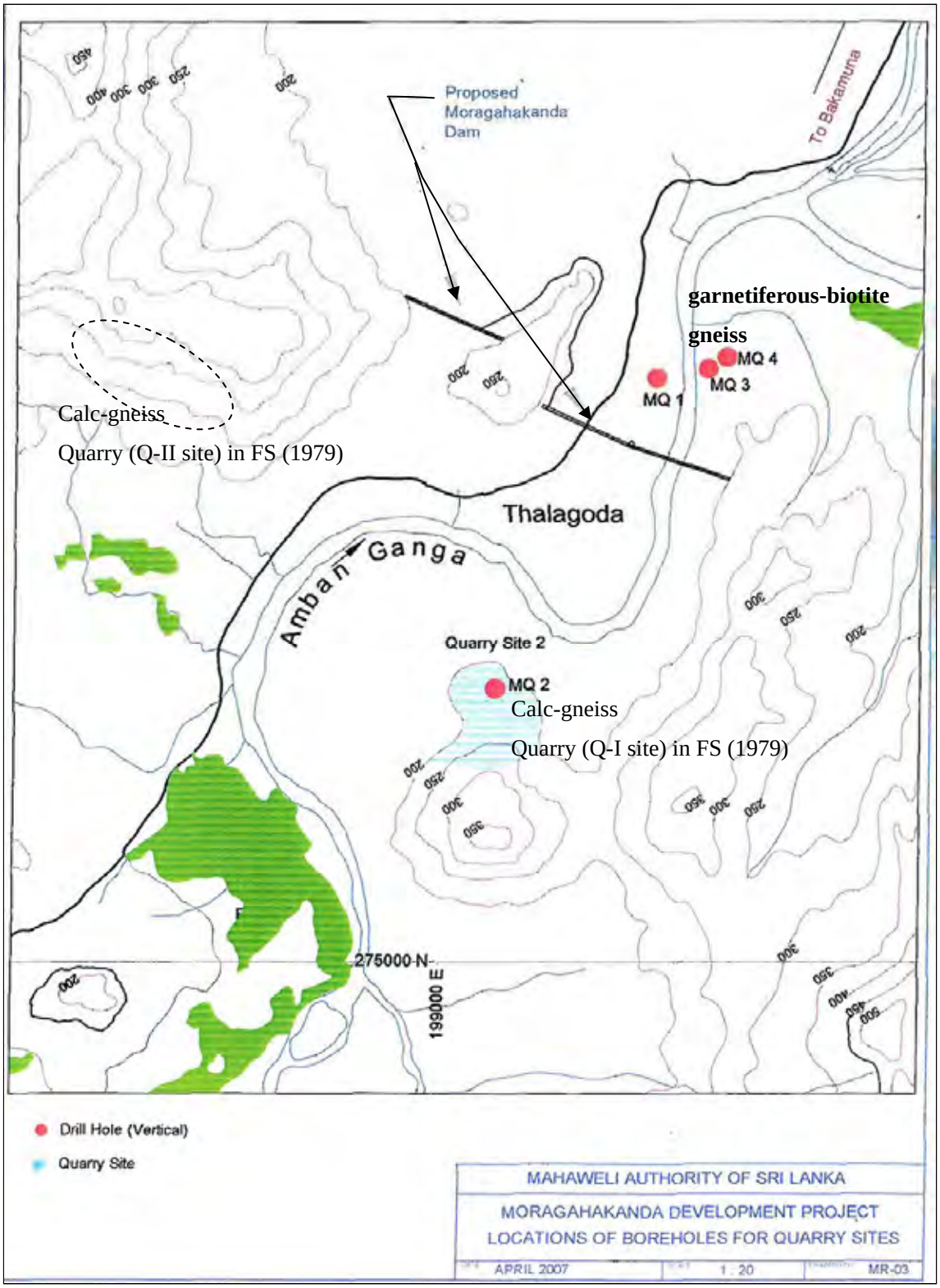


Fig. 6.2 Location Map of Quarry Site and Drill holes carried out in 2007 (base map: Geotechnical Investigations of Moragahakanda Reservoir-Saddle Dam 01 Reservoir Area & Quarry Site (2007))

7. Conclusion

Moragahakanda Dam site is underlain by gneiss. Slightly weathered rocks and fresh rocks are suitable for the dam foundation in strength. There are no serious problems in strength of foundation rocks.

Considerable issues of the dam site are water tightness of reservoir and groutability of cal gneiss rocks. No general karstifications of the calc gneiss were found except for some karstic features at fault zone and impervious zones (hydrogeological foundation) are confirmed except for fault zone. Considering these evidences mentioned above and the results of many drill survey, water leakage will not occur in the case that

- Faults zone are properly treated by grouting or other proper methods
- The both abutments of the dam site, where groundwater level does not exceed FSL, are properly treated by grouting or other proper methods.

Therefore, the additional geological investigations mentioned in the following clause are recommended for the detailed design of the dam.

8. Recommendation of Additional Geological Investigation

Locations of the drilling points and quantities are shown in Figure 10 of Appendix.

The purposes of additional geological investigation are to confirm:

1) Geological condition of fault and its permeability and groutability
   - ✓ Drill holes DN-101 to DN-104
   - ✓ Trench Tr-1

2) Water tightness of both abutment and reservoir area
   - ✓ Drill holes DN-105 to DN-108
   - ✓ Ground mapping and groundwater/spring water monitoring of the area covering right abutment of dam site to approximately 2 km upstream of dam site considering FSL as well as the opposite of reservoir area.

3) Water tightness of Saddle dam No.2
   - ✓ Evaluation of the results of grouting carried out in saddle dam No.2

4) Details of geological condition of the dam site
   - ✓ Comprehensive geological study to close examine the results of the previous geological investigations

- ✓ Preparation of necessary geological drawings
- ✓ Evaluation of the results of the previous geological investigations

Additionally, in the construction stage, observation of the foundation rocks and geotechnical assessment of faults will be critical information for foundation treatment. Geological information such as hardness, scale and direction of faults is necessary to be obtained during the observation.

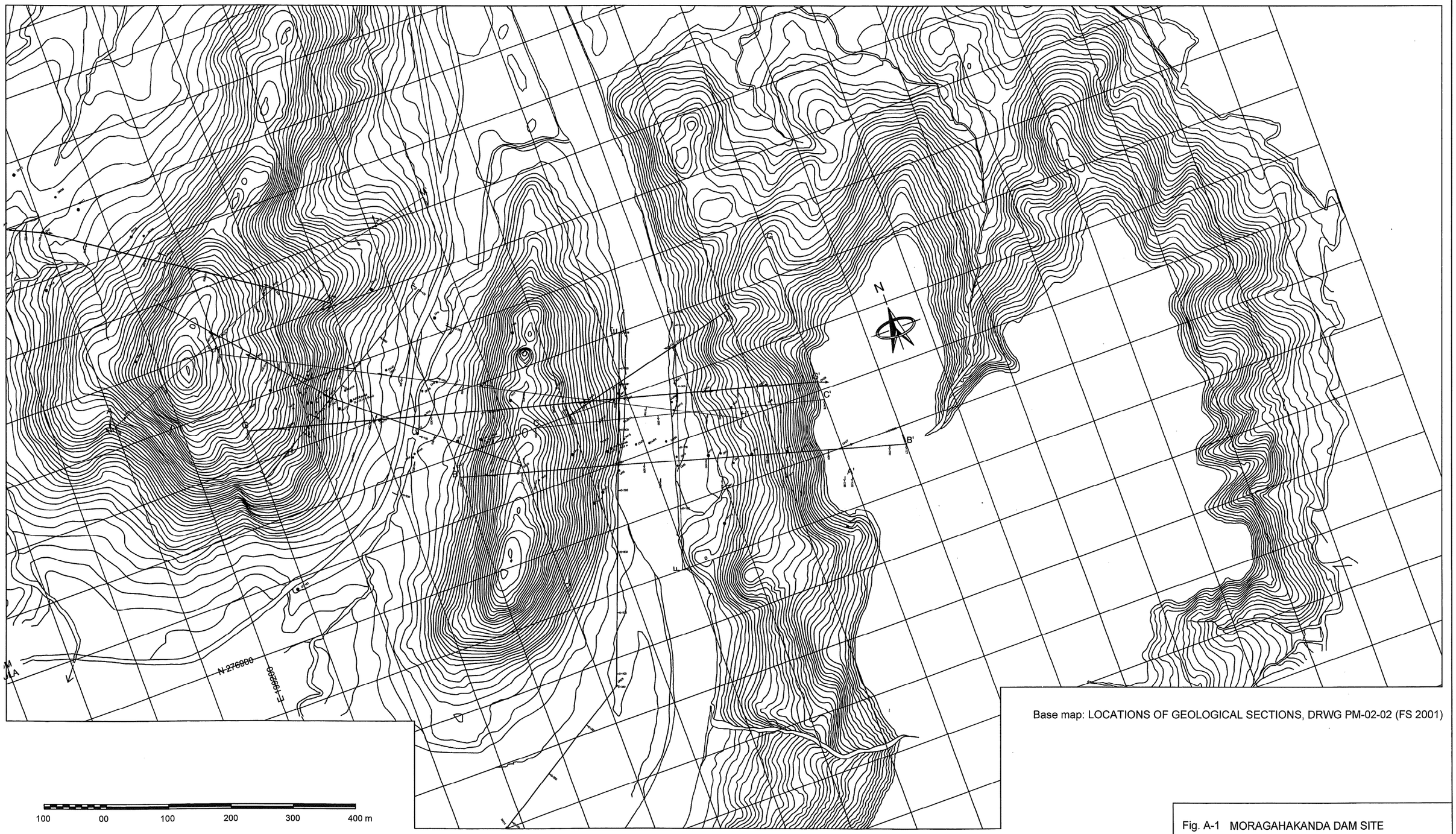
Locations and quantities of recommended additional investigation are shown in Table 8.1.

Table 8.1 Locations and Quantities of Recommended Additional Geological Investigation

Additional Geological Investigation of Dam site

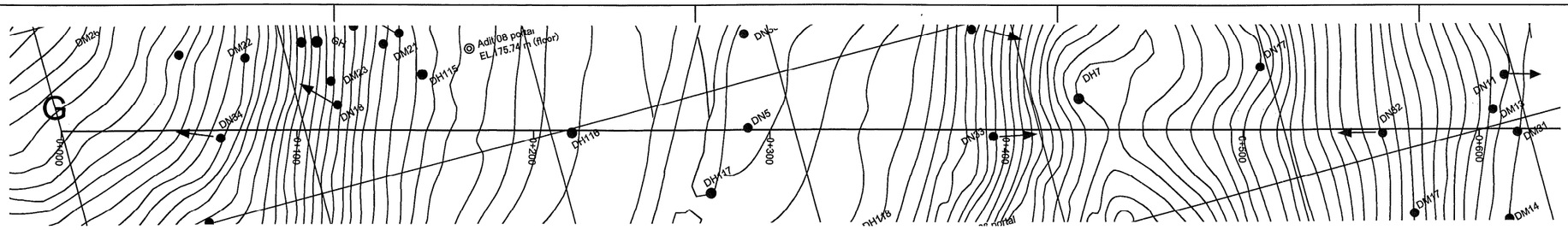
Drill Hole No.	Depth(m)	Inclination	Bearing	Location	In-situ test
DN-101	70	undecided	undecided	SD-1, right bank	Lugeon test - in the section of rock (including weathered rock) of the hole - 5 m intervals
DN-102	100	undecided	undecided	SD-1, right bank	
DN-103	75	45° to horizontal	295°	Main Dam, right side of the riverbed	
DN-104	100	(60° to horizontal)	(295°)		
DN-105	105	vertical	-	SD-1 left bank	
DN-106	70	vertical	-	Top ridge between SD-1 and SD-2	
DN-107	90	vertical	-	SD-2 right bank	
DN-108	80	vertical	-	MD right bank	
total	690				
Trench	Length (m)				
Tr-1	25				

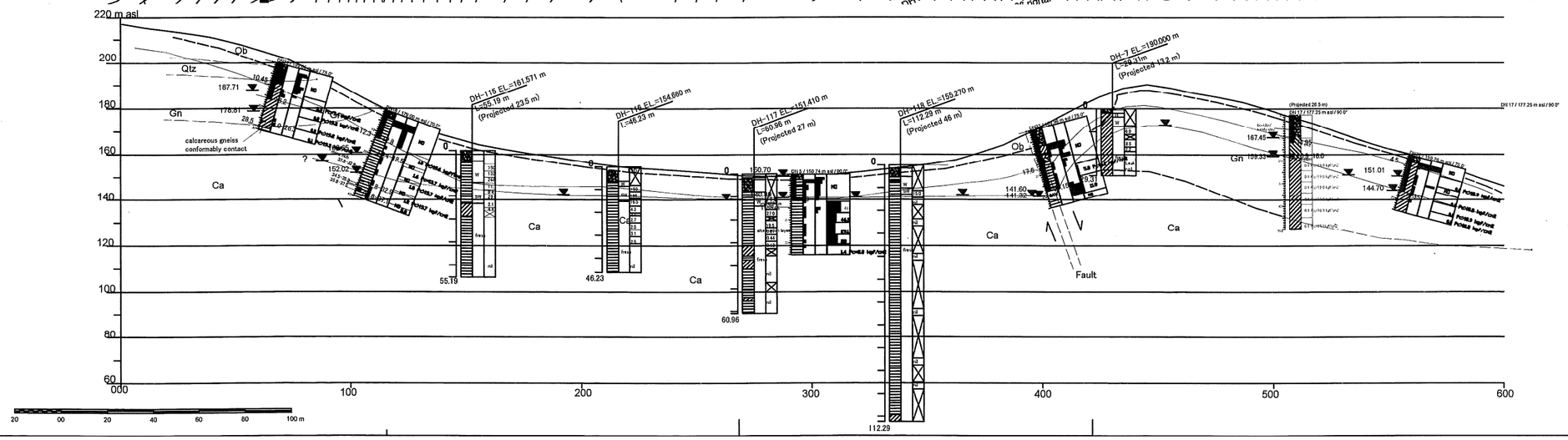
Note:
1. Location and Depth of Drill hole DN-101 and DN-102 shall be determined based on the results of trench surve
2. Location and depth of Drill hole DN-104 shall be determined based on the results of DN-103.
3. Quanties of drill hole might be revised according to the new findings in the field or the requirement from the alternative study of the dam types.



Base map: LOCATIONS OF GEOLOGICAL SECTIONS, DRWG PM-02-02 (FS 2001)

Fig. A-1 MORAGAHAKANDA DAM SITE
LOCATIONS OF GEOLOGICAL SECTIONS





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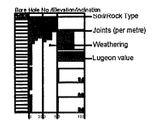


Soil and Rock Classification

- Overburden (Ob)
- Charnockite (Ch)
- Quartzo Biotite Gneiss (Gn)
- Calc Gneiss (Ca)
- Quartzite (Qtz)

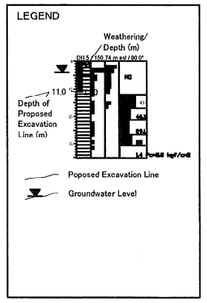
Weathering Classification

0 - Fresh
1 - Slightly
2 - Moderately
3 - Highly
4 - Completely
5 - Decomposed Soil

Jointing Classification (joints/m)

0-5	Slightly
5-10	Moderately
10-15	Distinctly
15-20	Heavy
>20	Very Heavy

LEGEND



Groundwater Elevation
For DH holes max. and min. levels observed since completion of drilling are indicated

Fault Axis

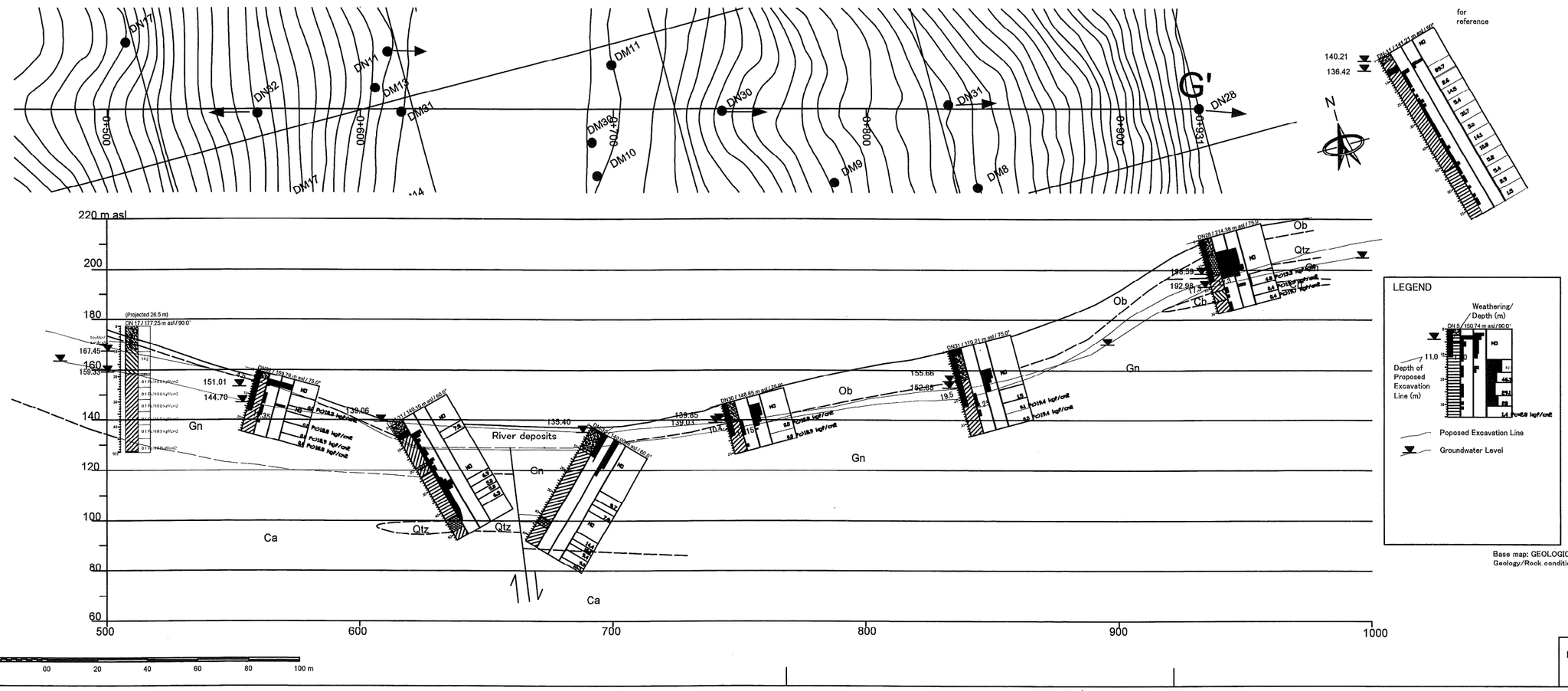
Ground Surface

Geological Boundary

Drill hole with direction if inclined

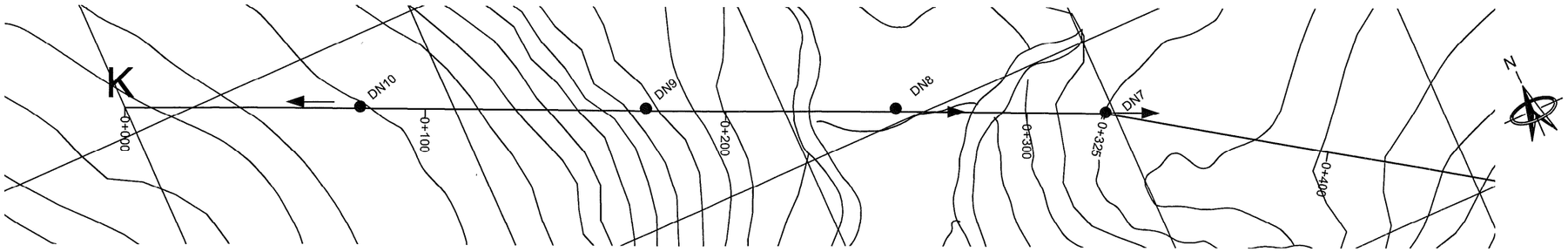
Base map: GEOLOGICAL CROSS SECTION G-G' of FS (2001)

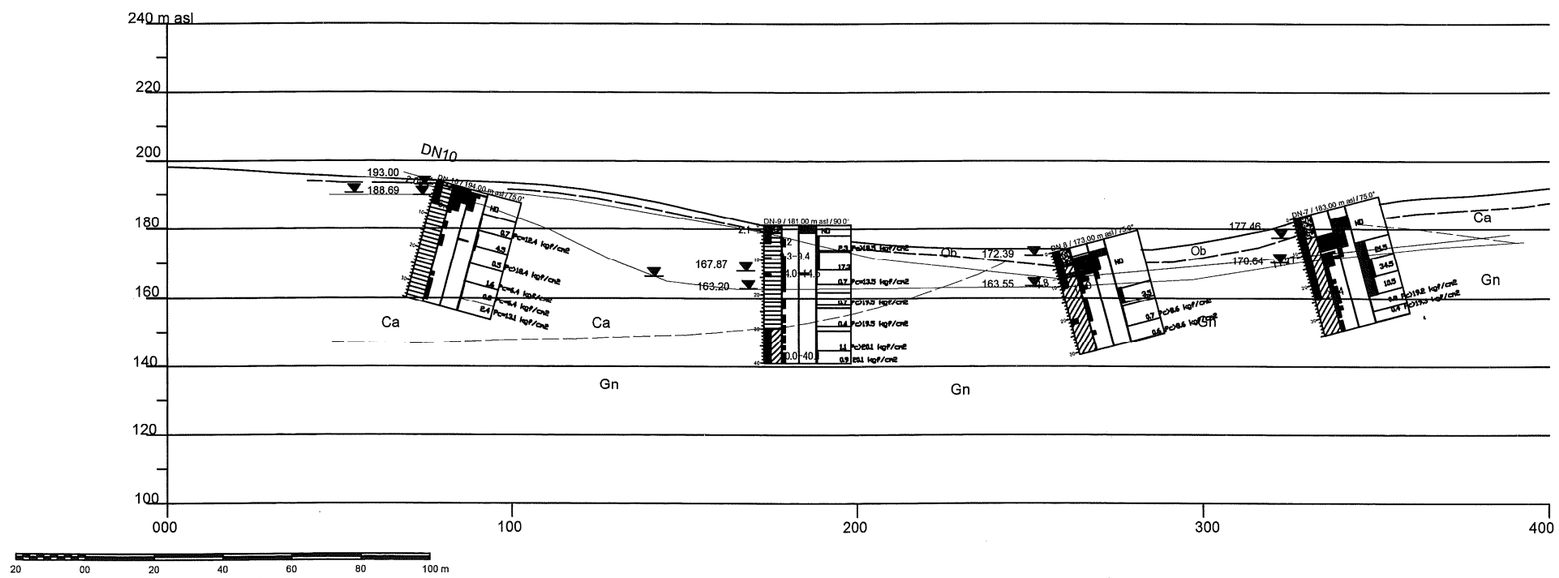
Fig. A-2 (1) MORAGAHAKANDA DAM SITE
GEOLOGICAL CROSS SECTION G - G' (1)

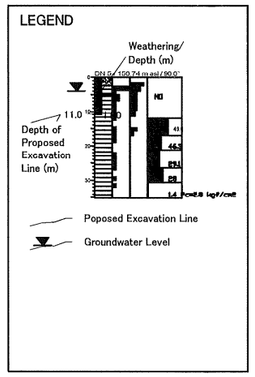


Base map: GEOLOGICAL CROSS SECTION G-G' of FS (2001)
Geology/Rock condition/Permeability of Drill Holes were revised in this Study.

Fig. A-2 (2) MORAGAHAKANDA DAM SITE
GEOLOGICAL CROSS SECTION G - G' (2)







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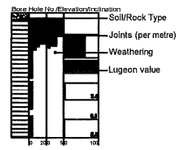


Soil and Rock Classification

- Overburden (Ob)
- Charnockite (Ch)
- Garnet Bolite Gneiss (Gn)
- Calc Gneiss (Ca)
- Quartzite (Qz)

Weathering Classification

0 - Fresh
1 - Slightly
2 - Moderately
3 - Highly
4 - Completely
5 - Decomposed Soil

Jointing Classification (joints/m)

0-5	Slightly
5-10	Moderately
10-15	Distinctly
15-20	Heavy
>20	Very Heavy

Groundwater Elevation
For DN holes max. and min. levels observed since completion of drilling are indicated.

Fault Axis

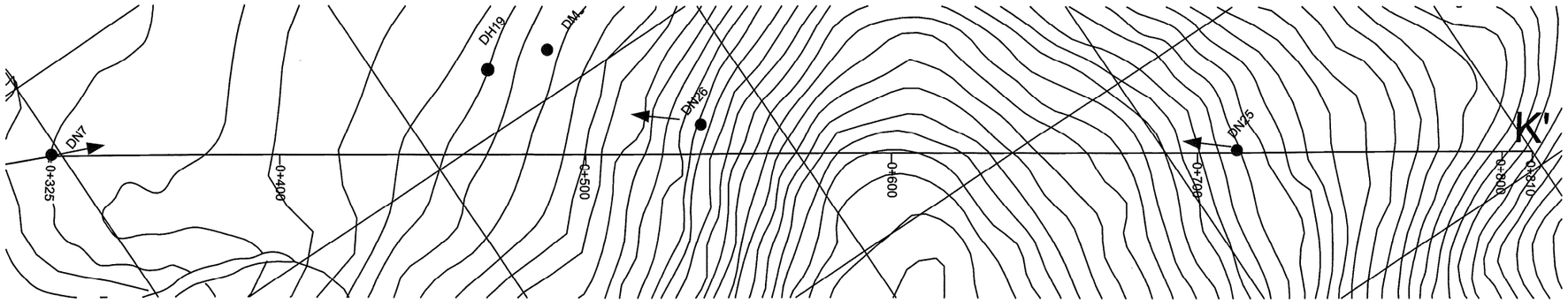
Ground Surface

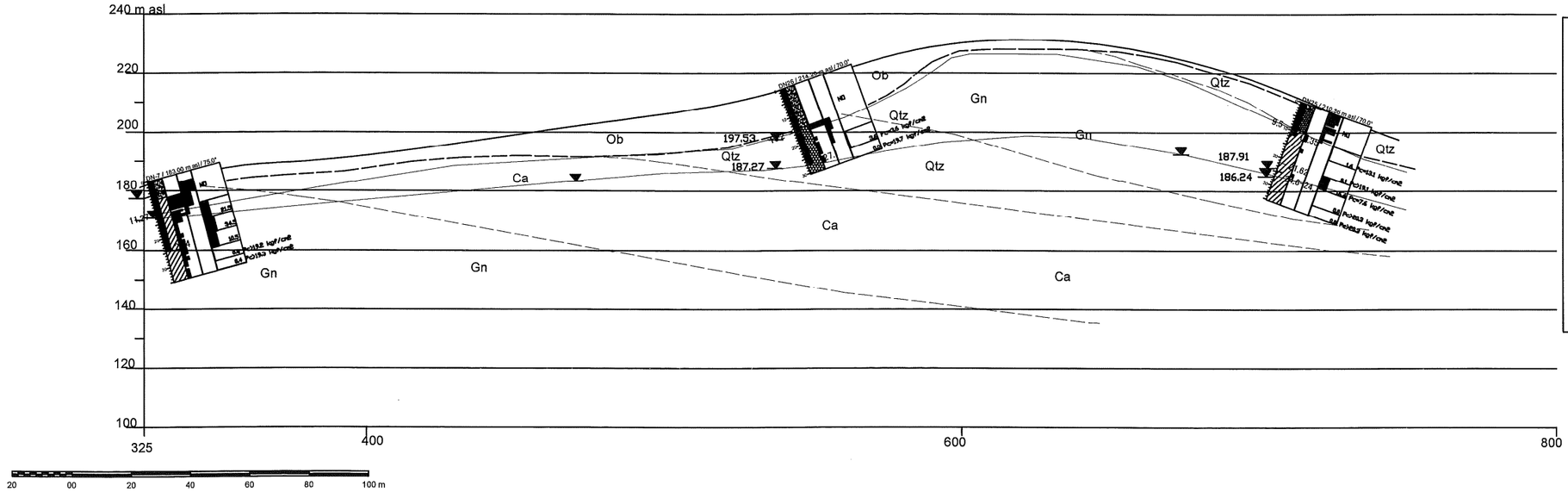
Geological Boundary

Drill hole with direction if inclined

Base map: GEOLOGICAL CROSS SECTION K-K' of FS (2001)
Geology/Rock condition/Permeability of Drill Holes were revised in this Study.

Fig. A-3 (1) MORAGAHAKANDA DAM SITE
GEOLOGICAL CROSS SECTION K - K' (1)





Soil and Rock Classification

- Overburden (Ob)
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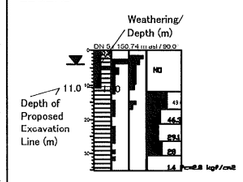
5-10	Moderately
10-15	Distinctly
15-20	Heavy
>20	Very Heavy

- Groundwater Elevation
  For DN holes max. and min. levels observed since completion of drilling are indicated.
- Fault Axis
- Ground Surface
- Geological Boundary
- Drill hole with direction if inclined

LEGEND



- Poposed Excavation Line
- Groundwater Level

Base map: GEOLOGICAL CROSS SECTION K-K' of FS (2001)

Fig. A-3 (2) MORAGAHAKANDA DAM SITE
GEOLOGICAL CROSS SECTION K - K' (2)

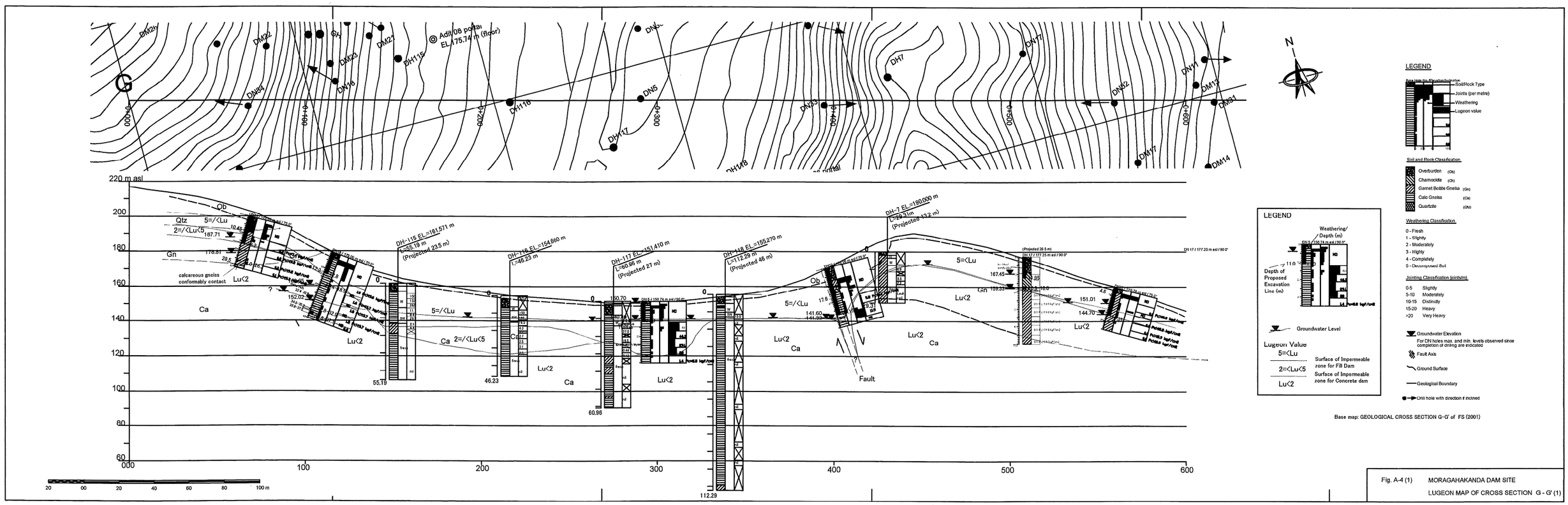
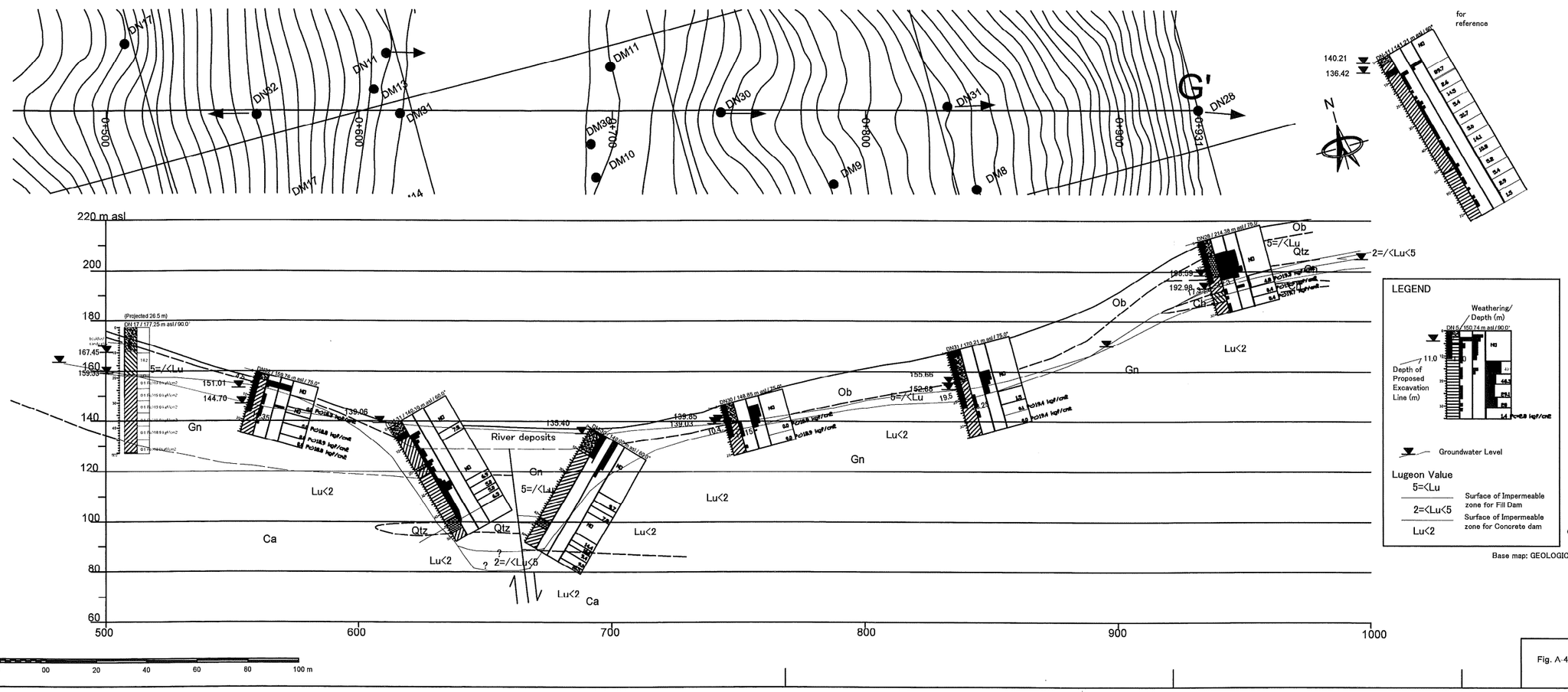
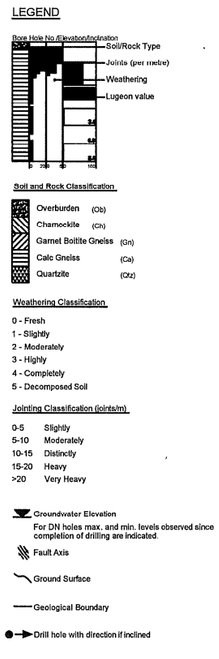


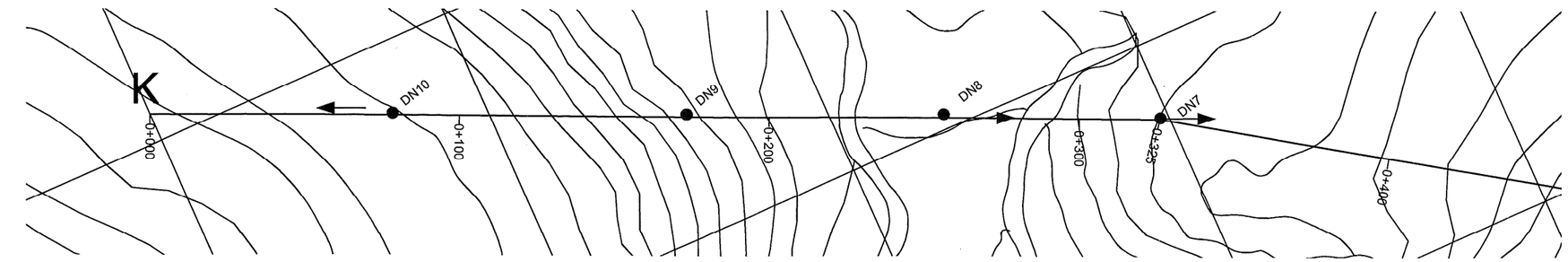
Fig. A-4 (1) MORAGAHAKANDA DAM SITE
LUGEON MAP OF CROSS SECTION G - G' (1)

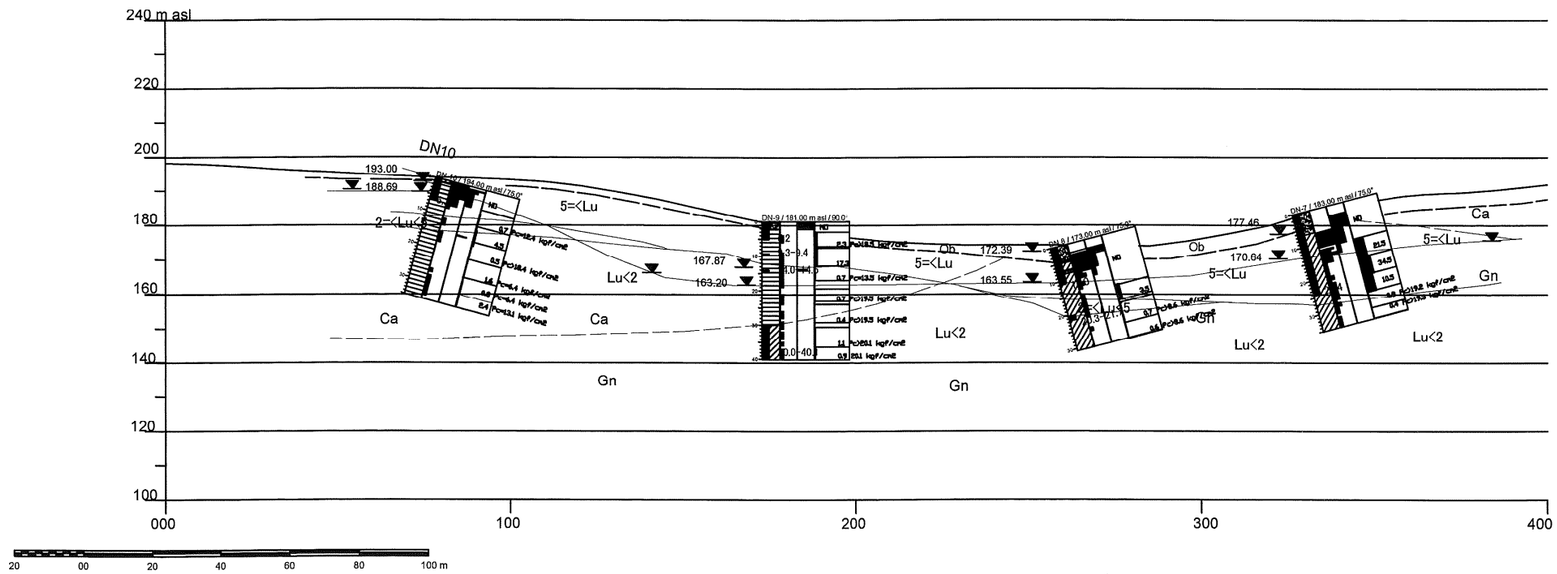


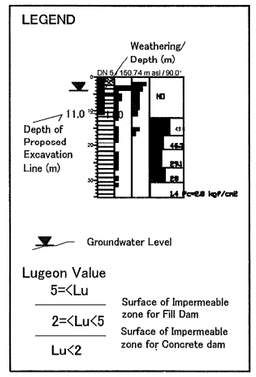


Base map: GEOLOGICAL CROSS SECTION G-G' of FS (2001)

Fig. A-4 (2) MORAGAHAKANDA DAM SITE
LUGEON MAP OF CROSS SECTION G - G' (2)







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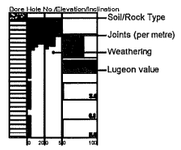


Soil and Rock Classification

- Overburden (Ob)
- Charnockite (Ch)
- Garnet Biotite Gneiss (Gn)
- Calc Gneiss (Ca)
- Quartzite (Qtz)

Weathering Classification

0 - Fresh
1 - Slightly
2 - Moderately
3 - Highly
4 - Completely
5 - Decomposed Soil

Jointing Classification (joints/m)

0-5	Slightly
5-10	Moderately
10-15	Distinctly
15-20	Heavy
>20	Very Heavy

Groundwater Elevation
For DN holes max. and min. levels observed since completion of drilling are indicated.

Fault Axis

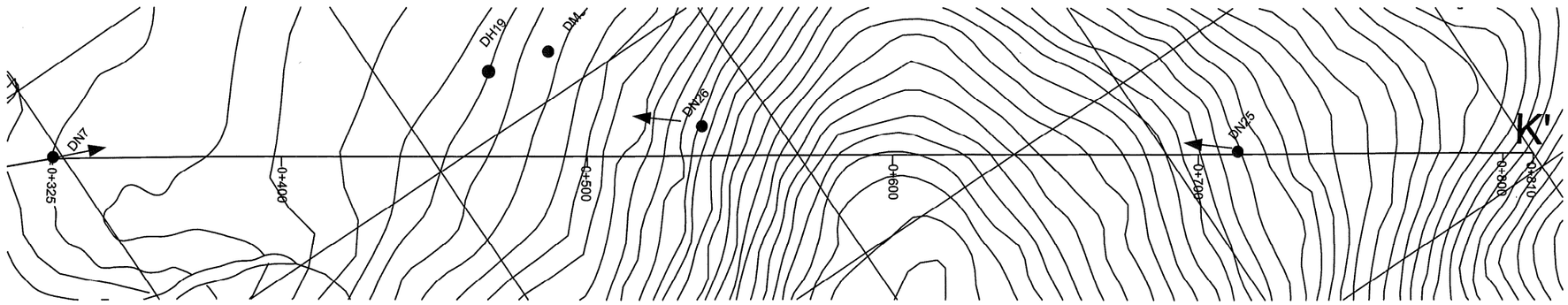
Ground Surface

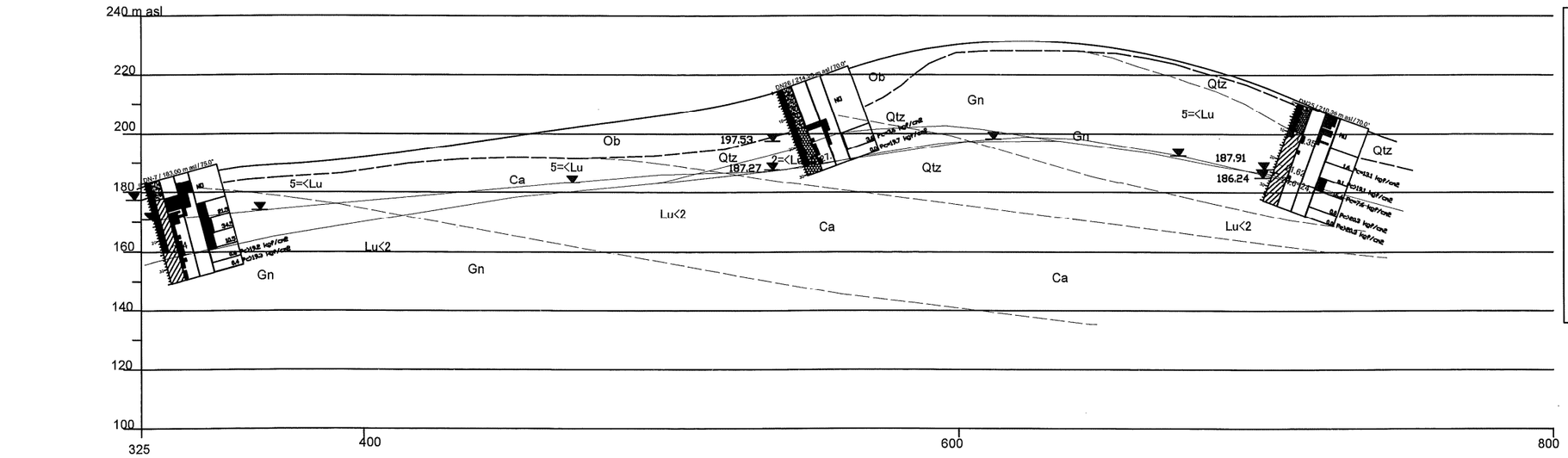
Geological Boundary

Drill hole with direction if inclined

Base map: GEOLOGICAL CROSS SECTION K-K' of FS (2001)

Fig. A-5 (1) MORAGAHAKANDA DAM SITE
LUGEON MAP OF CROSS SECTION K - K' (1)





LEGEND

Weathering/ Depth (m)

Depth of Proposed Excavation Line (m)

Groundwater Level

Lugeon Value

5=<Lu — Surface of Impermeable zone for Fill Dam

2=<Lu<5

Lu<2 — Surface of Impermeable zone for Concrete dam

LEGEND

Bore Hole No./Elevation/Inclination

- Soil/Rock Type
- Joints (per metre)
- Weathering
- Lugeon value

Soil and Rock Classification

- Overburden (Ob)
- Charnockite (Ch)
- Garnet Biotite Gneiss (Gn)
- Calc Gneiss (Ca)
- Quartzite (Qtz)

Weathering Classification

0 - Fresh
1 - Slightly
2 - Moderately
3 - Highly
4 - Completely
5 - Decomposed Soil

Jointing Classification (joints/m)

0-5	Slightly
5-10	Moderately
10-15	Distinctly
15-20	Heavy
>20	Very Heavy

Groundwater Elevation
For DN holes max. and min. levels observed since completion of drilling are indicated.

Fault Axis

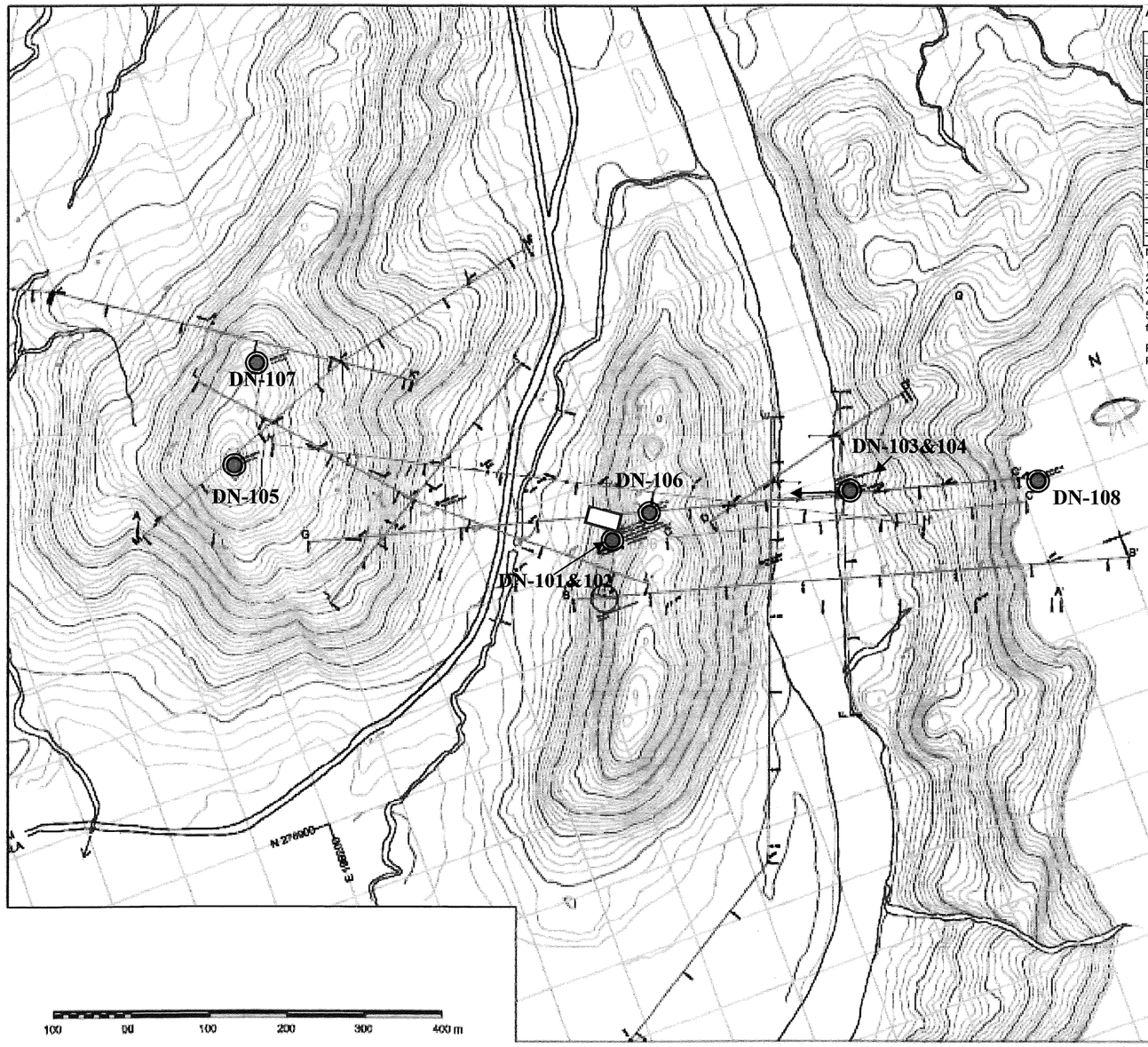
Ground Surface

Geological Boundary

Drill hole with direction if inclined

Base map: GEOLOGICAL CROSS SECTION K-K' of FS (2001)

Fig. A-5 (2) MORAGAHAKANDA DAM SITE
LUGEON MAP OF CROSS SECTION K - K' (2)



Additional Geological Investigation of Dam site

Drill Hole No.	Coordinates E	Coordinates N	Depth (m)	Inclination	Bearing	Location	In-situ test	Priority
DN-101			70	undecided	undecided	SD-1, right bank		B
DN-102			100	undecided	undecided	SD-1, right bank		B
DN-103	199970	277076	75	45° to horizontal	295°	Main Dam, right side of	Lugeon test	A
DN-104	199970	277076	100	(60° to horizontal)	(295°)	the riverbed	– in the section of rock	B
DN-105	199244	277382	105	vertical	–	SD-1 left bank	(including weathered	A
DN-106	199731	277140	70	vertical	–	Top ridge between MD and SD-1	rock) of the hole – 5 m intervals	B
DN-107	199320	277492	90	vertical	–	SD-2 right bank		B
DN-108	200231	277005	80	vertical	–	MD right bank		A
Total (Priority A)			260					
Total (Priority A & B)			690					
Trench			Length (m)					
Tr-1			25					B

Note:
1. Coordinates of Drill holes are subject to revision based on actual site condition.
2. Location and Depth of Drill hole DN-101 and DN-102 shall be determined based on the results of trench survey.
3. Location and depth of Drill hole DN-104 shall be determined based on the results of DN-103.
4. Coordinates of DN-105 and DN-108 might be modified according to the arrangement of dam axis.
5. Quanties of drill hole might be revised according to the new findings in the field or the requirement from the alternative study of the dam types.

Priority A: Recommended to be carried out for D/D
Priority B: Recommended to be carried out before/during construction.

LEGEND

Drill Point DN-101, 102, 103, 104, 105, 106, 107, 108

Trench Tr-1

Fig. A-5 Additional Geological Investigation of Dam site

APPENDIX B

WATER BALANCE

PREPARATORY SURVEY

ON

MORAGAHAKANDA DEVELOPMENT PROJECT

FINAL REPORT

APPENDIX B WATER BALANCE

Appendix B-1	Rainfall Data	B1-1
Appendix B-2	Inflow Data	B2-1

Appendix B-1
Rainfall Data

Rainfall (mm) **Angamedilla** **M021** Historic Data

Mahaweli Ganga *60* *Elev (m):* *70.0* *Lat:* *07-51-33N* *Long:* *80-54-15E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	271.0	37.0	64.0	189.0	18.0	0.0	34.0	88.0	0.0	217.9	344.2	517.7	1,780.8
1950	138.9	154.9	204.2	55.9	58.4	0.0	0.0	52.8	96.3	174.2	160.0	202.9	1,298.5
1951	549.4	97.3	140.5	9.4	103.6	0.0	0.3	107.4	51.8	12.4	443.7	244.6	1,760.4
1952	518.2	257.6	13.0	180.1	105.2	0.0	12.7	0.0	87.1	96.8	164.8	218.4	1,653.9
1953	246.9	103.4	89.9	229.9	0.0	17.8	190.2	45.0	58.9	420.6	234.2	364.7	2,001.5
1954	303.0	92.2	265.7	183.6	19.8	0.0	21.3	60.7	0.0	185.4	195.1	492.0	1,818.8
1955	349.8	105.2	31.5	118.9	35.1	0.0	0.0	72.1	103.1	52.1	126.7	206.0	1,200.5
1956	109.0	71.6	87.6	94.0	4.8	45.5	3.0	5.8	0.0	159.8	349.5	369.6	1,300.2
1957	144.0	342.9	0.0	56.1	121.9	0.0	38.1	9.7	99.8	360.2	434.3	1286.0	2,893.0
1958	153.7	105.9	287.0	108.5	37.6	0.0	2.5	54.9	73.2	157.2	248.2	386.8	1,615.5
1959	172.2	39.4	0.0	52.6	73.9	0.0	0.0	31.8	68.6	262.9	446.8	263.4	1,411.6
1960	274.8	529.3	41.4	340.6	65.0	4.1	169.2	0.0	35.6	146.6	309.1	130.0	2,045.7
1961	271.5	158.5	136.4	105.4	92.2	3.8	0.0	0.0	10.7	133.9	438.9	486.7	1,838.0
1962	229.6	49.5	88.9	93.5	142.0	0.0	0.0	55.4	24.1	168.9	177.8	229.9	1,259.6
1963	455.7	328.2	156.2	172.5	23.6	0.0	39.4	0.0	61.7	219.7	459.2	598.2	2,514.4
1964	215.4	271.8	139.2	115.3	80.3	0.0	71.9	20.1	56.6	57.9	241.0	155.2	1,424.7
1965	100.3	232.2	152.1	189.5	207.5	2.8	0.0	101.9	0.0	194.1	496.1	414.5	2,091.0
1966	281.7	47.0	143.5	67.8	0.0	0.0	2.5	94.0	81.3	498.6	306.6	189.7	1,712.7
1967	67.8	157.5	72.6	72.1	50.0	17.0	0.0	3.0	51.3	340.6	430.3	440.7	1,702.9
1968	150.1	5.8	206.0	57.1	0.0	0.0	0.0	15.2	115.3	224.3	304.3	213.4	1,291.5
1969	225.8	90.9	5.6	242.3	0.0	0.0	12.2	166.9	25.7	479.8	192.0	686.6	2,127.8
1970	150.9	303.8	103.4	169.4	49.8	11.7	0.0	48.3	49.5	56.4	296.9	303.8	1,543.9
1971	275.3	81.3	85.6	72.6	17.8	2.8	28.2	132.3	11.4	31.8	180.1	651.0	1,570.2
1972	35.6	0.0	18.5	82.0	227.1	0.0	0.0	0.0	364.5	343.9	574.5	332.7	1,978.8
1973	19.6	71.4	22.9	12.2	24.4	46.5	127.3	5.8	168.1	137.7	338.6	710.4	1,684.9
1974	0.0	132.6	4.6	115.6	1.5	0.0	0.0	0.0	109.0	12.7	126.0	378.2	880.2
1975	138.9	85.6	74.2	76.0	-1.0	0.0	218.7	10.7	22.9	40.4	164.6	254.0	-1.0
1976	88.6	63.2	5.6	44.4	2.8	0.0	48.3	68.6	6.9	131.3	238.8	449.6	1,148.1
1977	125.7	29.2	36.8	48.3	18.5	0.0	-1.0	-1.0	124.5	297.9	194.8	340.0	-1.0
1978	94.7	27.4	89.7	10.7	17.8	0.0	0.0	0.0	0.0	353.6	262.1	519.7	1,375.7
1979	124.0	38.9	61.2	88.4	89.7	0.0	4.6	41.9	118.6	186.2	393.5	307.6	1,454.6
1980	20.9	0.0	32.5	333.2	34.0	0.0	0.0	0.0	62.2	197.3	258.8	214.4	1,153.3
1981	147.3	119.6	20.3	104.1	58.7	0.0	49.0	119.4	94.0	146.6	82.8	291.1	1,232.9
1982	1.3	0.0	106.2	63.5	160.8	6.4	6.1	4.6	35.3	188.2	264.4	505.2	1,342.0
1983	17.0	0.0	0.0	12.5	161.5	5.8	110.0	0.0	3.6	230.1	111.5	558.8	1,210.8
1984	448.6	578.9	216.1	121.1	31.2	0.0	38.4	9.7	153.4	71.6	192.0	62.7	1,923.7
1985	202.9	211.8	130.3	148.6	60.7	0.0	7.4	71.1	239.3	24.6	243.3	378.7	1,718.7
1986	412.2	119.4	196.9	29.2	116.8	15.2	22.9	5.0	0.0	301.0	66.0	236.0	1,520.6
1987	121.9	38.1	22.9	193.8	60.9	0.0	0.0	0.0	45.7	381.0	147.6	54.9	1,066.8
1988	99.1	21.6	306.0	328.9	0.0	0.0	83.8	16.5	84.8	196.9	209.5	215.1	1,562.2
1989	279.7	0.0	104.1	209.8	143.5	19.0	280.9	30.5	269.2	208.3	322.6	170.2	2,037.8
1990	423.4	206.7	196.9	105.4	116.8	0.0	0.0	193.0	43.2	375.4	214.6	596.1	2,471.5
1991	417.8	0.0	104.9	0.0	120.1	19.1	0.0	139.7	110.5	281.7	254.0	445.2	1,893.0
1992	42.9	0.0	0.0	116.1	112.5	0.0	0.0	30.5	327.3	12.7	616.4	282.2	1,540.6
1993	10.8	57.3	63.8	41.5	113.4	0.0	27.9	0.0	126.4	284.3	628.8	656.2	2,010.4
1994	444.9	507.3	47.1	92.4	0.0	0.0	0.0	0.0	159.4	268.6	611.0	229.7	2,360.4
1995	250.8	111.3	0.0	205.1	169.5	0.0	5.2	0.0	51.1	170.8	141.8	124.9	1,230.5
1996	147.6	214.4	1.8	115.4	5.3	35.9	0.0	-1.0	5.2	-1.0	188.6	68.4	-1.0
1997	28.0	0.0	13.9	196.1	234.4	48.0	26.0	0.0	98.0	494.3	612.0	488.4	2,239.1
1998	129.0	16.0	12.0	22.0	63.0	0.0	125.0	251.0	30.5	14.0	170.0	363.0	1,195.5
1999	343.0	291.0	0.0	103.0	0.0	0.0	0.0	0.0	87.0	197.0	356.0	205.0	1,582.0
2000	227.0	267.0	24.0	76.0	31.0	0.0	15.0	62.8	80.0	29.0	410.6	147.0	1,369.4
2001	304.0	164.5	0.0	148.0	0.0	27.0	102.0	0.0	42.0	176.0	167.5	484.0	1,615.0
2002	195.0	211.0	74.0	147.0	14.0	0.0	0.0	94.0	70.0	219.0	347.0	523.0	1,894.0
2003	249.0	277.0	62.0	106.0	46.0	8.0	13.0	28.0	17.5	82.0	506.0	151.0	1,545.5
2004	157.0	51.0	175.0	64.0	50.0	0.0	0.0	0.0	103.0	374.0	482.0	564.0	2,020.0
2005	206.0	17.0	37.0	181.0	155.0	0.0	51.0	27.0	0.0	158.0	420.5	126.5	1,379.0
2006	392.5	131.0	229.0	82.0	161.0	0.0	0.0	0.0	204.0	534.0	311.0	198.5	2,243.0
2007	128.0	111.0	17.0	180.0	26.0	6.0	24.0	0.0	53.0	291.0	263.0	775.0	1,874.0
2008	220.0	134.0	287.5	96.0	13.0	0.0	30.0	136.0	0.0	335.0	346.0	262.0	1,859.5
Mean	205.8	132.8	88.5	117.9	66.9	5.7	34.6	43.3	77.9	210.1	303.6	362.0	1,674.9
Max	549	579	306	341	234	48	281	251	365	534	629	1,286	2,893
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	66.0	54.9	880.2
Stdv	137.4	133.4	84.4	78.3	63.1	12.0	59.6	56.2	77.7	134.4	144.2	215.2	405.5
% Mean	12.3	7.9	5.3	7.0	4.0	0.3	2.1	2.6	4.6	12.5	18.1	21.6	

Rainfall (mm) **Anuradhapura** **M026** Historic Data

Malwathu Oya *90* *Elev (m):* *92.5* *Lat:* *8.33N* *Long:* *80.38E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	153.2	33.8	78.2	162.3	81.8	1	42.9	74.4	0.8	278.1	252	197.9	1,356.4
1950	41.7	75.2	94.7	36.1	57.7	13.2	0	17.3	40.1	116.6	219.2	177.8	889.6
1951	278.4	83.6	59.4	181.9	156	0	29.5	23.1	260.1	190.5	337.3	64.8	1,664.6
1952	190	33.3	70.9	210.8	15.5	0.3	49	0	65	180.1	124.5	113.3	1,052.7
1953	73.2	42.2	60.2	373.6	0	0.3	122.9	20.1	62.7	440.7	141	208.8	1,545.7
1954	154.4	2.3	258.8	294.1	68.6	0	50.5	71.4	4.6	217.4	130.6	379.7	1,632.4
1955	149.9	30.7	119.6	361.7	113.5	0.8	46.7	146.3	186.7	145.5	168.7	65	1,535.1
1956	60.2	31.5	45	63.5	7.6	47.2	12.4	11.4	0	96.5	231.6	138.2	745.1
1957	50.8	88.4	8.6	160.3	221	14.5	33	0.8	40.6	352.8	528.6	927.1	2,426.5
1958	62	33.5	147.3	136.9	109.2	5.3	2.3	57.1	6.9	180.8	197.1	85.1	1,023.5
1959	128.8	16.8	32	308.1	209	69.6	12.2	0	96	205.2	370.3	212.3	1,660.3
1960	78.5	151.9	10.2	133.6	64	5.6	165.1	8.9	22.6	210.8	335.3	76.5	1,263.0
1961	313.2	113.5	39.6	134.4	69.9	62	20.8	5.6	20.1	259.6	212.9	224	1,475.6
1962	226.1	52.6	42.7	180.8	222.8	5.8	4.6	12.4	67.6	479	119.9	198.9	1,613.2
1963	348.7	105.2	130.8	184.7	74.9	7.9	58.2	14.7	57.7	152.1	375.7	436.9	1,947.5
1964	43.2	51.6	142.2	115.8	46	0.5	69.3	8.9	112.8	306.3	194.6	147.3	1,238.5
1965	35.1	88.4	52.3	222	111	1.3	0.8	217.9	20.8	360.7	395.2	322.6	1,828.1
1966	119.6	6.9	49.5	235.5	12.2	0	11.4	85.3	84.6	237.2	252.7	169.7	1,264.6
1967	12.7	76.7	77.5	30	67.6	5.6	1.3	6.9	25.7	274.6	181.9	257.3	1,017.8
1968	38.6	1	46	155.7	16.8	9.9	6.9	0.3	90.2	226.3	175.3	104.1	871.1
1969	40.4	47.5	37.8	158	30	0.3	2.5	89.2	34.3	520.2	149.9	384	1,494.1
1970	62.5	89.4	82.8	111.5	114.6	5.8	4.3	70.6	46.2	256.3	353.8	171.7	1,369.5
1971	199.4	100.1	25.4	231.4	42.9	4.8	1.5	168.4	86.1	239.8	133.1	488.9	1,721.8
1972	12.2	0	1	138.7	175.8	14	26.4	0.5	77	413	173.5	157.2	1,189.3
1973	1	5.1	62.2	69.1	45.2	6.4	104.9	55.9	70.6	111.5	140.2	342.4	1,014.5
1974	3.6	58.9	35.3	275.6	62	1.8	4.1	11.2	43.7	65	73.7	228.6	863.5
1975	53.1	6.9	91.9	125.5	163.3	18	41.4	11.2	69.1	141.5	233.7	69.1	1,024.7
1976	7.4	0.3	180.3	138.7	1.3	0	1.8	5.3	15.2	358.4	384.8	101.1	1,194.6
1977	17	54.6	25.4	127.3	238.8	5.3	19.1	13	47.2	450.6	235.5	164.1	1,397.9
1978	30.5	3	74.4	113.8	80.3	1	85.9	0.8	32	178.6	363.5	231.1	1,194.9
1979	21.3	17.5	17.1	149.2	27.9	0	18.7	50.4	143.8	425.4	311.8	188.2	1,371.3
1980	0.1	0	112.1	184.3	103.8	22.1	2.6	0	103.3	215.5	291	88.8	1,123.6
1981	46.7	19.3	53.8	151.7	74.1	13.8	61.2	85.8	146	165.5	159.7	82.6	1,060.2
1982	0	0	56.1	119.9	84	16	0	0	23.9	330	211.3	143.8	985.0
1983	7.9	0	0	46.5	214.4	8.9	16.5	31.7	52.1	165.1	120.6	427.7	1,091.4
1984	362.5	492.2	119.1	139.5	23.6	0	52.6	0	195.6	103.1	290.3	61.2	1,839.7
1985	132.3	68.9	81.6	56.8	159.3	9.7	16.9	64.3	119	48.4	355.6	160.5	1,273.3
1986	199.9	17.2	148.7	122.7	110	0	9	10.1	22.3	245.2	126.8	102.6	1,114.5
1987	49.7	0	22.9	159.2	112.1	0	0	4.3	143.3	424.7	172.1	88.6	1,176.9
1988	14.8	41.7	16	302.5	24	7.1	86.7	67.1	88.8	88.8	240	78.2	1,055.7
1989	35.5	0	22.2	54.9	65.8	59.1	146.5	7.8	102.3	245.3	317.3	47.7	1,104.4
1990	208.9	6.3	185.1	58.2	180.1	0	0.2	78.1	49	271.7	107.8	153.1	1,298.5
1991	59.5	15	74.3	153.8	145.3	49.7	17.9	3.3	32.2	211.4	503.9	190.5	1,456.8
1992	10.1	0	0	168.3	81	20	33.1	12.3	60	140.7	230.3	183.9	939.7
1993	13.1	1.4	52.8	150.1	74.7	1.3	20.7	0	2.1	405.8	403.9	453	1,578.9
1994	224.8	226.2	23.5	156.6	27.1	0.1	5.9	0.1	62.8	397.9	241	39.1	1,405.1
1995	114.1	10.7	5.9	194	77.9	1.7	0.3	0.9	51.6	205.5	167.5	19.3	849.4
1996	18.3	73.3	8.4	212.7	2.3	67.7	0.5	129	42.8	256.8	167.5	89	1,068.3
1997	7.6	9	74.4	257.9	89.3	16.4	70.1	0	62.4	188.2	271.7	283.3	1,330.3
1998	69.4	0	8.6	100.9	268.3	0.7	51.4	84.2	6.2	109.3	253.2	254.4	1,206.6
1999	150	96.1	42.6	142.4	11.9	14.4	0	0	85.9	282	199.8	167.6	1,192.7
2000	160.5	113.5	17.3	38.1	51.7	1.2	0.5	31	121	88.7	390	232.4	1,245.9
2001	110.7	29.8	0	274.1	1.8	173.1	101.9	0	27.1	180.3	226.5	137.1	1,262.4
2002	56.4	63.7	64.5	142	11.7	0.4	0	60.5	17.7	220.8	301.9	320.8	1,260.4
2003	189.1	36.2	79.2	158.7	22.4	18.7	52.3	47.3	127.6	192	219.7	49.1	1,192.3
2004	48.5	13.8	105.6	238.1	127.6	16.9	3.1	0	131.9	343.9	162.4	252.5	1,444.3
2005	49.6	0	68.3	113.3	42.3	2.4	52.6	12.1	0	314.7	339	104.5	1,098.8
2006	135.2	37.2	183.3	91.1	77.5	0	0	0	23.7	357.8	287.6	131	1,324.4
2007	113.4	15.7	28.4	291.5	2.1	22.1	27.1	6.6	56.2	372.8	187.8	257.2	1,380.9
2008	61.5	97.5	297.2	197.6	0	0	10.7	59.8	17.8	271.4	150.1	321.9	1,485.5
Mean	94.3	49.8	69.2	163.3	82.9	14.2	31.5	34.3	65.1	248.6	243.2	199.3	1,295.6
Max	363	492	297	374	268	173	165	218	260	520	529	927	2,427
Min	0.0	0.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0	48.4	73.7	19.3	745.1
Stdv	90.2	73.5	61.7	78.8	68.5	27.3	38.3	46.4	53.2	112.9	100.1	147.5	302.5
% Mean	7.3	3.8	5.3	12.6	6.4	1.1	2.4	2.6	5.0	19.2	18.8	15.4	

Rainfall (mm) **Bakamuna** **M040** Historic Data

Mahaweli Ganga *60* *Elev (m): ----* *Lat: 7.77N* *Long: 80.82E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	350.0	47.0	71.1	175.8	15.2	3.0	1.0	86.4	0.0	152.9	356.4	338.6	1,597.4
1950	162.1	133.1	135.1	32.8	47.8	0.0	0.0	6.4	21.3	74.9	156.0	211.8	981.3
1951	665.5	143.3	129.8	124.0	133.9	8.6	11.9	80.0	119.6	158.5	512.3	295.4	2,382.8
1952	437.1	170.2	24.1	211.3	110.0	0.0	18.5	0.0	144.0	98.8	187.2	364.2	1,765.4
1953	299.7	95.8	64.0	380.5	0.0	1.5	43.2	105.4	43.9	318.5	345.7	359.2	2,057.4
1954	394.7	133.6	306.8	215.6	0.0	0.0	25.1	80.8	0.0	210.3	148.3	526.5	2,041.7
1955	449.6	114.3	49.0	208.3	36.1	0.0	4.6	25.9	115.8	28.7	95.0	190.5	1,317.8
1956	188.5	75.4	89.2	90.7	0.0	0.0	0.0	0.0	0.0	48.8	531.6	645.7	1,669.9
1957	218.9	340.1	0.0	34.8	64.0	0.0	15.2	0.0	77.0	391.2	432.3	1312.4	2,885.9
1958	173.5	114.3	221.7	126.7	95.3	0.0	2.0	0.0	0.0	55.9	139.7	320.0	1,249.1
1959	83.1	26.2	11.4	132.8	89.9	68.6	6.4	15.0	4.3	177.3	367.0	371.1	1,353.1
1960	281.4	598.2	3.6	400.1	17.3	0.0	69.3	0.0	1.5	86.4	484.9	205.0	2,147.7
1961	253.2	187.5	205.2	94.7	22.9	3.8	1.0	0.0	1.3	160.5	378.0	534.2	1,842.3
1962	360.9	36.6	23.9	272.0	95.3	0.0	1.0	40.1	1.0	195.3	197.6	274.6	1,498.3
1963	379.5	219.5	70.1	387.1	25.9	0.8	7.1	0.0	9.7	127.3	491.5	667.3	2,385.8
1964	280.7	117.9	38.1	187.2	45.0	0.0	176.0	8.9	38.6	287.3	110.2	213.6	1,503.5
1965	122.7	276.4	128.0	264.4	144.5	0.0	0.0	119.6	0.0	281.2	364.7	471.4	2,172.9
1966	421.6	20.8	145.3	111.8	0.0	0.0	0.0	4.3	57.1	339.9	287.3	242.1	1,630.2
1967	23.6	119.4	43.7	151.9	9.7	24.4	0.0	0.0	0.0	397.0	513.1	447.0	1,729.8
1968	156.5	0.0	250.7	62.5	0.0	0.0	0.0	0.0	0.0	240.0	295.0	263.0	1,267.7
1969	209.0	97.0	16.0	148.6	2.3	0.0	0.0	192.3	20.3	242.6	136.1	947.2	2,011.4
1970	477.3	599.7	105.9	121.7	21.6	0.0	0.0	0.0	51.1	121.2	288.5	322.1	2,109.1
1971	247.1	185.2	128.8	214.9	30.7	3.8	0.0	180.6	52.0	59.4	137.7	690.6	1,930.8
1972	28.2	0.0	50.8	186.9	107.9	0.0	0.0	0.0	111.0	459.7	377.2	296.2	1,617.9
1973	0.0	96.0	1.0	30.2	0.0	0.0	0.0	0.0	34.3	181.6	319.5	722.6	1,385.2
1974	0.0	101.3	0.0	129.0	5.1	0.0	0.0	34.3	132.1	31.0	18.8	364.7	816.3
1975	119.4	76.7	181.9	86.4	45.7	6.4	101.1	0.0	1.3	0.0	275.6	293.6	1,188.1
1976	147.1	47.8	10.4	112.0	0.0	0.0	7.9	10.9	0.0	150.9	317.2	467.1	1,271.3
1977	20.6	11.2	35.6	126.2	42.2	0.0	37.1	27.9	65.5	267.0	319.8	307.8	1,260.9
1978	63.2	53.3	57.9	60.2	33.0	0.0	46.2	0.0	0.0	328.7	351.8	222.5	1,216.8
1979	156.7	44.2	135.1	73.2	49.3	0.0	0.0	20.3	20.6	202.4	195.3	253.0	1,150.1
1980	20.3	0.0	15.2	86.4	54.4	0.0	0.0	0.0	5.1	101.6	398.5	183.4	864.9
1981	220.7	131.6	61.5	77.2	3.8	0.0	35.0	39.9	98.6	242.8	114.6	248.4	1,274.1
1982	2.0	0.0	104.1	167.4	235.4	20.8	0.0	9.4	15.3	235.5	283.4	659.2	1,732.5
1983	17.5	0.0	0.0	5.8	15.0	0.0	0.0	0.0	0.0	93.7	95.4	652.2	879.6
1984	532.7	734.4	365.9	203.3	124.5	0.0	14.8	8.4	184.1	58.1	329.0	139.7	2,694.9
1985	288.4	172.7	139.4	102.5	27.7	7.1	0.0	11.3	131.0	88.6	240.8	519.9	1,729.4
1986	460.9	145.4	197.2	148.5	45.6	17.8	0.0	0.0	0.3	323.9	126.0	394.0	1,859.6
1987	166.9	6.5	81.0	259.3	166.6	0.0	0.0	0.0	166.6	388.3	154.2	108.2	1,497.6
1988	78.5	4.6	119.1	229.1	36.8	0.0	90.9	3.0	25.4	60.9	126.7	70.1	845.1
1989	284.5	0.0	72.9	47.5	0.0	1.3	88.9	35.5	154.3	160.4	408.0	178.1	1,431.4
1990	267.4	114.2	67.5	28.1	56.5	0.0	0.0	70.6	74.9	388.6	299.8	516.5	1,884.1
1991	251.1	17.6	96.4	0.0	85.4	30.9	13.5	4.9	55.8	151.7	306.4	-1.0	-1.0
1992	101.7	0.0	0.0	92.4	124.3	0.0	0.0	16.0	114.1	21.7	493.6	275.7	1,239.5
1993	42.0	167.7	65.8	32.0	123.9	10.2	85.3	0.0	36.9	138.8	500.0	450.0	1,652.6
1994	297.1	367.6	36.0	57.9	13.2	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	131.7	209.7	169.6	-1.0
1996	184.0	102.7	35.0	239.6	30.0	69.9	0.0	79.5	54.0	176.0	330.5	207.0	1,508.2
1997	6.9	9.5	88.0	89.4	191.0	26.0	13.2	0.0	197.5	477.4	696.2	469.9	2,265.0
1998	354.4	9.0	13.5	25.5	122.0	0.0	46.5	110.8	0.0	22.0	64.0	283.9	1,051.6
1999	287.1	278.9	11.0	24.8	0.0	0.0	0.0	0.0	46.2	232.7	185.6	222.8	1,289.1
2000	258.5	339.8	74.7	4.0	17.0	0.0	34.0	65.5	63.1	29.6	520.0	221.1	1,627.3
2001	406.2	220.1	14.0	247.4	23.0	23.3	37.0	0.0	127.0	172.2	252.6	649.7	2,172.5
2002	281.0	188.6	65.5	189.4	23.5	0.0	0.0	94.8	48.5	129.7	369.5	312.7	1,703.2
2003	423.4	360.5	206.6	214.1	32.5	0.0	56.3	36.6	63.4	20.6	430.1	162.1	2,006.2
2004	161.9	51.8	110.6	167.5	45.9	4.2	0.0	-1.0	150.3	390.6	474.0	616.7	-1.0
2005	174.1	34.0	31.5	194.4	125.9	0.0	6.5	80.5	0.0	187.7	349.6	69.8	1,254.0
2006	518.8	59.4	212.1	117.0	22.7	1.2	0.0	0.0	60.5	319.9	509.9	300.5	2,122.0
2007	139.3	140.7	19.2	75.5	0.0	0.0	36.7	3.0	102.5	322.4	253.8	602.3	1,695.4
2008	231.2	130.0	269.0	175.7	0.0	0.0	28.0	93.1	1.2	234.3	178.5	337.9	1,678.9
Mean	231.0	136.8	89.9	139.9	51.5	5.7	19.7	31.1	53.4	189.4	302.2	382.1	1,632.1
Max	666	734	366	400	235	70	176	192	198	477	696	1,312	2,886
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.8	69.8	816.3
Stdv	156.7	153.7	83.5	93.7	54.7	14.1	33.6	46.1	56.3	123.2	146.2	224.5	461.9
% Mean	14.2	8.4	5.5	8.6	3.2	0.3	1.2	1.9	3.3	11.6	18.5	23.4	

Rainfall (mm) **Delwita Estate (Rambodagalle)** **M096** Historic Data

Deduru Oya *99* *Elev (m): 149.0* *Lat: 7.53N* *Long: 80.52E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	157.2	32.0	63.5	247.4	285.5	189.0	303.3	399.3	75.7	125.5	278.1	202.2	2,358.7
1950	64.0	154.2	151.4	90.2	150.1	162.3	162.1	128.8	178.1	184.7	230.9	108.5	1,765.3
1951	358.9	68.3	123.4	300.2	237.5	154.9	173.2	9.9	447.0	289.6	511.0	104.1	2,778.0
1952	133.6	160.0	102.9	225.6	385.6	107.7	22.6	147.8	67.3	344.2	223.0	75.7	1,996.0
1953	23.6	50.0	71.6	438.9	0.0	27.7	419.9	32.5	111.3	381.8	167.6	74.9	1,799.8
1954	101.1	64.5	298.7	297.9	107.9	160.0	97.3	145.5	32.8	440.4	186.2	460.8	2,393.1
1955	115.6	69.9	180.3	201.7	210.1	277.4	70.9	85.1	265.7	166.6	165.1	55.4	1,863.8
1956	32.3	2.3	75.2	115.8	132.1	308.4	43.7	48.5	41.9	264.9	487.7	150.1	1,702.9
1957	115.1	143.5	43.4	130.6	139.4	251.0	121.9	45.7	11.9	398.5	633.7	866.9	2,901.6
1958	22.9	15.0	292.1	423.7	263.1	100.3	45.0	222.2	27.2	267.7	217.2	144.0	2,040.4
1959	28.2	28.7	2.5	192.3	264.2	218.4	295.1	80.8	100.3	358.4	364.5	109.0	2,042.4
1960	64.0	224.8	49.5	474.5	91.7	131.6	207.0	40.4	168.9	403.6	453.6	69.1	2,378.7
1961	102.4	112.0	61.7	210.1	288.5	159.8	132.3	130.6	173.7	361.9	234.2	220.7	2,187.9
1962	67.3	13.0	78.5	183.4	314.2	97.8	188.5	106.9	153.4	295.1	151.9	121.4	1,771.4
1963	79.2	36.6	40.4	364.5	149.6	178.1	210.6	61.5	205.2	221.0	303.0	319.5	2,169.2
1964	131.1	253.0	104.9	139.2	130.6	122.7	197.1	72.1	124.5	188.5	337.1	129.5	1,930.3
1965	69.6	89.7	103.4	167.1	275.8	83.8	24.9	279.9	74.4	416.3	288.8	195.6	2,069.3
1966	46.0	3.8	143.8	248.4	9.9	98.3	39.6	35.3	344.7	237.7	396.7	185.7	1,789.9
1967	72.1	264.7	114.6	165.9	66.0	188.5	126.7	75.9	68.3	419.6	322.6	425.2	2,310.1
1968	56.4	5.6	62.2	318.3	80.0	273.8	204.0	43.4	131.8	431.8	257.6	208.5	2,073.4
1969	106.4	8.6	58.4	309.1	157.0	106.4	21.3	134.4	88.1	617.7	124.5	262.9	1,994.8
1970	109.2	367.0	47.0	295.4	182.4	142.5	115.1	58.2	186.2	286.0	422.0	212.0	2,423.0
1971	142.2	145.8	141.5	459.5	84.8	249.2	71.9	285.0	394.2	210.6	215.6	493.5	2,893.8
1972	3.8	0.0	17.8	339.6	462.3	93.0	81.5	41.9	181.6	678.9	401.1	263.1	2,564.6
1973	0.0	11.2	64.0	165.6	95.8	152.9	135.9	91.4	95.5	196.3	198.9	355.6	1,563.1
1974	0.0	96.0	56.1	351.8	169.9	212.6	298.4	91.2	205.0	74.9	100.6	155.2	1,811.7
1975	42.7	89.4	122.4	239.3	152.4	115.1	224.8	183.1	211.8	158.7	427.5	169.2	2,136.4
1976	78.5	0.0	29.5	331.0	1.0	41.1	87.9	123.7	14.5	436.1	345.2	92.5	1,581.0
1977	2.5	12.4	101.9	353.3	338.8	197.9	64.8	111.3	25.1	555.0	339.3	40.9	2,143.2
1978	1.8	86.4	20.6	88.4	402.3	107.7	58.4	74.4	158.7	356.4	538.7	119.6	2,013.4
1979	7.4	111.5	45.5	195.1	83.0	155.0	112.5	31.5	269.3	338.3	666.2	142.8	2,158.1
1980	0.0	0.3	0.0	253.5	110.8	90.7	82.0	108.5	197.1	243.8	402.4	101.0	1,590.1
1981	0.0	8.1	90.2	193.8	81.8	144.5	175.3	86.6	206.5	249.2	439.2	38.6	1,713.8
1982	0.0	0.0	137.4	305.3	202.7	210.9	101.0	128.8	15.0	302.5	402.7	282.3	2,088.6
1983	0.0	0.0	0.0	30.2	259.0	73.7	94.6	92.8	70.6	428.0	251.6	194.7	1,495.2
1984	192.4	214.5	188.2	382.9	84.8	71.0	100.9	0.0	356.6	186.2	357.7	177.3	2,312.5
1985	105.9	65.5	58.7	145.5	195.6	336.3	64.3	42.7	165.1	224.0	307.3	106.2	1,817.1
1986	339.3	51.1	47.0	254.2	191.8	62.0	26.2	85.3	139.5	230.4	0.0	19.8	1,446.6
1987	6.3	0.0	50.8	308.1	107.9	148.0	2.5	172.0	232.4	569.7	228.3	99.3	1,925.3
1988	17.8	58.2	44.0	387.8	312.1	77.8	182.9	190.5	171.5	108.5	260.6	84.6	1,896.3
1989	213.9	0.0	276.9	89.4	82.6	202.2	243.3	102.6	126.0	347.0	523.0	31.0	2,237.9
1990	170.6	193.0	211.9	114.1	230.3	43.4	103.5	42.1	37.9	387.6	399.5	162.0	2,095.9
1991	259.3	25.4	71.5	51.2	59.0	307.9	154.5	57.9	43.1	235.7	-1.0	272.6	-1.0
1992	39.9	0.0	0.5	349.2	175.8	98.3	190.7	65.0	91.9	396.7	343.5	98.4	1,849.9
1993	27.1	77.7	146.0	157.0	313.7	295.4	126.7	76.5	14.2	433.4	354.7	369.8	2,392.2
1994	177.1	103.7	9.1	102.8	183.0	64.5	42.2	62.4	104.2	440.8	288.6	103.1	1,681.5
1995	179.6	21.3	90.2	258.7	356.2	75.7	19.7	26.9	5.6	349.6	133.6	5.4	1,522.5
1996	14.3	35.1	10.4	278.4	3.5	75.0	73.8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1997	0.0	3.8	38.1	141.2	276.6	56.0	123.6	39.9	354.0	510.4	355.1	706.3	2,605.0
1998	35.1	33.6	7.7	89.5	297.4	108.9	156.2	139.0	256.4	310.0	120.2	184.2	1,738.2
1999	313.6	198.2	42.9	318.3	179.0	183.1	44.8	16.2	61.1	238.6	166.4	129.8	1,892.0
2000	57.6	219.3	34.6	238.5	47.0	175.0	0.3	197.6	121.6	138.1	209.8	195.3	1,634.7
2001	204.3	235.4	0.0	509.7	29.4	64.8	58.5	0.0	288.3	277.6	193.0	203.1	2,064.1
2002	44.3	58.0	32.5	421.4	47.4	137.8	15.9	64.8	30.5	508.2	424.9	43.0	1,828.7
2003	39.1	80.0	184.7	409.2	39.5	72.3	79.4	76.3	101.4	183.1	149.4	128.0	1,542.4
2004	49.5	57.3	40.7	285.6	-1.0	156.0	58.5	78.2	276.3	189.1	243.7	273.1	-1.0
2005	42.9	69.0	131.4	160.7	5.8	113.9	109.6	27.8	37.2	360.9	236.7	-1.0	-1.0
2006	29.1	20.6	269.3	31.1	91.7	95.2	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2007	80.2	93.0	6.0	458.4	90.6	432.3	123.8	99.6	118.0	492.1	354.9	388.1	2,737.0
2008	180.1	95.0	150.2	486.4	126.3	-1.0	545.8	116.4	88.0	463.5	380.1	481.8	-1.0
Mean	85.9	79.0	87.3	254.6	167.7	149.8	126.4	96.8	143.9	326.1	307.3	200.2	2,031.7
Max	359	367	299	510	462	432	546	399	447	679	666	867	2,902
Min	0.0	0.0	0.0	30.2	0.0	27.7	0.3	0.0	5.6	74.9	0.0	5.4	1,446.6
Stdv	86.9	83.1	75.1	124.0	112.2	83.0	101.0	73.7	105.6	132.5	134.2	163.6	361.7
% Mean	4.2	3.9	4.3	12.5	8.3	7.4	6.2	4.8	7.1	16.0	15.1	9.9	

Rainfall (mm) **Elkaduwa** **M126** Historic Data

Mahaweli Ganga *60* *Elev (m): 792.7* *Lat: 7.42N* *Long: 80.68E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	152.9	25.1	32.0	268.5	97.8	150.9	393.7	222.2	204.5	225.3	194.1	371.3	2,338.3
1950	154.9	98.3	60.2	96.5	205.2	128.8	200.7	152.1	230.4	284.2	213.6	124.5	1,949.4
1951	669.3	104.6	30.7	199.6	251.2	301.8	184.1	44.4	393.7	308.6	416.6	320.0	3,224.6
1952	321.3	228.6	47.2	255.3	383.5	158.7	66.0	237.7	236.2	373.4	156.2	157.0	2,621.1
1953	87.6	127.0	83.1	494.0	2.5	15.2	230.6	85.1	81.3	435.6	231.1	170.2	2,043.3
1954	240.0	132.1	196.9	251.5	169.2	68.6	105.2	254.0	45.7	241.3	309.4	414.0	2,427.9
1955	330.2	154.9	126.5	321.1	163.6	267.5	109.7	102.6	395.0	307.8	229.4	82.0	2,590.3
1956	89.9	8.4	53.6	177.0	85.9	441.7	61.5	131.3	80.5	333.0	611.6	222.8	2,297.2
1957	205.0	202.7	33.3	140.5	279.1	259.3	226.1	111.5	134.6	223.5	765.3	1115.3	3,696.2
1958	91.2	50.8	226.8	329.4	243.8	130.8	62.5	240.8	71.9	567.7	354.3	219.5	2,589.5
1959	41.9	57.7	6.4	176.5	171.4	337.1	296.7	96.5	165.1	599.4	385.3	202.4	2,536.4
1960	324.9	421.4	17.0	229.6	181.9	178.6	287.8	53.8	283.5	359.4	584.7	86.6	3,009.2
1961	130.0	192.5	78.7	257.6	275.1	100.1	197.1	189.7	121.7	241.6	340.1	324.9	2,449.1
1962	170.2	85.1	141.7	229.1	324.4	66.0	147.6	197.9	234.4	466.3	172.2	201.2	2,436.1
1963	284.0	104.4	86.9	225.8	139.4	115.1	194.8	93.5	213.6	375.2	394.7	528.8	2,756.2
1964	300.7	200.9	97.0	53.3	138.4	100.6	317.0	127.5	124.0	311.4	390.9	256.0	2,417.7
1965	71.9	196.1	76.5	298.4	329.7	90.4	69.6	267.0	77.5	297.9	326.4	261.4	2,362.8
1966	102.1	30.0	96.8	138.2	13.7	138.2	54.6	64.0	393.7	382.3	255.0	211.8	1,880.4
1967	185.4	199.6	118.6	228.3	48.5	164.3	120.9	95.3	169.4	443.2	421.6	397.8	2,592.9
1968	90.2	54.6	181.6	104.6	74.2	178.1	233.4	87.9	184.7	369.1	264.9	295.1	2,118.4
1969	127.0	51.6	166.6	225.3	208.0	127.8	26.9	172.7	310.9	561.6	204.0	421.9	2,604.3
1970	100.1	337.8	71.4	409.2	112.5	112.3	128.3	83.1	212.6	268.7	406.7	328.9	2,571.6
1971	172.5	30.5	0.0	636.0	153.0	356.9	155.7	252.7	928.4	385.3	271.8	286.5	3,629.3
1972	4.6	0.0	0.0	80.0	292.1	25.9	185.9	62.5	198.6	688.8	317.5	359.4	2,215.3
1973	15.2	12.2	41.1	121.9	151.4	142.0	186.7	132.3	93.2	181.6	442.0	339.9	1,859.5
1974	0.0	121.4	2.3	265.7	438.9	120.4	260.1	270.5	238.3	198.1	0.0	176.0	2,091.7
1975	70.1	61.0	119.4	115.6	142.2	188.0	199.9	198.1	128.3	194.1	491.5	189.2	2,097.4
1976	86.9	14.5	47.5	146.1	0.0	17.3	104.4	84.3	48.0	353.3	444.8	157.5	1,504.6
1977	0.0	21.6	63.0	295.1	183.6	124.2	180.1	86.4	68.8	687.3	228.6	160.5	2,099.2
1978	30.2	59.7	62.7	120.4	336.8	79.2	245.0	148.6	126.0	305.8	398.5	162.6	2,075.5
1979	94.7	0.0	0.0	96.0	215.0	179.0	200.4	36.6	388.1	274.7	428.5	254.8	2,167.8
1980	3.8	0.0	53.1	232.9	184.4	129.3	94.5	139.9	111.5	351.8	366.3	162.8	1,830.3
1981	127.8	34.5	23.4	155.2	14.7	139.2	285.0	154.9	262.9	227.6	283.2	118.1	1,826.5
1982	3.1	0.0	117.3	127.0	302.2	17.9	108.5	59.0	55.9	314.9	519.4	506.3	2,131.5
1983	32.4	0.0	5.2	22.9	226.6	107.9	160.4	163.1	122.8	244.9	374.1	241.3	1,701.6
1984	195.2	252.4	186.1	249.8	58.9	133.8	273.6	79.2	539.0	206.1	296.4	192.3	2,662.8
1985	146.8	97.4	284.6	86.6	294.4	444.6	244.5	96.8	205.8	275.8	250.4	166.9	2,594.6
1986	444.6	236.0	90.2	235.0	91.4	88.0	120.2	157.6	112.8	485.3	125.1	127.0	2,313.2
1987	129.1	0.0	92.5	241.1	248.0	141.6	0.3	110.3	336.7	424.4	367.2	129.9	2,221.1
1988	12.6	157.5	205.6	422.1	101.3	83.6	197.2	257.9	286.6	114.3	262.6	78.9	2,180.2
1989	205.2	9.1	45.8	80.5	85.2	102.2	395.8	121.9	277.7	372.2	235.6	0.0	1,931.2
1990	235.6	61.5	175.8	79.1	173.6	140.0	48.6	85.1	109.1	433.1	217.9	150.6	1,910.0
1991	238.7	0.0	34.2	15.6	162.9	229.4	115.4	83.3	82.4	58.8	26.4	7.0	1,054.1
1992	5.2	0.0	0.0	209.5	183.1	221.9	145.7	66.7	80.6	195.9	71.9	27.8	1,208.3
1993	0.0	-1.0	6.6	64.8	328.3	339.6	204.6	80.9	77.9	456.8	356.5	325.8	-1.0
1994	407.3	240.1	22.5	158.8	158.0	63.8	156.8	125.8	149.1	577.9	401.9	27.9	2,489.9
1995	45.0	34.7	4.5	401.2	341.2	43.9	17.5	116.1	142.3	463.1	281.1	15.9	1,906.5
1996	63.5	29.9	14.1	187.6	2.7	73.2	182.7	57.3	297.7	349.4	-1.0	-1.0	-1.0
1997	8.6	8.1	188.0	416.4	277.3	73.3	160.6	52.9	360.1	240.8	655.6	-1.0	-1.0
1998	16.2	0.2	46.5	119.1	223.0	252.4	755.7	474.5	412.6	308.8	253.3	738.9	3,601.2
1999	323.6	296.3	85.3	385.3	269.6	-1.0	43.9	-1.0	-1.0	970.1	169.0	217.8	-1.0
2000	82.3	101.4	112.6	115.4	110.0	269.3	86.6	83.5	177.9	195.6	125.2	522.2	1,982.0
2001	536.4	62.6	126.0	267.2	42.5	137.0	229.0	37.1	170.0	188.7	174.9	202.4	2,173.8
2002	14.7	44.3	78.2	327.6	82.8	143.8	55.0	83.4	8.4	286.4	-1.0	-1.0	-1.0
2003	261.1	97.6	195.0	252.7	100.7	90.2	101.2	102.9	138.6	88.2	317.5	15.7	1,761.4
2004	47.6	30.4	44.5	274.3	178.5	82.6	104.6	40.7	249.0	249.3	322.6	-1.0	-1.0
2005	103.0	102.5	174.5	287.0	164.0	116.0	162.0	62.5	170.5	237.0	621.0	203.6	2,403.6
2006	418.0	67.8	242.5	159.5	269.0	103.5	95.0	74.5	143.0	469.5	683.0	204.0	2,929.3
2007	-1.0	0.0	-1.0	-1.0	92.0	231.0	-1.0	56.0	284.1	322.0	156.0	434.0	-1.0
2008	291.0	129.0	389.0	220.0	81.0	83.8	217.0	77.0	50.5	160.4	327.0	143.0	2,168.7
Mean	155.0	92.9	91.7	216.6	177.7	151.7	172.8	126.8	203.4	341.9	325.7	245.7	2,306.3
Max	669	421	389	636	439	445	756	475	928	970	765	1,115	3,696
Min	0.0	0.0	0.0	15.6	0.0	15.2	0.3	36.6	8.4	58.8	0.0	0.0	1,054.1
Stdv	145.8	95.6	81.0	120.2	103.4	96.7	116.7	79.7	148.3	158.9	157.7	188.6	522.2
% Mean	6.7	4.0	4.0	9.4	7.7	6.6	7.5	5.5	8.8	14.8	14.1	10.7	

Rainfall (mm) **Galgamuwa Tank** **M144** Historic Data

Kala Oya *93* *Elev (m):* *0.0* *Lat:* *0* *Long:* *0*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	145.5	0.0	107.2	213.1	169.2	14.0	53.1	131.8	16.0	178.6	138.2	93.7	1,260.4
1950	38.4	63.8	130.0	65.0	48.3	20.1	0.0	23.9	51.6	137.9	202.7	210.1	991.8
1951	274.3	86.1	70.4	203.5	146.3	52.8	0.0	52.6	208.5	163.1	313.4	88.9	1,659.9
1952	242.1	56.4	50.5	303.3	42.7	15.0	11.2	9.9	10.4	287.8	106.2	57.4	1,192.9
1953	76.2	81.8	59.4	343.2	0.0	18.5	122.2	20.6	124.5	482.3	87.1	152.1	1,567.9
1954	120.9	0.0	271.5	62.7	62.7	5.6	91.4	6.9	0.0	286.3	175.0	296.2	1,379.2
1955	85.1	36.3	46.2	348.5	154.2	2.8	0.0	22.1	394.2	346.5	219.5	109.5	1,764.9
1956	26.9	0.0	186.4	112.0	56.6	68.6	0.0	9.4	0.0	107.2	316.0	184.7	1,067.8
1957	50.8	69.3	33.3	235.7	128.8	64.0	22.6	0.0	0.0	299.7	436.4	783.3	2,123.9
1958	26.9	12.7	226.3	394.2	109.2	80.0	0.0	85.3	0.0	171.2	236.2	107.9	1,449.9
1959	100.3	5.3	0.0	341.1	208.3	50.5	14.7	0.0	37.1	210.1	294.9	128.8	1,391.1
1960	42.7	81.3	46.2	218.4	64.8	20.6	210.1	0.0	4.3	97.3	391.2	108.2	1,285.1
1961	188.7	78.5	25.4	142.2	201.9	147.6	64.8	15.5	36.6	445.0	211.1	132.8	1,690.1
1962	115.3	39.6	278.6	177.5	115.3	6.1	5.3	7.6	131.6	574.0	151.6	126.0	1,728.5
1963	227.3	106.4	88.4	130.0	95.0	65.5	56.4	16.0	128.3	338.8	366.8	266.2	1,885.1
1964	46.7	20.1	61.2	155.7	37.6	18.0	119.1	33.3	66.8	129.5	312.9	87.6	1,088.5
1965	36.1	61.5	19.8	319.0	156.0	0.0	0.0	106.2	0.0	433.6	338.3	297.4	1,767.9
1966	79.8	0.0	89.4	243.1	34.3	0.0	6.9	0.0	108.2	351.3	391.9	217.7	1,522.6
1967	29.2	55.9	115.3	106.4	72.9	51.8	13.5	0.0	24.9	436.9	178.6	243.1	1,328.5
1968	44.2	0.0	175.5	160.8	5.3	29.5	33.5	0.0	89.2	259.6	264.7	244.6	1,306.9
1969	29.0	13.2	17.0	143.5	42.9	0.0	0.0	147.1	5.3	394.7	59.4	269.0	1,121.1
1970	58.9	164.6	30.7	291.1	112.3	0.0	12.7	0.0	86.6	185.2	141.5	109.0	1,192.6
1971	171.0	68.0	56.0	313.0	56.0	62.0	7.0	118.0	68.0	236.0	124.0	256.0	1,535.0
1972	14.0	0.0	56.0	159.0	232.0	1.0	13.0	0.0	98.0	320.0	244.0	162.0	1,299.0
1973	1.0	14.0	63.0	128.0	71.0	35.0	59.0	18.0	73.0	210.0	120.0	371.0	1,163.0
1974	0.0	112.0	78.0	280.0	72.0	8.0	33.0	23.0	78.0	11.0	44.0	109.0	848.0
1975	33.0	61.0	80.0	224.0	122.0	34.0	83.0	25.0	96.0	103.0	225.0	141.0	1,227.0
1976	37.0	0.0	93.0	242.0	1.0	0.0	6.0	7.0	13.0	323.0	394.0	120.0	1,236.0
1977	56.0	17.0	93.0	212.0	163.0	11.0	27.0	60.0	20.0	570.0	375.0	112.0	1,716.0
1978	21.0	48.0	69.0	58.0	190.0	2.0	52.0	5.0	20.0	351.0	449.0	181.0	1,446.0
1979	18.0	82.0	71.0	172.0	40.0	26.0	10.0	18.0	115.0	326.0	313.0	129.0	1,320.0
1980	0.0	0.0	68.0	170.0	43.0	82.0	6.0	7.0	103.0	236.0	303.0	78.0	1,096.0
1981	64.0	11.0	132.0	147.0	72.0	36.0	73.0	24.0	115.0	193.0	112.0	197.0	1,176.0
1982	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1983	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1984	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1985	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1986	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1987	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1988	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1989	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1992	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1993	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1996	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1997	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1998	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1999	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2001	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2002	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2003	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2004	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2005	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2006	59.0	15.0	149.0	9.0	0.0	0.0	0.0	0.0	0.0	317.4	341.5	123.5	1,014.4
2007	77.4	9.8	0.0	131.1	0.0	0.0	0.0	0.0	0.0	230.5	267.7	146.5	863.0
2008	74.5	62.9	262.5	164.3	0.0	0.0	38.7	77.5	43.4	505.1	188.2	0.0	1,417.1
Mean	75.3	42.6	94.4	197.8	86.9	28.6	34.6	29.7	65.7	284.7	245.4	178.9	1,364.5
Max	274	165	279	394	232	148	210	147	394	574	449	783	2,124
Min	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	11.0	44.0	0.0	848.0
Stdv	69.4	40.5	73.7	92.8	66.1	32.9	45.7	40.7	76.6	136.7	111.3	130.1	293.1
% Mean	5.5	3.1	6.9	14.5	6.4	2.1	2.5	2.2	4.8	20.9	18.0	13.1	

Rainfall (mm) **Galphele (Wattegama)** **M146** Historic Data

Mahaweli Ganga *60* *Elev (m): 701.2* *Lat: 7.35N* *Long: 80.7E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	97.0	39.9	53.6	275.1	110.5	175.5	302.3	197.1	111.8	184.7	227.8	366.3	2,141.6
1950	97.0	83.1	86.9	64.3	231.6	159.0	188.2	161.5	176.8	230.6	141.5	88.9	1,709.4
1951	493.3	129.3	45.7	137.4	89.4	289.6	150.1	19.8	248.2	180.6	281.9	179.3	2,244.6
1952	210.3	174.5	178.1	233.2	379.5	120.9	48.3	158.7	41.7	340.4	178.1	75.7	2,139.4
1953	95.0	81.8	86.4	350.5	0.0	76.7	307.1	85.6	89.4	313.2	169.7	168.1	1,823.5
1954	95.0	155.2	71.9	179.6	119.1	75.2	122.9	213.4	25.4	430.3	142.7	393.7	2,024.4
1955	236.0	121.7	185.2	170.9	154.4	293.1	133.4	98.8	234.9	192.8	193.3	59.9	2,074.4
1956	63.5	6.6	80.5	154.9	109.7	321.6	59.9	95.3	79.8	275.6	497.6	138.2	1,883.2
1957	137.9	153.9	9.4	174.0	180.6	198.9	243.6	69.6	59.4	288.0	532.4	856.5	2,904.2
1958	84.6	37.1	167.6	255.0	114.8	84.6	44.7	214.4	19.3	306.8	301.5	172.2	1,802.6
1959	41.7	37.8	5.6	157.5	195.1	301.2	284.5	90.7	195.1	350.0	268.2	170.2	2,097.6
1960	268.0	330.5	18.0	217.4	174.0	125.0	241.3	54.9	313.9	329.2	409.4	43.7	2,525.3
1961	148.3	104.4	53.6	204.7	203.7	87.4	123.7	151.9	102.4	222.2	273.6	302.5	1,978.4
1962	133.1	76.5	68.8	194.1	332.5	68.3	126.0	171.2	297.4	323.1	198.6	191.0	2,180.6
1963	208.3	79.2	23.1	164.1	25.9	119.1	133.1	76.7	120.4	209.3	326.9	307.8	1,793.9
1964	185.4	196.1	76.2	84.8	125.7	92.5	184.9	94.7	140.7	194.3	278.6	186.7	1,840.6
1965	49.3	207.5	23.6	238.8	195.6	110.7	47.2	249.2	57.4	136.7	281.7	224.8	1,822.5
1966	86.6	16.0	115.1	136.4	8.4	86.9	46.2	80.5	374.6	216.2	236.7	223.5	1,627.1
1967	94.0	148.3	67.1	70.9	30.7	168.1	127.0	72.1	98.3	278.9	338.3	383.0	1,876.7
1968	87.6	39.6	151.9	83.3	49.8	169.4	236.7	109.2	211.8	248.7	215.6	208.5	1,812.1
1969	144.0	72.6	27.7	257.6	166.1	115.8	33.0	135.4	149.1	426.0	122.4	320.8	1,970.5
1970	76.5	369.8	68.1	274.8	107.9	94.7	96.5	107.4	144.3	216.9	369.3	270.8	2,197.0
1971	112.8	54.9	74.9	282.2	102.6	207.5	125.0	186.2	493.0	192.8	205.2	385.3	2,422.4
1972	29.2	0.0	52.3	171.4	332.0	75.9	164.8	79.8	96.3	406.1	297.7	297.7	2,003.2
1973	0.0	18.5	36.6	98.3	52.1	61.0	114.8	146.8	41.1	118.9	279.7	303.8	1,271.6
1974	0.0	111.3	17.5	122.2	200.9	135.6	281.9	191.8	265.7	93.7	90.4	190.5	1,701.5
1975	32.8	42.7	134.9	85.1	130.6	190.5	106.2	306.3	162.6	289.8	419.9	223.8	2,125.2
1976	144.5	0.8	32.3	163.3	0.0	27.7	105.9	78.2	31.8	344.2	392.9	127.0	1,448.6
1977	10.4	32.8	136.7	146.3	198.1	111.3	128.5	91.7	64.3	413.5	268.7	114.8	1,717.1
1978	22.9	85.6	52.1	27.9	299.5	72.6	175.5	154.4	162.6	368.3	640.8	238.8	2,301.0
1979	0.0	16.8	15.7	72.3	33.1	38.1	28.7	13.5	236.0	405.1	343.2	204.5	1,407.0
1980	0.0	0.0	42.4	261.4	64.0	118.1	157.0	136.9	139.2	165.1	297.9	149.9	1,531.9
1981	110.5	28.7	61.7	148.8	122.4	252.5	433.6	26.9	425.4	150.4	238.0	129.0	2,127.9
1982	0.0	0.0	116.9	130.6	271.8	280.7	194.6	73.4	98.6	365.8	361.2	481.8	2,375.4
1983	25.4	9.4	0.0	51.6	230.9	149.3	176.8	191.8	127.3	209.0	302.5	408.4	1,882.4
1984	297.9	303.8	303.0	281.4	34.3	199.6	247.4	82.0	616.5	171.7	233.2	168.7	2,939.5
1985	126.5	74.4	176.5	55.9	173.3	551.7	237.2	109.7	170.4	221.2	317.3	250.2	2,464.3
1986	532.4	169.7	102.1	196.2	59.7	79.0	167.6	194.8	246.9	446.8	152.9	98.8	2,446.9
1987	118.3	6.9	118.9	196.4	190.8	181.3	0.0	186.7	482.1	477.2	320.5	156.6	2,435.7
1988	10.1	97.5	131.6	319.6	123.2	119.2	204.2	357.5	203.4	64.7	463.3	305.1	2,399.4
1989	293.9	16.5	96.8	89.9	120.7	208.0	417.8	120.9	269.0	247.0	355.7	24.5	2,260.7
1990	338.6	67.5	142.4	91.8	466.3	141.5	122.0	160.8	118.1	427.5	231.4	345.6	2,653.5
1991	275.2	12.0	89.6	171.4	150.4	324.0	176.0	166.8	89.2	404.5	243.8	351.0	2,453.9
1992	33.0	0.0	0.0	164.9	199.6	163.5	322.5	140.3	176.8	257.6	448.4	134.4	2,041.0
1993	28.2	140.0	58.0	57.2	330.9	427.3	214.9	95.0	64.5	655.9	347.0	502.5	2,921.4
1994	230.7	260.5	71.6	226.0	133.1	110.9	160.0	101.6	284.4	508.5	403.4	220.4	2,711.1
1995	209.1	106.6	40.9	358.8	220.4	200.1	82.9	105.1	207.5	520.6	348.8	49.5	2,450.3
1996	123.4	93.0	38.6	204.7	15.2	120.9	170.4	132.2	286.0	335.1	210.5	-1.0	-1.0
1997	10.2	52.1	100.0	241.3	164.7	71.6	133.3	92.6	427.4	629.3	426.0	327.1	2,675.6
1998	122.7	38.9	18.1	1.9	146.9	161.4	194.4	-1.0	269.3	148.6	166.6	-1.0	-1.0
1999	-1.0	150.2	40.2	174.9	220.7	207.4	39.1	49.7	92.7	413.5	-1.0	153.9	-1.0
2000	179.4	203.1	107.9	97.4	75.9	139.4	197.0	116.0	116.0	178.5	227.5	302.7	1,940.8
2001	290.3	53.2	26.3	291.2	35.0	-1.0	180.3	22.7	195.2	277.2	139.0	396.1	-1.0
2002	35.6	62.3	41.8	309.2	88.4	78.9	86.4	177.8	17.0	285.1	437.0	129.5	1,749.0
2003	196.4	74.2	220.2	123.5	53.1	90.4	126.6	114.9	80.8	90.1	218.9	27.3	1,416.4
2004	64.2	39.5	133.5	101.9	164.9	137.1	204.7	87.2	265.5	232.3	318.2	199.4	1,948.4
2005	86.1	75.2	77.3	180.0	132.0	278.8	217.0	114.1	231.0	304.1	446.6	262.1	2,404.3
2006	324.4	114.8	189.6	141.0	125.8	133.3	110.2	111.9	113.3	474.0	502.9	183.6	2,524.8
2007	139.2	15.0	26.0	337.7	68.8	227.8	205.9	47.6	307.0	316.8	86.7	281.8	2,060.3
2008	172.2	76.1	246.5	333.2	11.6	21.0	137.8	85.5	40.0	141.8	316.4	142.0	1,724.1
Mean	133.2	89.4	83.9	176.5	144.1	159.8	163.8	124.7	183.4	294.1	296.4	234.5	2,096.5
Max	532	370	303	359	466	552	434	358	617	656	641	857	2,940
Min	0.0	0.0	0.0	1.9	0.0	21.0	0.0	13.5	17.0	64.7	86.7	24.5	1,271.6
Stdv	116.5	83.4	64.4	87.3	99.1	98.1	88.7	65.7	128.3	128.8	115.7	140.1	394.0
% Mean	6.4	4.3	4.0	8.4	6.9	7.6	7.8	5.9	8.7	14.0	14.1	11.2	

Rainfall (mm) **Gammaduwa Estate** **M147** Historic Data

Mahaweli Ganga *60* *Elev (m): 731.0* *Lat: 07-34-26N* *Long: 80-41-42E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	498 1	84 8	39.1	150.1	89.9	73.2	168.4	226.6	53.1	214.9	576.8	802.6	2,977.6
1950	419.9	96.0	258.8	141.2	148 3	75.7	79.5	77.0	145.8	128.8	360.2	266.7	2,197.9
1951	1104.6	130.3	139.4	287.0	184.9	112.0	101.6	50.3	327.2	189.2	445.0	744.2	3,815.7
1952	565.7	218.4	59.7	291.1	293.1	55.1	20.6	33 5	90.4	273.6	252.7	432.6	2,586.5
1953	372.1	200 9	131.3	291.3	0.0	25.7	230.4	44 7	61.0	492.8	466.1	526.3	2,842.6
1954	317.0	355.9	273.1	187.7	30.2	85.1	76.2	160.8	9.7	340.4	323.6	801.4	2,961.1
1955	741.4	249.2	117.6	275.3	142.0	150.1	29.5	205.2	547.4	172.7	374.1	604.3	3,608.8
1956	374.6	93.5	88.6	196.9	62.5	147.1	7.9	21.3	26.7	268.7	578.4	555 0	2,421.2
1957	421.6	419.1	5.8	130.8	149.9	143.0	122.9	49.3	138.7	359.2	639.6	1530.9	4,110.8
1958	277.4	160.5	357.1	201.9	146.6	60.7	37.6	179.3	14.5	355.9	375.9	441.7	2,609 1
1959	256.0	62.2	51.1	254 8	122.4	142.0	150.1	59.2	118 1	338.6	410.5	390 7	2,355 7
1960	329.2	660.1	24.4	334 5	109.0	92.2	263.1	19.6	122.9	328.9	518 2	229 6	3,031.7
1961	339 1	284.0	116.8	170.4	148.8	139.7	156.0	100.3	82.8	334.5	461.3	504.4	2,838.1
1962	361.9	258.6	86.6	205.2	255 3	33.3	102.9	143.8	143 8	544.8	279.7	825.2	3,241 1
1963	504.2	141 7	76.2	343.4	96.8	111.3	93.5	61.0	117.1	188.0	640 8	759 0	3,133.0
1964	427 5	391 9	190.2	74.9	133.9	53.6	215 9	54.6	128.8	162.8	282 7	504.2	2,621.0
1965	250.2	344.9	204.2	322.6	210 1	46.5	27.9	292.9	19.8	452.9	397.5	286.8	2,856.3
1966	367.0	39.9	222.5	143.5	0.0	55.6	18.3	53.6	324 1	274.6	531.4	387.4	2,417.9
1967	243.1	346.5	98.6	121.7	53.8	124.2	42 2	39.1	78.0	494.0	892 3	635.0	3,168.5
1968	234.9	64.3	345.9	98.0	51.3	137.7	107.9	28.7	119.9	328.9	449.6	581.9	2,549.0
1969	345.4	240.5	88.1	319.5	86.6	34.0	12.7	257.6	184.1	657.6	178.1	687.8	3,092.0
1970	425.2	697.7	75.2	426.0	154.2	61.2	80.8	43 7	117.1	260.6	389.9	561.1	3,292.7
1971	524.0	223.3	202.4	291.1	84.1	142.7	54.4	242.6	287.3	249.2	260.9	971.6	3,533.6
1972	291.1	11.4	21.3	189.2	301.5	37.3	46.2	12.2	128.0	523.7	303.5	812.0	2,677.4
1973	53.3	129.3	26.2	187 7	120.4	58.7	279.7	70.0	169.0	205.0	258.0	794.0	2,351.3
1974	9 0	133.0	34.0	302.0	146.0	58.0	102.0	97.0	206.0	152.0	181.0	669.0	2,089.0
1975	237.0	234.0	171.0	214.0	206 0	131.0	209.0	158.0	182 0	157.0	550.0	327.0	2,776 0
1976	389.0	32.0	147.0	227.0	0.0	11.0	45.0	81.0	57 0	326.0	602.0	279.0	2,196 0
1977	31.0	32.0	156.0	193.0	126.0	21.0	31 0	68.0	7.0	554.0	473.0	238.0	1,930.0
1978	73.0	40.0	208.0	35.0	205 0	37.0	86.0	43.0	91 0	310.0	666.0	356.0	2,150 0
1979	136.0	126.0	49.0	158.0	120.0	139.0	77.0	64.0	205.0	227.0	525.0	257 0	2,083.0
1980	11.0	0.0	121.0	279.0	54.0	57.0	39.0	64.0	160.0	295.0	386.0	252.0	1,718 0
1981	345.0	164.0	59.0	148.0	78.0	96.0	172.0	108.0	101.0	197.0	302.0	162 0	1,932.0
1982	30 8	0.7	440.0	232.0	310.0	431 6	60.2	151 7	377.0	517.3	455 1	581.4	3,587.8
1983	220 9	3.8	85.1	91.8	117.3	56 3	144.8	72.1	38.2	224.5	317.3	689.3	2,061.4
1984	573.2	583.7	388.6	198 8	56.7	8.2	92.8	16.5	221.7	197.4	340.5	190.8	2,868.9
1985	574.7	193.2	131 9	118 4	99.3	194.3	77.4	58 5	117.7	310.9	277.2	449 8	2,603.3
1986	652.3	226.9	73 3	234.9	272.9	18.1	26.9	55 8	59.2	317.2	158 2	387.5	2,483.2
1987	364.4	49.3	47.3	216.2	238.4	36.7	9.4	35.2	140.9	760 1	247.1	87.4	2,232.4
1988	25.3	59.4	224.4	326.7	22.7	71.1	117.1	57.8	198.6	193.1	225.7	557.7	2,079.6
1989	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1992	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1993	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1 0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1996	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0
1997	-1.0	-1.0	-1 0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1998	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1 0	-1.0	-1.0
1999	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0
2000	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0
2001	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1 0	-1.0
2002	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0
2003	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0
2004	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0
2005	-1.0	-1.0	-1 0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2006	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2007	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2008	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1 0	-1.0	-1.0	-1.0	-1.0	-1.0
Mean	342 9	194.6	140.9	215.3	130.7	89.1	95 4	91.4	142.9	322 0	408 8	528.0	2,702.0
Max	1,105	698	440	426	310	432	280	293	547	760	892	1,531	4,111
Min	9.0	0.0	5.8	35.0	0.0	8.2	7.9	12.2	7.0	128 8	158.2	87.4	1,718.0
Stdv	220.4	173.7	107 2	85.4	83.3	73.0	71.5	72.1	109.5	147.8	157.9	272 4	562.2
% Mean	12 7	7.2	5.2	8.0	4.8	3.3	3.5	3.4	5.3	11.9	15.1	19.5	

Rainfall (mm) **Gonawella Estate** **M159** Historic Data

Mahaweli Ganga *60* *Elev (m): 1280.0* *Lat: 07-22-34N* *Long: 80-48-00E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	352.0	131.0	64.0	339.0	96.0	185.0	442.0	320.0	158.0	225.0	527.0	846.0	3,685.0
1950	335.0	172.0	157.0	122.0	315.0	129.0	197.0	152.0	366.0	229.0	226.0	291.0	2,691.0
1951	1088.0	218.0	136.0	235.0	156.0	568.0	218.0	182.0	649.0	326.0	498.0	764.0	5,038.0
1952	681.0	386.0	168.0	436.0	523.0	118.0	112.8	268.2	214.4	439.2	354.3	301.5	4,002.4
1953	353.1	215.4	157.5	446.5	3.3	96.3	446.0	115.3	127.8	667.3	305.6	427.5	3,361.6
1954	423.2	389.9	338.3	269.0	141.0	129.3	202.4	436.4	54.9	624.3	325.1	621.5	3,955.3
1955	799.1	338.6	176.8	290.6	288.5	389.6	201.9	157.0	351.3	322.8	362.2	223.5	3,901.9
1956	256.8	60.2	134.6	170.4	140.7	645.7	109.0	241.0	156.7	454.4	752.1	523.2	3,644.8
1957	401.8	411.2	16.3	196.1	385.3	271.3	381.8	148.6	169.9	305.3	926.3	1617.5	5,231.4
1958	365.3	89.7	379.5	431.8	161.8	186.9	119.1	365.0	94.5	508.5	493.8	405.4	3,601.3
1959	300.7	74.9	32.3	361.7	284.2	469.9	338.3	160.0	267.5	578.6	491.7	465.6	3,825.4
1960	461.3	773.4	38.4	473.7	228.9	218.4	437.4	116.6	518.9	363.0	458.0	197.9	4,285.9
1961	405.4	228.6	227.1	339.3	341.6	112.0	171.7	227.3	115.6	333.5	683.5	642.6	3,828.2
1962	374.4	260.6	176.0	335.5	507.5	68.8	181.9	278.6	267.2	476.2	369.3	455.7	3,751.7
1963	526.3	371.6	220.0	309.4	145.8	176.3	239.5	132.3	275.8	422.7	605.0	768.1	4,192.8
1964	598.2	497.6	246.9	91.2	158.7	107.4	300.7	134.9	233.7	254.0	379.2	461.0	3,463.5
1965	323.6	538.2	135.6	395.7	340.1	121.9	73.2	401.6	94.0	432.1	474.0	390.4	3,720.4
1966	360.9	87.9	260.6	270.3	18.5	116.6	73.7	150.6	514.9	461.3	423.4	348.2	3,086.9
1967	272.8	390.9	116.6	223.3	45.2	221.7	170.7	82.0	220.5	386.3	866.1	528.3	3,524.4
1968	261.1	128.5	329.4	255.5	140.7	206.8	290.6	167.4	240.5	355.3	272.0	495.0	3,142.8
1969	357.1	174.5	52.1	415.3	251.7	217.2	71.9	320.8	268.7	557.0	212.1	840.0	3,738.4
1970	379.0	638.8	104.1	453.6	96.5	125.7	164.3	279.9	176.8	370.8	397.0	652.8	3,839.3
1971	387.6	124.2	133.9	291.3	155.2	232.9	199.4	316.2	587.2	263.4	255.8	1452.9	4,400.0
1972	265.4	14.5	41.9	241.6	396.5	147.3	232.2	121.2	205.2	698.8	443.0	773.7	3,581.3
1973	52.6	188.7	167.9	243.3	120.4	113.3	239.5	278.1	172.2	195.8	407.9	621.3	2,801.0
1974	1.5	194.3	89.9	344.9	308.6	136.0	340.0	288.0	386.0	204.0	144.0	601.0	3,038.2
1975	211.0	222.0	211.0	267.0	164.0	466.0	259.0	493.0	307.0	245.0	559.0	661.0	4,065.0
1976	465.0	57.0	87.0	256.0	5.0	45.0	269.0	169.0	49.0	332.0	558.0	492.0	2,784.0
1977	36.0	124.0	164.0	322.0	214.0	134.0	207.0	146.0	108.0	718.0	473.0	449.0	3,095.0
1978	123.0	121.0	176.0	163.0	445.0	130.0	324.0	189.0	157.0	524.0	629.0	639.0	3,620.0
1979	209.0	106.0	102.0	327.0	175.0	242.0	160.0	153.0	431.0	479.0	509.0	399.0	3,292.0
1980	99.0	1.0	73.0	429.0	88.0	83.0	124.0	190.0	203.0	272.0	561.0	236.0	2,359.0
1981	206.0	197.0	110.0	202.0	133.0	219.0	360.0	195.0	277.0	187.0	365.0	357.0	2,808.0
1982	26.8	0.6	272.6	232.7	279.8	245.6	246.6	149.4	103.2	470.5	505.6	974.3	3,507.7
1983	375.1	21.1	33.1	125.9	352.9	67.7	68.9	258.6	114.1	370.2	380.9	708.4	2,876.9
1984	273.8	452.9	293.8	398.2	132.5	177.0	409.0	149.8	543.3	261.7	504.9	288.7	3,885.6
1985	323.0	252.7	332.1	137.4	172.6	1416.3	199.0	274.1	319.5	296.8	542.2	616.5	4,882.2
1986	526.5	296.5	315.6	193.7	87.1	240.5	158.3	182.9	205.2	663.7	248.1	429.3	3,547.4
1987	246.3	67.4	127.9	230.7	185.2	101.8	117.9	144.0	362.7	647.4	251.3	279.8	2,762.4
1988	141.4	147.0	221.9	365.5	88.5	66.5	174.4	303.1	311.3	232.4	325.8	447.0	2,824.8
1989	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1992	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1993	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1996	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1997	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1998	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1999	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2001	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2002	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2003	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2004	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2005	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2006	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2007	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2008	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Mean	341.1	229.1	165.5	290.8	206.8	228.6	225.8	220.9	259.5	403.9	451.6	567.3	3,591.1
Max	1,088	773	380	474	523	1,416	446	493	649	718	926	1,618	5,231
Min	1.5	0.6	16.3	91.2	3.3	45.0	68.9	82.0	49.0	187.0	144.0	197.9	2,359.0
Stdv	208.7	179.5	96.1	101.8	131.5	235.4	107.0	95.8	149.5	152.9	169.2	293.0	642.3
% Mean	9.5	6.4	4.6	8.1	5.8	6.4	6.3	6.2	7.2	11.2	12.6	15.8	

Rainfall (mm) Hingurakgoda Agr. M186 Historic Data

Mahaweli Ganga *60* *Elev (m):* *39.6* *Lat:* *8.05N* *Long:* *80.95E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	193.0	56.0	71.0	143.0	7.0	0.0	101.0	86.0	17.0	205.7	269.0	493.0	1,641.7
1950	132.1	94.0	164.6	18.8	127.5	0.0	5.6	98.0	47.0	92.5	197.1	166.6	1,143.8
1951	559.8	105.9	37.6	144.3	152.1	5.8	8.1	31.8	94.5	87.9	494.0	182.6	1,904.4
1952	403.6	55.6	26.7	111.3	91.9	0.5	30.7	0.0	139.2	134.1	164.6	181.1	1,339.3
1953	243.3	47.8	15.5	258.8	1.8	1.5	233.4	70.4	70.1	309.1	193.0	465.1	1,909.8
1954	272.8	34.3	172.5	181.4	1.3	0.0	87.9	34.0	0.0	184.9	164.6	416.3	1,550.0
1955	267.2	124.5	52.8	190.2	49.0	0.0	1.0	91.9	102.6	67.6	158.2	177.0	1,282.0
1956	162.6	46.0	18.3	76.5	1.3	71.4	0.8	27.7	0.8	238.3	286.3	266.4	1,196.4
1957	108.5	255.3	0.0	52.1	112.5	4.1	69.1	36.8	48.8	192.0	607.1	1341.0	2,827.3
1958	235.5	113.5	114.0	64.0	68.3	0.8	10.9	157.0	49.5	122.7	213.9	210.6	1,360.7
1959	174.8	11.2	6.6	113.5	113.8	52.6	3.3	13.2	50.0	287.5	348.7	267.0	1,442.2
1960	281.2	422.4	59.7	206.5	227.1	2.5	161.3	29.5	147.3	182.4	485.6	104.1	2,309.6
1961	453.9	216.9	156.0	125.0	61.2	10.4	6.9	1.3	30.7	253.7	306.8	503.2	2,126.0
1962	196.9	73.9	91.2	102.6	51.8	0.0	0.0	93.0	130.0	139.4	220.0	210.1	1,308.9
1963	455.4	195.1	183.9	120.9	16.3	0.0	86.1	21.1	141.0	121.2	587.0	500.9	2,428.9
1964	141.0	134.1	124.7	33.8	114.0	0.0	103.1	15.7	56.6	178.1	118.6	133.6	1,153.3
1965	93.2	180.3	15.7	215.9	225.0	0.0	9.9	121.2	0.0	412.0	400.3	546.1	2,219.6
1966	173.0	24.9	154.2	137.9	2.0	0.5	3.8	54.1	157.0	531.6	411.5	214.9	1,865.4
1967	33.3	92.5	88.9	68.3	43.9	4.8	1.5	10.2	73.9	345.2	487.9	576.8	1,827.2
1968	148.3	0.0	139.4	62.2	11.7	0.0	0.0	85.3	134.4	186.7	229.4	212.9	1,210.3
1969	84.6	63.2	2.8	158.7	16.3	0.0	103.4	60.2	160.5	329.2	280.9	852.2	2,112.0
1970	122.4	225.3	53.8	187.7	83.8	41.9	0.5	115.6	48.3	59.9	285.2	331.7	1,556.1
1971	223.3	93.5	46.2	225.8	119.6	11.9	36.3	59.4	25.4	88.9	132.6	643.4	1,706.3
1972	74.4	1.8	17.0	125.5	137.4	0.0	0.0	0.3	369.1	311.7	373.1	308.6	1,718.9
1973	0.0	57.9	50.8	39.6	53.8	75.9	226.8	12.7	94.5	140.2	94.2	476.0	1,322.4
1974	0.0	57.1	9.7	102.9	166.6	0.0	0.0	3.3	85.1	6.1	115.6	423.2	969.6
1975	142.2	57.4	66.0	172.7	132.6	0.0	212.9	69.6	128.3	48.5	240.0	181.1	1,451.3
1976	32.3	21.6	4.6	160.3	15.7	0.0	36.3	48.3	29.2	88.4	319.0	496.1	1,251.8
1977	84.1	36.6	56.6	12.2	32.8	0.0	49.0	39.4	218.4	356.4	374.4	374.9	1,634.8
1978	71.6	20.6	86.4	50.3	28.2	0.0	84.8	0.0	-1.0	400.8	437.9	465.0	-1.0
1979	22.9	70.9	62.0	53.3	56.0	0.0	0.0	139.7	64.4	226.5	511.5	210.3	1,417.5
1980	0.0	0.0	8.9	196.4	50.2	3.0	0.0	0.0	58.7	204.5	279.3	296.1	1,097.1
1981	142.0	149.2	38.4	99.9	94.5	0.0	240.4	104.2	78.8	253.1	63.9	301.3	1,565.7
1982	0.0	0.0	67.6	99.4	211.7	9.5	0.0	0.0	50.6	354.7	456.7	397.0	1,647.2
1983	27.8	0.0	0.0	2.3	58.3	1.5	53.6	0.0	16.6	312.6	195.2	412.9	1,080.8
1984	498.1	572.4	108.2	0.0	0.0	0.0	78.5	41.6	197.9	91.5	194.0	99.4	1,881.6
1985	270.9	74.0	73.3	40.9	32.5	0.7	93.8	4.4	128.2	22.7	169.4	395.8	1,306.6
1986	244.0	32.7	-1.0	0.0	68.8	18.1	13.4	27.2	0.0	331.4	211.7	267.9	-1.0
1987	134.8	0.0	91.3	0.0	51.9	0.0	0.0	0.0	194.3	349.9	140.8	105.3	1,068.3
1988	29.1	69.7	95.6	155.3	13.9	0.0	153.6	110.8	133.8	226.8	-1.0	-1.0	-1.0
1989	187.7	0.0	109.9	110.6	87.0	15.7	212.2	4.2	107.3	34.6	187.9	116.6	1,173.7
1990	297.5	28.9	172.5	132.8	231.1	0.0	13.1	139.5	54.9	153.4	143.0	426.2	1,792.9
1991	167.7	12.8	118.4	48.6	56.1	11.0	0.0	9.6	65.4	190.5	285.5	352.5	1,318.1
1992	24.3	0.0	0.0	149.1	68.0	0.0	0.0	13.7	219.6	17.6	506.5	372.3	1,371.1
1993	23.6	97.8	8.0	24.3	114.8	0.0	116.9	67.2	66.9	216.0	677.1	649.7	2,062.3
1994	312.3	258.4	66.7	71.5	51.5	0.0	0.0	0.0	202.1	225.4	435.1	346.7	1,969.7
1995	185.1	66.0	48.3	198.4	73.6	0.0	63.6	0.0	92.1	166.0	166.3	82.2	1,141.6
1996	166.6	88.1	0.0	202.9	8.4	63.7	7.2	202.3	29.3	118.7	231.6	225.2	1,344.0
1997	5.3	8.6	41.1	82.0	206.1	7.1	12.9	0.2	213.3	355.8	486.2	463.2	1,881.8
1998	257.1	36.0	0.0	8.4	87.8	0.0	105.3	238.9	4.6	146.0	212.1	430.1	1,526.3
1999	425.7	203.8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	308.0	231.0	70.0	72.0	52.0	1.0	22.5	45.0	100.0	22.4	733.0	316.0	1,972.9
2001	338.4	83.0	0.0	155.0	0.0	98.0	98.0	0.0	88.0	146.5	72.0	453.0	1,531.9
2002	117.5	147.8	52.5	142.0	25.5	0.0	0.0	77.5	42.5	130.5	399.7	482.6	1,618.1
2003	200.8	149.5	74.0	57.6	29.5	40.0	75.0	116.2	11.8	86.1	489.7	105.9	1,436.1
2004	67.0	15.5	91.8	131.5	98.0	0.0	14.0	0.0	74.8	439.6	434.1	341.8	1,708.1
2005	131.4	0.0	37.8	186.8	146.3	0.0	61.4	96.6	0.0	203.5	327.4	77.0	1,268.2
2006	261.8	119.0	93.1	175.0	91.0	0.0	21.7	0.0	81.9	397.3	282.8	155.3	1,678.9
2007	113.4	219.8	0.0	107.9	10.5	53.2	11.9	24.5	76.3	303.6	117.6	585.9	1,624.6
2008	47.8	87.5	233.0	190.4	0.0	0.0	10.5	172.9	0.0	151.2	227.7	227.7	1,348.7
Mean	176.2	95.7	66.4	111.1	73.6	10.3	53.5	52.9	88.0	203.1	304.0	352.0	1,582.2
Max	560	572	233	259	231	98	240	239	369	532	733	1,341	2,827
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	63.9	77.0	969.6
Stdv	134.8	105.3	56.2	67.1	63.1	22.1	67.9	56.9	71.9	121.0	158.1	213.2	382.7
% Mean	11.1	6.0	4.2	7.0	4.7	0.7	3.4	3.3	5.6	12.8	19.2	22.2	

Rainfall (mm) **Horowpotana** M198 Historic Data

Yan Oya *67* *Elev (m): -----* *Lat: 7.52N* *Long: 80.15E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	202.4	12.2	0.0	111.5	100.6	0.0	82.6	158.0	158.7	142.2	227.6	525.8	1,721.6
1950	120.9	103.4	16.3	13.2	144.3	0.0	0.0	209.6	0.0	164.3	269.2	205.7	1,246.9
1951	413.3	163.6	35.1	92.2	194.8	0.0	36.1	80.3	51.6	68.6	458.7	158.5	1,752.8
1952	348.7	73.4	7.9	182.4	96.5	0.0	27.4	8.9	65.5	128.8	309.4	218.2	1,467.1
1953	188.0	9.9	36.3	341.4	0.0	13.0	144.8	66.8	38.9	307.8	163.1	226.6	1,536.6
1954	240.5	25.1	235.2	179.6	41.4	0.0	26.2	236.7	22.6	124.0	85.6	702.6	1,919.5
1955	227.1	106.7	7.6	174.5	57.9	0.0	8.6	261.6	148.1	116.6	132.1	100.3	1,341.1
1956	94.0	17.3	3.0	77.0	0.0	102.1	47.2	34.8	22.4	253.5	412.2	147.1	1,210.6
1957	103.6	136.7	0.0	1.8	153.4	0.0	182.1	73.2	134.9	181.6	583.9	902.7	2,453.9
1958	71.9	44.4	73.2	136.9	94.2	0.0	0.0	278.9	144.3	226.3	246.4	217.4	1,533.9
1959	101.9	6.4	8.4	48.0	44.4	76.7	0.0	172.2	38.1	175.5	392.9	171.4	1,235.9
1960	161.3	190.2	117.9	242.3	148.6	0.0	96.8	28.7	78.0	134.1	331.5	102.1	1,631.5
1961	411.2	180.1	13.2	71.4	74.2	0.0	0.0	0.0	77.5	308.4	315.0	588.0	2,039.0
1962	171.4	51.6	0.0	31.0	60.5	0.0	19.1	73.2	169.9	214.4	196.3	225.3	1,212.7
1963	443.7	183.9	63.2	100.6	66.5	0.0	250.2	53.8	60.7	217.4	472.4	500.1	2,412.5
1964	105.7	43.9	50.3	55.1	66.3	0.0	182.1	9.4	65.0	151.4	182.6	291.1	1,202.9
1965	61.0	251.5	26.4	279.4	136.1	0.0	0.0	119.4	49.3	381.0	101.9	443.5	1,849.5
1966	147.1	53.6	189.0	141.7	6.1	0.0	0.0	163.1	129.0	583.2	378.7	220.7	2,012.2
1967	49.0	153.7	125.7	70.1	62.2	6.9	6.4	142.5	110.7	249.9	473.2	467.1	1,917.4
1968	7.6	26.2	102.4	42.4	53.6	22.9	0.0	39.9	242.1	270.8	389.1	230.4	1,427.4
1969	126.2	95.8	0.0	183.6	11.4	0.0	62.0	82.0	47.5	320.5	296.9	676.4	1,902.3
1970	161.3	169.7	77.2	230.9	53.3	13.5	0.0	155.4	27.4	202.0	479.0	298.0	1,867.7
1971	261.0	41.0	18.0	80.0	29.0	0.0	52.0	175.0	117.0	169.0	270.0	690.0	1,902.0
1972	47.0	10.0	10.0	63.0	163.0	17.0	55.0	6.0	147.0	330.0	264.0	402.0	1,514.0
1973	8.0	42.0	37.0	35.0	82.0	40.0	134.0	45.0	118.0	157.0	171.0	720.0	1,589.0
1974	16.0	61.0	6.0	117.0	141.0	0.0	32.0	82.0	141.0	55.0	120.0	292.0	1,063.0
1975	80.0	24.0	102.0	92.0	143.0	1.0	60.0	74.0	69.0	107.0	323.0	265.0	1,340.0
1976	19.0	1.0	7.0	228.0	38.0	6.0	25.0	90.0	87.0	184.0	294.0	388.0	1,367.0
1977	11.0	150.0	41.0	105.0	130.0	19.0	29.0	62.0	180.0	364.0	360.0	262.0	1,713.0
1978	55.0	56.0	75.0	123.0	66.0	1.0	76.0	0.0	66.0	295.0	454.0	359.0	1,626.0
1979	37.0	47.0	45.0	82.0	68.0	14.0	58.0	50.0	247.0	316.0	518.0	249.0	1,731.0
1980	0.0	0.0	32.0	259.0	120.0	2.0	9.0	24.0	115.0	188.0	310.0	203.0	1,262.0
1981	55.0	149.0	26.0	102.0	259.0	19.0	164.0	92.0	157.0	354.0	206.0	416.0	1,999.0
1982	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1983	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1984	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1985	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	161.8	378.4	207.1	-1.0
1986	271.8	29.3	211.9	27.3	87.9	1.3	22.4	5.2	11.5	265.3	160.3	221.5	1,315.7
1987	162.1	0.0	36.7	83.9	158.0	0.0	0.0	0.0	268.9	699.1	74.2	104.7	1,587.6
1988	19.3	-1.0	100.3	94.1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1989	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	193.7	151.9	164.4	-1.0
1992	47.0	0.0	0.0	-1.0	-1.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	380.9	-1.0
1993	0.0	0.0	0.0	0.0	147.5	0.0	78.6	65.9	211.4	281.6	604.0	571.0	1,960.0
1994	258.0	169.0	26.0	19.0	0.0	0.0	0.0	0.0	186.0	281.9	338.2	65.9	1,344.0
1995	224.1	53.2	0.0	171.0	94.0	0.0	121.5	3.0	153.0	98.0	110.0	28.5	1,056.3
1996	60.5	101.0	3.5	269.5	20.0	48.5	77.0	192.0	63.5	214.0	282.5	233.8	1,565.8
1997	10.0	0.0	17.0	142.0	75.0	49.0	0.0	25.0	180.0	124.0	282.0	263.0	1,167.0
1998	163.0	0.0	0.0	17.0	64.0	0.0	114.0	39.0	89.5	62.2	118.0	230.6	897.3
1999	197.0	65.0	0.0	209.0	0.0	39.0	0.0	10.5	67.0	214.8	151.2	201.3	1,154.8
2000	129.0	164.5	0.0	213.5	24.0	0.0	2.0	24.0	262.0	14.8	275.5	341.1	1,450.4
2001	233.0	0.0	0.0	217.0	0.0	19.0	25.0	0.0	14.5	126.8	242.2	294.5	1,172.0
2002	25.6	60.3	64.0	151.9	0.0	0.0	0.0	91.5	101.8	149.0	426.6	323.2	1,393.9
2003	175.0	97.0	-1.0	128.0	21.0	20.0	206.0	33.0	180.5	24.5	523.5	11.0	-1.0
2004	70.0	0.0	33.0	185.0	280.5	0.0	36.5	56.0	326.5	201.9	293.8	-1.0	-1.0
2005	124.3	0.0	44.9	227.8	128.2	0.0	0.0	0.0	0.0	-1.0	-1.0	221.0	-1.0
2006	-1.0	35.0	132.5	50.5	79.0	-1.0	15.0	0.0	169.5	162.1	228.0	169.0	-1.0
2007	245.0	0.0	0.0	123.0	57.0	88.5	5.8	133.0	65.0	291.0	63.0	321.5	1,392.8
2008	0.0	74.7	505.9	99.8	0.0	0.0	31.0	209.0	0.0	163.5	380.6	238.8	1,703.3
Mean	133.9	67.9	53.1	125.4	81.2	12.1	50.0	77.6	111.3	214.8	293.7	310.5	1,556.6
Max	444	252	506	341	281	102	250	279	327	699	604	903	2,454
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	63.0	11.0	897.3
Stdv	113.3	66.2	84.9	81.3	65.1	23.4	62.2	76.0	77.4	123.3	136.9	189.1	347.0
% Mean	8.6	4.4	3.4	8.1	5.2	0.8	3.2	5.0	7.2	13.8	18.9	19.9	

Rainfall (mm) **Illukkumbura** **M205** Historic Data

Mahaweli Ganga *60* *Elev (m): 1219.5* *Lat: 7.55N* *Long: 80.77E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	532.1	88.0	247.4	210.6	89.7	45.0	47.2	83.3	81.8	101.1	397.0	731.0	2,654.2
1950	309.6	156.2	252.2	142.2	282.7	65.8	97.3	59.4	125.7	117.9	139.7	246.1	1,994.8
1951	1146.6	123.4	152.4	256.5	167.1	97.5	79.2	122.7	260.4	166.9	295.1	524.3	3,392.1
1952	768.0	516.6	125.2	424.9	271.3	69.6	0.0	0.0	71.9	96.0	164.6	594.6	3,102.7
1953	502.2	302.3	197.6	654.6	0.0	0.0	314.2	96.8	147.8	401.6	379.5	680.2	3,676.8
1954	735.1	486.4	371.9	324.4	92.2	16.8	62.2	89.7	0.0	241.8	462.5	733.8	3,616.8
1955	635.0	308.6	353.6	260.0	233.2	49.5	5.6	40.1	107.4	99.6	126.2	319.8	2,538.6
1956	149.9	143.5	191.3	215.9	137.7	97.8	64.8	39.6	5.3	99.1	431.0	559.8	2,135.7
1957	498.6	623.1	10.9	306.6	274.1	116.3	57.7	27.4	96.5	270.0	833.1	1228.3	4,342.6
1958	566.7	203.2	479.6	260.0	390.7	116.3	78.7	18.8	42.9	93.5	367.0	471.9	3,089.3
1959	574.8	116.8	38.4	173.7	69.6	100.6	99.1	33.8	221.5	211.1	441.5	410.0	2,490.9
1960	541.0	772.7	224.0	192.5	241.8	57.7	114.3	84.3	94.7	176.0	263.9	226.8	2,989.7
1961	255.0	227.8	157.5	282.2	147.8	177.8	91.7	31.8	20.8	336.3	601.7	555.2	2,885.6
1962	601.2	331.0	257.6	431.3	179.3	31.5	34.8	86.6	52.3	288.3	204.2	321.8	2,819.9
1963	951.2	419.9	648.7	508.5	342.6	59.4	61.0	119.9	57.0	154.0	513.0	643.0	4,478.2
1964	447.8	238.3	30.2	0.8	0.8	0.0	26.2	26.4	30.0	7.1	32.8	373.1	1,213.5
1965	232.9	441.2	30.0	239.5	6.4	0.0	1.0	107.7	0.0	245.6	372.1	458.0	2,134.4
1966	470.2	57.4	287.8	159.3	0.0	25.7	0.0	2.0	87.4	190.0	341.6	368.6	1,990.0
1967	338.1	212.1	130.0	158.0	102.4	50.8	1.3	0.0	129.0	263.9	702.3	389.9	2,477.8
1968	370.6	109.7	18.0	158.5	0.5	1.0	4.3	0.0	1.8	264.4	383.3	441.7	1,753.8
1969	195.1	209.6	0.8	211.6	1.3	0.0	0.0	104.6	80.0	350.0	88.4	632.2	1,873.6
1970	734.1	422.1	55.4	352.0	26.9	0.8	0.0	0.0	79.8	181.6	295.7	842.8	2,991.2
1971	878.1	236.2	111.0	54.4	54.6	31.8	2.8	178.3	86.1	186.9	321.1	680.2	2,821.5
1972	188.5	1.3	53.1	57.7	365.0	0.0	0.0	0.0	110.2	605.5	675.4	749.6	2,806.3
1973	82.3	83.8	108.2	31.8	25.9	3.8	30.0	3.3	129.3	172.7	215.4	646.2	1,532.7
1974	0.8	137.9	92.7	281.9	172.5	14.0	33.0	50.5	52.8	52.3	120.6	510.8	1,519.8
1975	195.8	199.4	240.0	201.4	182.4	80.8	58.4	50.5	101.3	30.2	326.4	385.8	2,052.4
1976	771.1	66.0	30.2	135.6	0.0	0.0	0.8	33.3	44.7	112.0	301.2	299.0	1,793.9
1977	88.6	184.4	216.2	134.1	95.3	28.4	39.6	26.0	50.8	588.8	748.3	777.2	2,977.7
1978	339.9	122.2	259.1	39.9	93.0	0.0	46.5	21.8	30.5	446.0	589.0	645.4	2,633.3
1979	331.0	207.0	94.0	105.9	78.7	64.8	26.2	66.0	123.9	201.7	501.1	462.0	2,262.3
1980	91.4	0.0	116.8	239.0	7.6	0.0	0.0	30.5	53.8	240.8	563.1	232.4	1,575.4
1981	262.0	287.8	124.5	190.8	41.9	0.0	27.9	31.8	35.6	137.2	277.6	470.7	1,887.8
1982	79.1	0.0	214.9	134.9	112.8	29.2	27.2	20.6	38.3	522.7	536.4	749.3	2,465.4
1983	295.6	0.0	61.0	33.0	139.2	20.8	7.4	12.7	5.3	306.3	297.7	922.5	2,101.5
1984	596.1	562.9	300.0	197.6	38.1	0.0	29.5	43.2	254.6	160.5	502.9	295.4	2,980.8
1985	572.5	177.8	313.9	56.4	38.1	127.0	8.6	22.9	55.9	349.8	244.6	662.2	2,629.7
1986	915.2	287.0	311.1	262.4	112.0	45.7	5.1	78.5	0.0	204.7	227.1	604.5	3,053.3
1987	521.2	18.8	139.2	175.5	203.5	7.6	0.0	20.3	92.0	636.1	254.0	150.1	2,218.3
1988	111.8	143.8	252.5	420.9	30.5	0.0	80.3	116.6	155.2	244.3	378.8	706.4	2,641.1
1989	705.3	10.2	127.0	40.6	93.7	7.6	239.0	3.3	0.0	238.7	607.9	343.5	2,416.8
1990	375.4	202.7	206.5	41.4	243.6	0.0	0.0	45.2	52.2	246.0	303.6	1160.0	2,876.6
1991	464.6	77.9	315.8	73.0	75.5	138.5	59.2	0.0	62.0	226.9	426.3	853.1	2,772.8
1992	427.7	0.0	0.0	244.8	93.2	21.8	61.2	24.9	78.4	206.1	811.2	634.2	2,603.5
1993	225.2	298.0	32.3	64.5	190.0	76.7	70.9	0.0	24.6	372.2	727.0	1088.0	3,169.4
1994	775.3	358.1	-1.0	-1.0	-1.0	-1.0	0.0	6.3	293.1	548.3	778.9	679.4	-1.0
1995	261.7	288.1	135.6	396.0	261.3	0.0	0.0	115.1	47.4	348.2	177.7	223.1	2,254.2
1996	270.7	397.8	53.3	405.9	0.0	94.1	27.8	99.8	46.0	209.4	270.3	-1.0	-1.0
1997	-1.0	125.9	260.2	239.9	210.6	12.2	56.2	0.0	102.4	363.9	490.3	483.3	-1.0
1998	283.2	79.9	83.5	129.1	173.1	45.0	86.0	119.0	0.0	112.0	179.0	480.0	1,769.8
1999	774.0	516.0	128.0	106.0	76.0	98.0	0.0	0.0	32.0	214.0	433.0	469.0	2,846.0
2000	548.0	320.0	61.0	118.0	45.0	26.0	0.0	133.0	103.0	32.0	586.0	461.0	2,433.0
2001	734.0	246.0	23.0	284.3	88.6	18.5	0.0	0.0	172.0	248.5	311.4	639.0	2,765.3
2002	429.6	324.8	94.5	274.0	41.0	26.0	0.0	43.0	0.0	354.0	721.0	580.3	2,888.2
2003	828.0	226.0	242.5	192.7	25.0	7.4	60.0	16.0	114.5	94.0	575.7	205.9	2,587.7
2004	360.1	475.0	70.0	188.0	57.0	25.5	34.0	0.0	98.0	403.0	667.0	971.0	3,348.6
2005	535.0	107.0	66.0	173.0	96.0	12.0	53.2	31.0	26.0	228.0	637.0	281.0	2,245.2
2006	1041.0	257.1	285.6	220.0	152.0	15.0	33.0	0.0	109.0	427.0	978.0	623.0	4,140.7
2007	69.8	128.0	44.0	255.0	12.0	68.0	42.0	3.0	213.0	-1.0	377.0	812.3	-1.0
2008	529.4	199.4	-1.0	266.8	0.0	0.0	49.9	108.6	6.0	166.4	388.7	458.9	-1.0
Mean	466.4	231.1	164.3	210.0	115.0	39.4	42.3	45.5	79.9	247.3	422.7	561.8	2,613.0
Max	1,147	773	649	655	391	178	314	178	293	636	978	1,228	4,478
Min	0.8	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	7.1	32.8	150.1	1,213.5
Stdv	267.7	169.3	128.2	128.4	101.3	43.0	54.7	44.8	67.9	145.0	209.6	237.2	682.2
% Mean	17.8	8.8	6.3	8.0	4.4	1.5	1.6	1.7	3.1	9.5	16.2	21.5	

Rainfall (mm) Kalawewa Tank/Coconut **M225** Historic Data

Kala Oya *93* *Elev (m): 122.0* *Lat: 8.00N* *Long: 80.53E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	158.5	34.0	30.5	127.3	62.7	12.2	35.3	88.4	40.4	133.6	220.7	309.6	1,253.2
1950	102.1	54.6	88.6	54.1	53.1	7.6	12.4	49.3	39.1	117.3	134.6	128.0	840.8
1951	364.7	66.8	75.9	150.4	69.1	17.8	18.0	23.9	143.5	104.6	292.6	185.4	1,512.7
1952	265.9	55.1	47.8	155.4	71.6	8.9	24.4	16.3	55.4	98.6	181.4	120.1	1,100.9
1953	149.1	64.0	65.5	172.7	2.8	10.2	55.9	30.5	62.7	238.8	187.5	189.7	1,229.4
1954	170.2	58.9	126.7	173.2	43.9	5.3	18.0	55.1	18.0	227.1	163.8	295.7	1,355.9
1955	246.4	100.8	76.2	153.4	61.5	11.9	15.0	62.7	133.1	131.6	171.4	106.9	1,270.9
1956	90.7	22.6	61.0	65.8	9.1	42.4	12.2	40.1	31.0	128.5	299.2	196.8	999.4
1957	66.4	124.8	20.5	215.1	174.6	58.2	12.7	9.1	68.7	400.6	451.7	962.5	2,564.9
1958	124.3	18.2	195.7	275.6	117.2	10.0	2.2	34.8	0.0	162.1	179.9	107.7	1,227.7
1959	155.2	19.2	52.0	130.9	135.1	18.2	28.0	2.2	100.0	376.7	344.4	236.3	1,598.2
1960	195.8	138.2	47.4	277.5	54.3	156.6	196.2	2.2	44.5	207.1	263.5	128.5	1,711.8
1961	170.0	96.6	62.4	75.3	170.6	78.8	33.1	11.3	35.0	365.4	168.4	227.0	1,493.9
1962	167.8	29.1	102.0	223.0	173.3	6.6	9.8	7.3	175.3	387.8	271.5	199.8	1,753.3
1963	294.0	139.4	120.8	266.4	33.1	10.3	15.9	25.3	42.5	199.1	315.1	397.7	1,859.6
1964	58.1	65.7	59.9	130.4	47.1	14.0	48.9	18.0	110.6	111.0	201.8	131.4	996.9
1965	44.0	108.7	51.4	165.4	70.2	9.8	3.5	201.1	0.7	374.9	283.9	644.9	1,958.5
1966	100.5	3.9	147.7	219.3	1.7	8.2	10.3	9.5	83.8	297.5	371.6	184.3	1,438.3
1967	45.8	45.9	104.2	61.4	71.8	46.4	16.2	6.2	42.1	290.0	102.9	323.8	1,156.7
1968	70.1	0.0	109.9	99.6	35.4	27.0	10.8	0.0	49.7	317.9	173.8	185.8	1,080.0
1969	50.3	56.0	36.0	164.8	10.4	2.2	8.0	145.3	41.8	334.6	152.5	331.9	1,333.8
1970	80.2	146.9	30.6	130.3	52.4	2.7	23.4	0.0	84.5	71.9	102.2	164.8	889.9
1971	233.3	49.5	22.8	363.6	14.3	65.5	0.0	45.8	143.1	164.6	73.3	306.6	1,482.4
1972	51.4	0.5	1.5	153.7	240.3	0.0	5.8	0.0	53.1	380.8	270.5	218.6	1,376.2
1973	0.0	13.0	5.5	90.1	82.8	5.7	87.7	22.3	23.2	173.2	198.3	426.7	1,128.5
1974	0.0	19.0	15.0	260.0	91.0	1.0	12.0	5.0	189.0	26.0	93.0	176.0	887.0
1975	70.0	23.0	55.0	275.0	125.0	20.0	109.0	30.0	43.0	115.0	182.0	145.0	1,192.0
1976	19.0	0.0	35.0	297.0	0.0	0.0	4.0	2.0	38.0	270.0	367.0	222.0	1,254.0
1977	61.5	23.4	32.3	115.7	36.3	0.0	19.1	23.6	29.9	286.5	284.2	201.6	1,114.1
1978	36.1	54.4	44.8	108.3	68.4	3.6	69.0	3.6	10.0	225.3	309.6	275.4	1,208.5
1979	20.8	26.9	24.4	139.2	10.8	3.1	22.8	24.9	127.9	156.0	335.8	87.9	980.5
1980	0.0	0.0	34.4	146.6	65.7	20.4	1.5	5.1	127.6	243.0	363.1	122.1	1,129.5
1981	10.2	10.2	104.9	152.6	40.7	20.4	31.0	38.0	61.5	186.0	186.0	180.0	1,021.5
1982	0.0	0.0	148.0	177.0	178.0	2.0	0.0	0.0	21.0	216.5	280.5	224.0	1,247.0
1983	0.0	0.0	0.0	79.3	219.6	1.5	90.0	5.0	4.0	87.0	200.0	542.0	1,228.4
1984	295.0	280.0	324.0	208.0	30.0	0.0	33.3	0.0	171.0	86.0	276.3	138.3	1,841.9
1985	142.1	53.4	98.6	18.7	85.5	43.2	47.1	3.2	48.5	119.0	294.5	248.5	1,202.3
1986	232.0	106.7	87.5	135.1	73.2	0.0	11.3	5.4	9.3	237.9	56.8	127.6	1,082.8
1987	38.9	0.0	68.6	72.4	117.4	0.0	0.0	4.3	61.6	374.8	187.2	75.2	1,000.4
1988	15.7	4.6	39.0	387.9	26.4	4.7	93.2	50.8	32.6	11.6	160.7	53.8	881.0
1989	58.5	0.0	42.2	58.6	19.5	36.9	117.4	0.0	48.9	124.0	390.3	44.3	940.6
1990	207.6	25.4	150.9	71.3	104.6	0.0	0.0	146.4	114.9	286.2	96.2	119.6	1,323.1
1991	62.7	0.0	56.7	75.1	60.6	64.5	0.8	0.0	74.6	164.8	287.4	303.9	1,151.1
1992	1.2	0.0	0.0	166.2	52.5	2.0	3.8	18.5	90.1	175.4	340.4	143.0	993.1
1993	7.9	83.7	58.2	91.0	86.0	19.2	6.2	6.6	5.3	420.6	523.0	423.0	1,730.7
1994	253.7	281.9	19.3	82.0	43.0	0.0	0.0	5.4	107.9	419.9	185.5	144.6	1,543.2
1995	101.2	0.0	53.7	176.8	142.8	0.0	0.0	21.4	0.0	156.6	368.4	42.5	1,063.4
1996	35.0	35.4	57.4	373.7	0.0	41.5	5.2	67.3	117.0	250.7	261.3	-1.0	-1.0
1997	0.0	0.0	0.7	125.6	119.9	21.0	28.7	0.0	74.0	473.7	337.9	-1.0	-1.0
1998	139.8	0.0	-1.0	-1.0	135.3	135.3	122.2	102.0	22.5	123.2	138.4	187.3	-1.0
1999	249.3	205.8	5.2	123.8	33.5	8.9	0.0	0.0	65.8	-1.0	146.5	112.2	-1.0
2000	213.3	210.7	9.7	99.5	29.6	5.8	0.0	206.0	20.9	34.7	213.5	138.3	1,182.0
2001	98.9	117.2	0.0	180.4	0.0	13.1	3.4	0.0	84.4	183.1	178.7	106.6	965.8
2002	50.5	94.7	3.1	209.7	50.8	0.0	0.0	17.4	26.9	256.6	246.0	165.1	1,120.8
2003	171.5	64.9	3.2	128.6	42.2	5.2	57.5	0.0	79.1	116.8	174.6	43.3	886.9
2004	5.2	0.0	55.9	184.2	37.5	10.0	5.0	0.0	231.8	220.3	207.9	216.5	1,174.3
2005	61.4	0.0	19.8	238.1	27.9	10.5	74.1	7.8	4.5	307.9	399.9	279.5	1,431.4
2006	168.2	29.2	167.7	93.8	123.8	14.2	0.0	0.0	8.4	232.0	286.7	37.3	1,161.3
2007	57.6	138.9	11.6	70.0	0.0	17.1	1.7	5.5	75.7	277.1	436.1	409.5	1,500.7
2008	111.3	83.6	443.8	209.6	0.0	3.3	20.0	28.2	7.0	230.5	219.5	328.9	1,685.7
Mean	107.5	58.1	68.0	159.8	68.9	19.4	28.2	29.0	64.3	218.5	243.2	220.3	1,281.0
Max	365	282	444	388	240	157	196	206	232	474	523	963	2,565
Min	0.0	0.0	0.0	18.7	0.0	0.0	0.0	0.0	0.0	11.6	56.8	37.3	840.8
Stdv	91.8	67.0	76.3	82.1	57.1	29.9	38.7	45.8	52.3	110.4	100.2	157.3	325.4
% Mean	8.4	4.5	5.3	12.5	5.4	1.5	2.2	2.3	5.0	17.1	19.0	17.2	

Rainfall (mm) **Kantalai Tank** **M247** Historic Data

Kantale Oya *61* *Elev (m):* *76.2* *Lat:* *08.35N* *Long:* *80.98E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	153.9	31.5	33.0	190.2	81.0	0.0	44.4	249.4	40.4	141.0	385.8	512.3	1,862.9
1950	70.6	80.8	36.8	15.2	167.1	0.0	0.0	108.2	65.3	129.5	268.5	272.0	1,214.0
1951	477.0	106.7	56.9	149.9	67.3	0.0	45.7	28.7	144.3	92.7	342.4	239.3	1,750.9
1952	421.9	33.0	1.3	145.3	70.4	0.0	41.7	0.0	67.6	29.0	234.9	169.7	1,214.8
1953	253.5	62.5	93.0	307.3	0.0	10.4	291.8	22.9	32.5	160.0	178.8	306.8	1,719.5
1954	322.3	53.3	105.9	126.0	15.5	0.0	58.4	95.5	51.8	189.2	151.1	633.7	1,802.7
1955	349.2	137.4	28.7	302.8	151.1	0.0	12.7	353.3	153.9	122.7	76.7	222.8	1,911.3
1956	149.4	50.0	3.8	101.9	3.0	70.9	67.6	70.4	112.5	265.4	390.9	203.2	1,489.0
1957	119.4	133.1	1.3	7.9	66.5	2.0	64.5	22.4	87.4	278.4	511.8	964.7	2,259.4
1958	100.6	69.8	129.8	107.9	11.7	0.0	42.2	65.3	52.3	161.0	141.2	127.8	1,009.6
1959	165.1	16.5	5.6	97.3	10.7	137.7	0.0	137.2	48.0	194.3	328.4	317.2	1,458.0
1960	231.9	285.5	25.9	185.9	56.1	0.0	184.1	0.0	62.0	127.0	455.2	114.8	1,728.4
1961	411.2	120.1	92.7	54.6	40.4	4.1	15.0	2.0	105.7	289.6	439.4	572.3	2,147.1
1962	255.0	55.6	30.0	104.1	101.3	0.0	17.8	35.1	80.5	132.1	201.7	321.8	1,335.0
1963	366.5	163.1	95.8	150.6	88.4	0.0	54.4	25.1	98.0	147.6	665.7	-1.0	-1.0
1964	112.8	32.3	150.4	47.2	10.2	0.0	131.3	122.9	8.9	223.5	133.1	154.7	1,127.3
1965	71.4	246.1	23.6	170.4	120.1	6.1	0.0	301.8	49.3	275.1	402.1	709.7	2,375.7
1966	46.0	47.2	80.5	141.0	0.0	0.0	7.1	212.1	112.3	412.5	416.8	233.9	1,709.4
1967	30.0	124.5	41.4	57.9	40.1	-1.0	-1.0	117.1	55.9	344.2	-999.0	468.6	-1.0
1968	88.1	4.1	207.8	109.7	25.4	2.5	0.0	132.3	133.3	115.1	381.8	364.5	1,564.6
1969	121.9	125.5	0.0	123.7	21.6	0.0	102.4	179.1	39.9	287.3	250.7	517.4	1,769.5
1970	172.7	172.0	55.6	134.9	96.5	10.4	0.8	67.1	95.0	106.4	356.9	231.6	1,499.9
1971	172.7	13.5	36.8	50.0	47.0	2.0	64.5	111.5	122.2	107.7	181.9	637.0	1,546.8
1972	30.7	37.8	19.8	44.4	62.5	42.7	41.4	0.0	215.6	308.6	250.2	281.4	1,335.1
1973	19.0	33.8	7.1	6.1	53.6	209.0	77.5	39.4	138.2	278.9	65.8	516.6	1,445.0
1974	0.0	48.5	2.0	118.1	118.1	0.0	71.1	36.6	104.4	24.1	114.3	358.6	995.8
1975	57.4	27.9	50.5	26.9	89.2	0.0	95.0	93.2	47.0	82.5	236.2	180.3	986.1
1976	21.6	3.0	1.8	64.3	0.0	38.1	79.2	77.0	89.7	133.6	269.5	396.5	1,174.3
1977	45.0	133.6	67.8	46.5	46.7	2.3	26.2	16.3	316.5	364.5	327.7	308.6	1,701.7
1978	104.1	9.1	72.4	31.7	55.4	2.5	40.1	0.0	3.0	313.2	350.5	305.1	1,287.1
1979	35.1	44.6	42.7	77.8	53.2	11.0	45.4	39.1	193.0	299.7	491.4	236.2	1,569.2
1980	4.6	0.0	30.7	112.3	15.7	3.6	0.0	11.2	51.3	166.6	168.1	100.1	664.2
1981	79.8	71.6	11.7	41.6	74.7	0.0	197.9	12.7	311.7	215.1	98.0	224.3	1,339.1
1982	3.6	0.0	39.1	53.6	61.0	19.3	22.9	35.1	77.1	182.7	456.1	413.3	1,363.8
1983	56.2	0.0	0.0	5.6	93.4	20.3	106.9	26.4	16.8	195.6	102.2	560.5	1,183.9
1984	329.9	496.9	48.7	94.3	33.0	0.0	49.8	76.2	97.4	60.4	325.5	136.3	1,748.4
1985	99.5	112.7	40.6	22.7	63.0	2.5	60.4	48.8	110.8	205.2	207.5	379.8	1,353.5
1986	243.0	188.0	275.9	166.5	72.1	36.0	100.2	11.6	15.0	228.3	202.8	226.6	1,766.0
1987	251.3	3.2	50.9	101.8	97.5	0.0	2.5	0.0	138.0	122.1	140.1	73.2	980.6
1988	33.8	45.0	162.8	172.6	16.6	0.5	79.3	68.0	72.2	175.3	198.5	158.9	1,183.5
1989	97.9	10.1	28.5	65.0	5.9	63.3	123.5	157.2	157.2	125.1	330.7	95.6	1,260.0
1990	174.3	48.0	64.0	37.9	107.5	0.0	12.6	75.9	154.0	118.7	75.4	450.4	1,318.7
1991	221.2	25.4	61.0	64.3	33.1	3.3	30.0	45.5	142.2	196.0	242.4	236.8	1,301.2
1992	21.0	0.0	0.0	53.1	114.6	7.1	72.3	9.7	176.9	45.2	525.8	525.4	1,551.1
1993	12.2	34.1	4.4	44.3	135.9	4.0	45.2	121.8	111.5	165.5	568.0	604.1	1,851.0
1994	212.0	322.8	52.1	75.6	138.3	0.0	0.0	0.0	278.5	340.2	578.3	92.9	2,090.7
1995	296.4	45.2	31.2	129.3	75.0	1.1	41.6	118.8	217.1	221.1	248.8	89.1	1,514.7
1996	63.6	95.6	0.0	141.4	1.8	89.7	76.3	209.8	48.8	150.5	326.0	225.7	1,429.2
1997	11.3	6.4	69.7	113.4	38.2	50.5	44.6	7.7	154.7	226.7	391.9	413.9	1,529.0
1998	257.9	0.8	-1.0	1.2	97.4	1.5	77.5	146.7	75.3	137.7	126.5	397.6	-1.0
1999	199.0	201.4	1.0	144.1	1.0	41.0	0.0	1.9	313.3	307.9	309.3	238.8	1,758.7
2000	323.9	240.8	14.1	59.3	66.5	57.5	72.1	27.0	74.8	22.6	452.0	365.6	1,776.2
2001	203.0	50.4	0.0	214.5	0.0	57.8	107.7	0.0	54.4	116.9	168.7	369.6	1,343.0
2002	161.7	112.6	0.0	92.0	19.8	5.2	0.0	18.7	114.4	99.2	348.9	724.7	1,697.2
2003	240.6	101.6	86.1	7.1	62.0	44.5	82.2	37.1	67.0	31.4	542.5	48.9	1,351.0
2004	46.9	40.6	48.2	79.3	112.3	0.0	26.8	92.9	240.6	505.7	458.0	623.5	2,274.8
2005	142.5	5.7	6.1	205.3	81.3	0.0	44.4	130.8	0.0	158.9	483.9	210.7	1,469.6
2006	140.2	53.3	185.1	120.0	74.5	0.0	5.3	8.5	114.8	290.3	302.5	191.9	1,486.4
2007	197.1	134.4	2.2	158.3	62.7	50.5	20.0	80.3	134.7	476.6	217.9	372.9	1,907.6
2008	128.4	86.2	244.6	73.7	0.0	0.0	22.6	298.1	3.5	207.8	382.3	412.9	1,860.1
Mean	153.8	83.9	53.5	99.1	58.7	18.8	55.0	77.3	107.5	193.9	304.7	336.3	1,532.3
Max	477	497	276	307	167	209	292	353	317	506	666	965	2,376
Min	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	22.6	65.8	48.9	664.2
Stdv	119.0	92.1	61.6	66.9	42.9	37.2	53.8	82.1	76.2	106.6	145.5	191.5	348.5
% Mean	10.0	5.5	3.5	6.5	3.8	1.2	3.6	5.0	7.0	12.7	19.9	21.9	

Rainfall (mm) **Kandy Met Station** **M231** Historic Data

Mahaweli Ganga *60* *Elev (m): 477.0* *Lat: 07-17-32N* *Long: 80-37-45E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	73.0	19.0	33.0	235.0	93.0	144.0	334.0	219.0	172.0	167.0	345.0	242.0	2,076.0
1950	56.0	112.0	74.0	129.0	183.0	122.0	187.0	126.0	240.0	213.0	251.0	70.0	1,763.0
1951	400.0	103.0	91.0	175.0	103.0	239.0	128.0	44.0	262.0	431.0	331.0	166.0	2,473.0
1952	214.4	168.7	138.7	252.2	320.5	86.6	23.1	153.2	45.5	285.0	188.5	157.5	2,033.9
1953	64.0	56.6	58.9	192.0	0.3	50.5	281.7	65.0	69.6	453.6	191.3	115.3	1,598.8
1954	104.9	114.8	256.0	197.9	119.4	69.3	113.5	220.5	27.7	377.7	193.3	396.7	2,191.7
1955	183.6	156.5	174.2	268.2	207.5	259.1	98.8	69.9	263.4	141.5	217.7	34.5	2,074.9
1956	19.8	7.6	81.3	53.6	110.2	293.1	40.9	79.5	47.0	246.1	357.1	162.6	1,498.8
1957	101.3	203.7	30.5	121.9	178.6	234.2	231.4	53.8	16.8	278.6	463.6	829.6	2,744.0
1958	57.9	13.2	260.9	275.6	120.9	82.6	52.1	188.0	24.9	282.2	255.3	153.4	1,767.0
1959	22.4	24.9	21.1	415.8	142.7	241.8	315.2	110.5	139.7	452.6	209.3	135.4	2,231.4
1960	170.9	315.0	31.5	243.3	143.3	122.4	216.4	40.9	248.4	158.7	346.2	58.4	2,095.4
1961	93.2	90.2	85.1	171.2	281.7	93.7	147.6	151.9	125.0	277.9	269.7	226.8	2,014.0
1962	74.9	71.9	47.5	175.3	208.8	104.4	108.2	147.6	168.9	324.9	154.7	174.0	1,761.1
1963	258.6	64.8	55.6	212.9	79.2	127.8	166.1	84.6	129.8	194.3	428.2	272.5	2,074.4
1964	155.7	124.0	62.7	126.5	112.5	107.9	197.9	104.6	143.8	285.7	288.3	192.0	1,901.6
1965	23.4	138.9	78.5	270.0	181.4	128.5	29.2	180.6	76.7	359.4	420.6	166.1	2,053.3
1966	63.8	37.1	64.8	192.5	4.6	78.2	41.1	61.2	284.7	260.6	258.6	165.9	1,513.1
1967	106.4	131.3	55.9	218.7	28.7	177.0	111.5	85.3	49.8	412.7	450.6	321.3	2,149.2
1968	54.6	60.7	123.4	135.1	58.7	173.5	211.1	107.4	176.0	262.1	405.4	215.9	1,983.9
1969	125.0	23.1	57.4	158.7	208.3	107.4	25.4	136.4	104.9	474.0	110.0	244.6	1,775.2
1970	73.4	222.8	66.0	189.5	82.8	106.9	126.5	59.9	126.5	336.8	379.5	196.3	1,966.9
1971	143.8	63.8	101.3	338.6	88.4	194.3	107.9	194.8	405.4	226.1	109.0	392.9	2,366.3
1972	17.5	0.0	26.9	200.9	412.0	69.1	138.9	62.0	130.6	443.0	324.9	293.9	2,119.7
1973	3.6	18.8	68.3	132.6	61.2	84.3	121.9	128.5	46.7	189.7	290.1	309.1	1,454.8
1974	0.0	123.7	31.5	250.4	214.1	116.8	236.7	151.6	225.0	138.4	88.9	165.1	1,742.2
1975	41.1	81.3	116.3	236.7	100.6	194.3	157.0	253.7	183.4	206.0	481.3	87.1	2,138.8
1976	101.3	3.0	33.3	153.9	0.5	30.0	89.4	111.3	62.0	241.8	409.2	201.7	1,437.4
1977	1.8	10.7	57.7	240.0	274.8	97.5	100.1	56.4	20.1	512.3	245.6	77.2	1,694.2
1978	58.7	71.1	118.1	57.1	265.2	127.8	86.1	103.6	166.6	318.3	500.1	129.3	2,002.0
1979	18.3	53.5	56.2	146.3	173.4	181.2	146.2	41.1	279.1	263.8	461.4	174.9	1,995.4
1980	4.8	0.4	39.1	210.3	186.4	111.7	102.5	87.7	150.0	211.6	362.7	85.4	1,552.6
1981	51.8	26.0	97.1	92.3	28.9	164.7	234.4	87.9	318.2	93.1	273.3	71.9	1,539.6
1982	4.8	0.0	59.2	333.6	319.9	218.3	157.7	67.3	51.6	196.6	358.5	278.1	2,045.6
1983	5.1	11.4	2.1	11.4	182.0	77.9	110.9	123.7	89.9	162.8	258.1	288.5	1,323.8
1984	203.9	147.5	227.9	313.7	147.5	115.4	175.3	53.0	263.6	133.5	230.4	127.9	2,139.6
1985	92.7	45.6	88.1	103.3	183.5	383.6	210.9	69.6	106.2	284.3	302.5	216.0	2,086.3
1986	349.6	272.9	74.1	138.4	45.8	110.0	70.1	122.0	130.1	255.1	98.9	56.4	1,723.4
1987	82.4	7.3	59.1	193.0	159.0	134.0	1.1	111.5	191.4	304.1	199.9	186.2	1,629.0
1988	13.2	107.8	57.1	267.0	82.8	89.2	185.7	226.0	171.0	30.2	350.4	105.4	1,685.8
1989	102.4	15.9	62.7	121.7	77.2	225.5	255.3	149.2	150.0	273.6	391.1	23.8	1,848.4
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1992	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1993	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1996	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1997	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1998	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1999	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2001	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2002	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2003	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2004	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2005	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2006	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2007	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2008	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Mean	92.5	81.0	81.1	193.9	145.7	143.3	143.3	114.4	148.4	272.2	298.8	194.3	1,908.9
Max	400	315	261	416	412	384	334	254	405	512	500	830	2,744
Min	0.0	0.0	2.1	11.4	0.3	30.0	1.1	40.9	16.8	30.2	88.9	23.8	1,323.8
Stdv	90.9	76.7	58.3	82.1	93.7	72.7	80.6	56.2	92.4	109.9	111.0	136.6	301.4
% Mean	4.8	4.2	4.2	10.2	7.6	7.5	7.5	6.0	7.8	14.3	15.7	10.2	

Rainfall (mm) **Maha Illuppallama M331** Historic Data

Kala Oya *93* *Elev (m): 137.8* *Lat: 08.12N* *Long: 80.47E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1950	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1951	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1952	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	63.0	102.0	-1.0
1953	85.0	16.0	32.0	167.0	0.0	1.0	81.0	65.0	79.0	400.0	177.0	233.0	1,336.0
1954	88.0	5.0	205.0	242.0	44.0	1.0	56.0	43.0	0.0	235.0	273.0	405.0	1,597.0
1955	201.0	34.0	60.0	180.0	123.0	1.0	0.0	71.0	321.0	196.0	174.0	48.0	1,409.0
1956	52.0	9.0	123.0	43.0	3.0	102.0	5.0	7.0	9.0	132.0	183.0	129.0	797.0
1957	67.0	85.0	11.0	234.0	169.0	30.0	3.0	3.0	38.0	322.0	462.0	1076.0	2,500.0
1958	194.0	16.0	142.0	269.0	137.0	9.0	5.0	66.0	0.0	188.0	189.0	87.0	1,302.0
1959	70.0	43.0	38.0	173.0	195.0	37.0	9.0	0.0	87.0	145.0	400.0	165.0	1,362.0
1960	133.0	195.0	21.0	405.0	89.0	9.0	217.0	2.0	69.0	176.0	409.0	161.0	1,886.0
1961	213.0	119.0	46.0	212.0	67.0	72.0	30.0	7.0	22.0	308.0	261.0	265.0	1,622.0
1962	129.0	18.0	34.0	157.0	148.0	5.0	10.0	6.0	77.0	522.0	107.0	241.0	1,454.0
1963	237.0	78.0	126.0	281.0	47.0	17.0	12.0	3.0	61.0	326.0	510.0	468.0	2,166.0
1964	64.0	43.0	99.0	110.0	64.0	5.0	74.0	12.0	128.0	183.0	189.0	110.0	1,081.0
1965	53.0	70.0	121.0	162.0	174.0	5.0	2.0	186.0	0.0	418.0	360.0	399.0	1,950.0
1966	58.0	18.0	209.0	239.0	1.0	5.0	24.0	38.0	160.0	302.0	406.0	230.0	1,690.0
1967	18.0	129.0	132.0	68.0	85.0	22.0	7.0	4.0	32.0	308.0	222.0	334.0	1,361.0
1968	45.0	0.0	100.0	110.0	10.0	47.0	9.0	0.0	49.0	244.0	307.0	140.0	1,061.0
1969	59.0	40.0	120.0	224.0	14.0	2.0	3.0	130.0	19.0	324.0	113.0	350.0	1,398.0
1970	83.0	144.0	73.0	136.0	115.0	1.0	18.0	1.0	81.0	166.0	344.0	148.0	1,310.0
1971	201.0	84.0	23.0	294.0	98.0	39.0	2.0	119.0	74.0	191.0	124.0	384.0	1,633.0
1972	25.0	0.0	18.0	169.0	163.0	1.0	21.0	0.0	81.0	320.0	193.0	168.0	1,159.0
1973	5.0	13.0	9.0	96.0	36.0	13.0	54.0	31.0	119.0	232.0	74.0	383.0	1,065.0
1974	1.0	98.0	38.0	265.0	95.0	1.0	9.0	7.0	204.0	29.0	99.0	174.0	1,020.0
1975	60.0	26.0	118.0	265.0	132.0	15.0	86.0	65.0	50.0	133.0	207.0	142.0	1,299.0
1976	16.0	0.0	74.0	282.0	0.0	0.0	4.0	5.0	45.0	283.0	315.0	218.0	1,242.0
1977	90.0	39.0	40.0	193.0	118.0	2.0	29.0	108.0	92.0	525.0	273.0	143.0	1,652.0
1978	30.0	43.0	43.0	98.0	189.0	0.0	111.0	1.0	28.0	299.0	555.0	226.0	1,623.0
1979	9.1	22.9	14.6	115.8	29.3	3.7	17.4	3.8	137.9	290.7	279.0	129.5	1,053.7
1980	0.0	0.0	49.5	166.6	111.6	40.9	0.7	10.5	192.4	179.1	422.2	155.6	1,329.1
1981	57.1	10.5	35.6	197.8	81.2	7.3	91.1	46.6	117.0	186.7	196.1	123.2	1,150.2
1982	0.0	0.0	97.4	114.8	162.9	17.3	1.4	4.7	42.0	265.5	243.3	145.9	1,095.2
1983	5.7	0.0	0.0	74.3	219.4	21.0	27.0	0.5	27.3	122.8	153.0	495.3	1,146.3
1984	186.5	474.3	381.1	153.3	32.3	0.0	62.9	0.0	278.8	114.9	306.2	156.7	2,147.0
1985	78.6	68.0	30.4	12.4	65.4	26.6	87.6	9.9	65.5	178.2	302.4	159.4	1,084.4
1986	180.8	38.2	125.5	120.1	154.6	0.5	16.0	4.3	76.1	149.3	78.2	121.6	1,065.2
1987	44.0	0.0	90.7	261.1	177.3	8.3	0.0	0.7	195.9	380.2	189.3	125.7	1,473.2
1988	253.6	16.7	59.8	458.3	17.4	17.1	65.0	96.7	69.5	83.0	48.0	50.0	1,235.1
1989	72.6	2.9	108.5	106.8	36.7	22.3	163.8	0.0	30.0	283.0	364.2	38.0	1,228.8
1990	174.8	10.4	123.5	21.9	209.4	0.1	5.5	117.7	80.6	424.7	98.4	132.7	1,399.7
1991	123.2	40.5	36.2	127.2	134.2	59.8	4.7	3.7	7.1	284.0	183.7	218.0	1,222.3
1992	17.1	0.0	0.0	185.1	98.3	3.7	34.3	12.2	50.8	226.3	319.0	115.2	1,062.0
1993	2.1	66.8	60.1	162.3	75.5	17.0	27.5	13.7	12.3	421.8	355.0	393.2	1,607.3
1994	145.5	372.2	17.0	145.0	18.0	0.0	3.7	3.1	201.6	416.1	159.4	114.1	1,595.7
1995	87.9	35.6	105.5	231.5	164.1	4.1	0.4	2.4	11.9	138.3	606.3	34.2	1,422.2
1996	49.7	148.0	13.6	202.7	1.8	82.8	12.3	155.0	115.2	182.6	228.4	77.1	1,269.2
1997	9.0	13.2	29.4	202.8	186.1	12.4	27.2	1.6	141.9	399.8	503.8	370.0	1,897.2
1998	141.3	0.0	15.2	129.2	142.6	1.2	59.6	74.1	55.8	52.3	161.0	185.7	1,018.0
1999	236.5	192.1	18.1	137.4	41.9	23.0	2.0	0.1	88.2	337.1	185.2	197.1	1,458.7
2000	160.9	274.1	41.0	79.9	42.3	8.6	0.9	123.8	59.2	86.3	323.2	260.8	1,461.0
2001	166.3	194.3	0.0	341.7	6.6	109.1	40.7	0.0	85.1	219.7	169.5	108.5	1,441.5
2002	27.3	38.0	32.2	299.1	51.2	5.7	0.0	4.2	157.9	605.2	295.1	286.0	1,801.9
2003	126.7	135.4	14.3	171.5	68.4	12.9	76.6	2.2	161.5	102.4	239.9	25.4	1,137.2
2004	106.7	0.0	88.0	103.5	114.3	20.2	5.2	1.6	219.2	323.1	161.5	240.6	1,383.9
2005	51.1	2.7	31.5	180.4	107.3	1.6	29.9	9.2	3.2	267.0	368.3	82.2	1,134.4
2006	160.4	37.3	177.9	134.1	116.4	35.6	1.1	0.6	51.4	244.9	447.3	122.0	1,529.0
2007	76.4	116.8	66.4	177.3	2.1	11.6	26.4	9.4	129.1	338.2	283.1	257.4	1,494.2
2008	60.0	70.1	375.5	296.3	0.0	8.4	14.0	24.2	6.2	207.3	207.5	276.2	1,545.7
Mean	90.9	66.9	76.7	181.9	89.0	18.3	31.9	30.7	85.6	257.5	260.8	212.7	1,408.3
Max	254	474	381	458	219	109	217	186	321	605	606	1,076	2,500
Min	0.0	0.0	0.0	12.4	0.0	0.0	0.0	0.0	0.0	29.0	48.0	25.4	797.0
Stdv	71.0	93.0	78.1	88.3	64.6	24.8	42.6	46.5	71.9	122.1	129.7	162.6	324.7
% Mean	6.5	4.7	5.4	12.9	6.3	1.3	2.3	2.2	6.1	18.3	18.5	15.1	

Rainfall (mm) **Maradankadawala M355** Historic Data

Malwathu Oya *90* *Elev (m): ----* *Lat: 08.13N* *Long: 80.57E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	218.7	34.8	4.8	97.8	91.4	5.3	18.8	143.8	0.0	374.9	204.7	207.5	1,402.5
1950	67.6	74.7	157.0	109.5	81.0	10.9	0.0	34.8	122.7	170.7	102.6	130.0	1,061.5
1951	307.1	95.0	78.7	335.5	32.8	8.6	23.6	22.4	226.1	188.2	342.6	151.6	1,812.2
1952	229.4	11.7	117.1	253.7	45.2	0.0	132.3	0.0	58.2	116.1	161.0	99.8	1,224.5
1953	123.4	16.0	33.5	178.6	0.0	0.0	73.2	112.8	35.1	277.1	170.7	248.7	1,269.1
1954	120.6	10.2	133.6	282.2	13.7	0.0	59.7	43.7	0.0	153.2	192.0	519.2	1,528.1
1955	233.2	31.5	125.7	182.6	103.9	0.0	1.3	85.1	211.8	230.9	145.3	107.2	1,458.5
1956	65.5	14.7	141.0	91.7	2.3	98.0	21.3	14.5	6.9	111.8	323.9	131.3	1,022.9
1957	98.3	104.6	1.3	222.0	189.7	21.3	9.9	10.7	22.1	303.8	435.1	1224.8	2,643.6
1958	197.1	32.5	184.4	140.2	116.8	5.3	4.1	167.9	2.8	230.9	187.5	86.1	1,355.6
1959	100.8	12.2	82.6	94.0	213.1	21.3	5.8	0.0	122.2	126.0	399.0	180.1	1,357.1
1960	209.0	170.2	37.3	195.6	35.1	18.3	134.1	1.3	46.2	151.6	580.6	78.5	1,657.8
1961	214.6	120.6	71.9	106.7	58.9	62.2	16.8	5.1	8.4	186.2	238.8	315.0	1,405.2
1962	172.2	29.7	104.4	168.1	91.4	0.8	10.2	63.0	142.0	528.1	167.1	188.5	1,665.5
1963	251.5	82.8	122.2	277.4	58.9	7.4	9.7	27.4	32.3	275.3	459.0	529.3	2,133.2
1964	75.2	46.7	125.7	113.3	108.7	0.8	89.2	5.1	92.2	154.2	122.4	121.9	1,055.4
1965	48.3	83.3	110.7	272.0	138.9	1.0	34.3	220.7	0.0	447.0	399.3	424.7	2,180.2
1966	71.6	15.0	210.3	254.0	0.8	0.0	17.3	8.4	212.6	271.3	422.4	215.6	1,699.3
1967	20.1	134.9	69.3	112.0	67.8	13.2	1.8	0.0	32.8	446.3	278.1	311.4	1,487.7
1968	54.4	0.0	113.3	120.9	36.6	52.3	2.3	0.0	130.8	281.7	268.0	141.5	1,201.8
1969	59.7	49.0	36.8	474.7	42.2	0.0	0.0	123.4	6.1	562.1	152.1	388.4	1,894.5
1970	77.0	145.3	24.6	149.9	107.9	0.0	7.1	0.0	44.7	222.5	241.8	195.1	1,215.9
1971	161.0	43.4	16.3	302.8	77.0	30.0	3.0	138.4	69.9	185.4	101.9	414.0	1,543.1
1972	37.6	0.0	7.4	230.9	141.5	0.0	13.7	0.0	75.2	237.0	182.9	182.6	1,108.8
1973	4.8	20.1	36.6	106.7	1.3	2.0	51.6	13.0	66.5	89.2	115.3	450.3	957.4
1974	0.0	164.8	11.4	164.1	78.0	0.0	4.8	0.0	155.4	96.3	67.6	159.3	901.7
1975	74.9	10.9	35.6	187.5	92.5	13.5	121.2	37.1	116.1	129.8	220.2	124.7	1,164.0
1976	11.4	0.0	80.8	224.0	0.0	0.0	4.8	1.8	32.5	184.7	393.7	277.1	1,210.8
1977	40.1	30.7	79.8	298.4	93.0	0.0	93.2	93.7	99.6	438.7	251.0	197.6	1,715.8
1978	35.1	37.1	82.3	78.0	82.8	0.0	111.8	0.0	16.0	259.0	404.6	213.1	1,319.8
1979	5.8	56.6	27.2	251.2	8.8	0.0	27.9	18.8	75.2	226.6	182.3	204.8	1,085.2
1980	0.6	0.0	30.6	117.7	98.7	14.3	0.0	2.6	141.1	186.7	331.1	104.8	1,028.2
1981	52.3	23.0	59.0	170.4	29.6	1.8	35.9	26.5	88.3	198.2	107.2	132.3	924.5
1982	0.0	0.0	69.0	87.0	302.7	0.0	0.0	2.0	30.7	180.1	306.5	204.0	1,182.0
1983	10.6	0.0	2.0	36.9	274.5	22.3	97.5	2.0	17.4	140.0	173.1	380.1	1,156.4
1984	394.7	303.7	222.7	151.3	29.3	0.0	40.7	0.0	186.1	72.0	301.0	154.4	1,855.9
1985	175.8	80.1	42.8	101.4	100.1	4.3	24.6	52.5	178.6	200.7	305.2	213.4	1,479.5
1986	214.9	125.0	181.3	59.9	72.2	0.0	5.0	0.5	23.0	382.6	53.5	114.3	1,232.2
1987	97.5	0.0	94.0	210.4	106.8	0.0	0.0	10.0	48.0	379.0	123.0	91.0	1,159.7
1988	13.0	29.5	64.2	344.0	15.0	6.0	118.2	93.3	73.1	44.8	30.0	0.0	831.1
1989	6.4	6.0	91.8	100.2	121.2	139.6	143.3	0.0	49.1	296.2	425.8	41.3	1,420.9
1990	131.8	0.0	81.5	82.3	203.6	0.0	0.0	43.7	140.1	400.2	115.9	233.7	1,432.8
1991	162.5	12.0	60.0	90.0	82.3	40.1	1.3	2.9	61.5	232.4	216.3	-999.0	-1.0
1992	198.7	0.0	0.0	377.1	74.7	0.0	31.8	2.8	0.0	97.8	313.8	143.3	1,240.0
1993	8.0	76.1	103.3	95.1	59.9	0.0	59.0	0.0	35.0	208.9	247.6	489.4	1,382.3
1994	158.9	269.0	17.9	94.7	62.5	0.0	2.0	0.8	198.8	293.5	272.6	106.6	1,477.3
1995	59.6	48.8	12.6	185.2	102.5	0.0	0.0	1.0	20.7	110.2	285.7	30.7	857.0
1996	63.3	104.2	14.7	170.8	13.5	98.0	0.5	106.4	131.7	186.9	217.0	78.8	1,185.8
1997	46.5	4.0	10.9	212.5	260.5	20.1	24.4	0.0	286.6	258.6	363.7	286.7	1,774.5
1998	188.2	1.0	77.0	91.0	185.6	0.0	74.8	124.5	33.0	71.4	166.2	234.1	1,246.8
1999	299.7	173.4	84.6	246.8	22.7	17.9	0.0	0.0	104.8	364.9	383.0	299.0	1,996.8
2000	146.5	165.8	28.2	156.8	24.1	7.4	1.1	145.2	57.3	84.6	432.5	230.0	1,479.5
2001	111.0	136.3	0.0	161.0	0.0	55.6	95.0	0.0	192.6	125.4	145.8	148.2	1,170.9
2002	50.7	58.1	18.2	323.6	90.5	0.0	0.0	80.6	77.5	371.1	285.6	238.0	1,593.9
2003	160.8	106.7	48.3	119.2	70.9	10.4	96.8	0.5	156.2	108.2	235.4	31.3	1,144.7
2004	70.8	0.0	60.0	192.6	83.7	14.0	4.7	3.2	173.7	206.1	154.0	238.9	1,201.7
2005	67.9	6.5	19.5	229.5	15.6	0.0	46.7	32.0	0.0	281.7	354.3	122.4	1,176.1
2006	127.2	36.9	146.2	262.5	-1.0	3.5	0.0	0.0	22.1	243.7	268.7	128.3	-1.0
2007	84.2	46.7	0.0	96.1	1.5	36.1	29.3	9.7	98.4	336.1	182.4	331.4	1,251.9
2008	67.8	81.3	299.1	234.2	0.0	0.0	0.0	27.0	1.0	115.7	178.6	264.7	1,269.4
Mean	109.3	59.6	73.4	181.3	79.9	14.4	34.0	36.0	81.5	230.6	248.2	225.3	1,377.4
Max	395	304	299	475	303	140	143	221	287	562	581	1,225	2,644
Min	0.0	0.0	0.0	36.9	0.0	0.0	0.0	0.0	0.0	44.8	30.0	0.0	831.1
Stdv	88.6	66.7	62.8	89.5	70.2	27.2	42.4	52.7	70.5	117.6	117.1	180.4	349.4
% Mean	7.9	4.3	5.3	13.2	5.8	1.0	2.5	2.6	5.9	16.7	18.0	16.4	

Rainfall (mm) | Mihintale | M374 | Historic Data

Malwathu Oya 90 *Elev (m): ----* *Lat: 08.37N* *Long: 80.51E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	185.9	14.0	44.2	204.2	85.9	0.0	11.9	29.2	0.0	163.8	248.2	262.6	1,249.9
1950	105.4	113.0	36.3	63.5	67.3	0.0	0.0	0.0	39.4	201.2	135.4	184.7	946.2
1951	331.7	86.1	64.0	238.3	106.4	0.0	40.6	39.9	262.1	230.4	716.3	69.1	2,184.9
1952	238.8	3.8	77.5	250.7	54.1	0.0	3.8	0.0	117.1	158.5	62.5	111.0	1,077.8
1953	104.4	19.1	33.0	245.1	0.0	7.6	101.3	47.5	63.8	318.3	212.1	224.0	1,376.2
1954	120.9	3.3	124.2	311.1	44.4	0.0	30.5	67.3	0.3	174.8	157.7	449.3	1,483.8
1955	167.9	39.9	50.0	268.2	105.2	0.0	31.8	133.6	264.2	151.9	114.0	49.3	1,376.0
1956	91.7	33.5	68.3	49.3	3.3	55.9	6.1	60.2	0.0	200.4	205.0	106.7	880.4
1957	78.7	127.0	0.5	230.1	171.7	11.9	5.8	0.0	20.3	381.8	496.8	974.1	2,498.7
1958	61.7	13.5	147.8	245.1	138.7	0.0	5.6	86.6	52.8	210.3	145.8	94.5	1,202.4
1959	148.3	14.5	3.8	206.5	157.5	51.1	4.6	12.7	267.7	176.0	316.2	171.7	1,530.6
1960	119.4	196.9	19.8	118.9	90.4	0.0	176.0	0.0	37.6	100.8	405.1	52.3	1,317.2
1961	355.6	135.4	62.0	146.1	105.4	51.3	73.4	1.5	23.6	228.9	185.2	268.0	1,636.4
1962	223.3	39.6	64.8	213.4	204.5	3.8	0.0	31.0	39.9	404.4	107.9	194.8	1,527.4
1963	378.0	96.3	204.0	224.5	28.2	2.0	31.5	21.1	72.6	265.7	401.3	445.0	2,170.2
1964	42.7	46.0	67.1	80.3	57.9	0.0	62.0	14.2	68.8	300.0	185.4	149.9	1,074.3
1965	24.1	95.3	163.1	215.9	66.5	0.8	9.7	201.2	41.9	291.1	352.3	330.5	1,792.4
1966	206.8	6.9	109.5	7.6	0.0	0.0	12.7	55.6	214.1	266.2	346.2	175.8	1,401.4
1967	14.0	81.0	38.6	58.2	55.1	0.3	0.3	24.4	35.3	235.5	202.4	307.3	1,052.4
1968	19.6	4.0	33.8	73.9	20.3	14.0	4.0	11.9	82.0	130.0	132.3	171.4	697.2
1969	31.2	19.1	51.6	180.1	65.0	0.0	21.1	62.5	38.6	412.2	123.2	340.1	1,344.7
1970	55.1	137.7	45.0	278.6	130.6	0.0	0.5	58.2	80.0	215.4	377.4	196.6	1,575.1
1971	161.3	73.9	68.8	251.2	19.8	3.8	35.3	134.1	156.5	188.5	119.0	529.6	1,741.8
1972	18.0	0.0	6.4	259.3	168.4	6.1	31.0	0.0	61.5	541.0	280.4	194.1	1,566.2
1973	9.9	11.7	117.9	96.8	18.0	0.0	158.0	55.6	64.0	115.3	156.5	523.0	1,326.7
1974	1.0	56.4	40.1	137.9	26.9	0.0	0.8	19.6	69.3	25.1	77.2	293.6	747.9
1975	50.3	9.7	153.7	114.3	140.7	19.3	99.8	39.9	59.7	168.4	333.0	74.9	1,263.7
1976	10.7	0.8	45.7	200.9	0.0	0.0	1.5	2.0	20.8	304.3	413.0	141.2	1,140.9
1977	21.1	70.4	34.0	171.0	148.0	1.0	38.0	41.0	59.0	396.0	332.0	159.0	1,470.5
1978	27.0	13.0	67.0	86.0	88.0	0.0	159.8	0.0	27.0	147.0	371.0	226.0	1,211.8
1979	19.7	33.0	14.0	45.2	35.1	0.0	32.8	61.5	231.5	263.6	381.0	252.7	1,370.1
1980	0.0	0.0	0.5	180.5	75.0	10.9	2.9	0.0	98.3	193.0	316.1	174.0	1,051.2
1981	48.0	39.5	62.2	93.6	58.2	3.5	68.5	148.6	131.3	164.5	131.7	123.5	1,073.1
1982	1.6	0.0	52.8	81.7	159.9	22.4	2.0	0.0	78.0	309.8	228.3	153.3	1,089.8
1983	2.8	0.0	18.0	60.9	136.7	17.6	16.6	18.5	60.8	233.8	93.9	419.5	1,079.1
1984	352.0	380.8	200.4	125.2	42.7	0.0	81.7	7.5	189.2	129.6	321.1	91.6	1,921.8
1985	313.3	75.9	61.4	64.2	88.6	7.6	44.9	3.6	120.1	49.6	282.8	227.9	1,339.9
1986	165.0	48.7	136.1	120.8	77.8	0.0	22.5	1.8	7.4	377.1	110.8	113.4	1,181.4
1987	61.3	0.0	50.8	145.4	60.4	0.0	0.0	0.0	163.5	339.9	161.8	105.7	1,088.8
1988	24.8	4.2	41.7	219.6	27.2	7.8	81.3	29.0	68.8	53.4	160.1	79.3	797.2
1989	17.3	0.0	117.5	27.6	39.0	116.2	107.8	22.6	99.2	209.2	233.2	79.6	1,069.2
1990	170.7	47.9	162.0	21.5	160.7	0.0	0.0	128.5	83.8	318.5	148.7	181.6	1,423.9
1991	123.6	40.1	81.2	130.2	114.5	77.3	18.5	13.3	81.8	213.2	311.0	336.7	1,541.4
1992	12.7	0.0	0.0	97.7	128.3	52.5	14.7	14.4	31.6	92.4	310.3	-1.0	-1.0
1993	15.7	-1.0	-1.0	140.2	5.7	1.3	37.7	-1.0	0.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1.0	-1.0	-1.0	-1.0	0.0	0.0	0.0	107.9	354.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	0.5	17.7	2.4	10.1	151.9	230.8	22.2	-1.0
1996	16.3	72.3	28.9	305.1	0.0	92.5	0.0	99.5	9.8	228.8	190.4	110.5	1,154.1
1997	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	311.8	333.1	525.1	-1.0
1998	-1.0	0.0	0.0	27.7	-1.0	-1.0	60.6	106.3	0.0	-1.0	227.7	227.3	-1.0
1999	132.1	66.6	-1.0	186.1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	193.5	99.9	50.9	26.2	28.8	31.2	-1.0	8.5	110.6	98.4	279.2	268.8	-1.0
2001	109.5	29.0	0.0	260.9	3.0	111.6	53.7	0.0	171.3	176.7	171.8	228.9	1,316.4
2002	43.5	76.0	99.7	328.6	3.0	0.0	0.0	17.7	0.0	224.3	258.0	350.8	1,401.6
2003	146.8	63.0	15.5	112.0	128.4	29.1	12.5	42.5	92.6	109.1	261.1	87.3	1,099.9
2004	126.4	33.5	74.7	211.7	135.1	8.6	0.0	41.3	123.2	274.9	176.8	277.1	1,483.3
2005	65.1	0.0	61.2	109.4	22.8	0.0	15.1	33.4	0.0	221.5	326.7	165.2	1,020.4
2006	111.1	51.9	263.8	63.0	21.5	0.0	0.0	0.0	47.0	267.1	467.3	104.8	1,397.5
2007	126.4	45.8	0.0	182.1	0.0	33.4	103.9	65.8	56.6	518.7	108.0	318.6	1,559.3
2008	70.5	55.5	372.0	205.6	0.0	0.0	0.0	171.3	0.0	241.2	234.7	327.1	1,677.9
Mean	104.9	50.5	72.9	154.4	71.3	15.0	34.3	40.2	77.8	232.1	248.5	229.0	1,346.2
Max	378	381	372	329	205	116	176	201	268	541	716	974	2,499
Min	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	0.0	25.1	62.5	22.2	697.2
Stdv	100.0	62.6	70.8	85.0	56.9	28.0	43.7	48.0	70.4	107.9	122.8	161.8	353.5
% Mean	7.8	3.7	5.4	11.5	5.3	1.1	2.5	3.0	5.8	17.2	18.5	17.0	

Rainfall (mm) **Millawana Tank/Estate** **M377** Historic Data

Deduru Oya *99* *Elev (m): ----* *Lat: 07.67N* *Long: 80.55E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	138.2	26.2	44.7	246.9	180.3	85.6	183.1	142.2	49.0	278.6	178.8	253.7	1,807.3
1950	106.4	72.6	96.8	64.5	88.1	69.1	42.2	62.2	71.6	107.7	221.0	161.0	1,163.2
1951	570.2	72.1	45.5	166.1	70.9	46.2	91.2	46.2	308.9	179.3	404.6	209.6	2,210.8
1952	214.9	78.7	58.2	184.1	187.2	41.7	33.3	13.2	101.3	226.3	162.3	262.6	1,563.8
1953	93.5	68.8	24.9	198.4	0.0	0.0	242.8	38.9	54.9	433.6	327.7	145.8	1,629.3
1954	226.8	175.5	173.0	267.0	39.1	32.0	80.5	45.2	22.6	447.5	210.6	598.2	2,318.0
1955	272.3	49.8	91.4	173.5	167.9	73.4	27.4	54.4	370.1	211.3	155.7	86.9	1,734.1
1956	67.8	50.5	10.9	97.3	57.9	105.4	4.6	7.4	21.3	196.9	528.8	238.0	1,386.8
1957	119.6	165.1	19.8	120.4	164.1	129.0	87.6	4.8	50.3	437.6	604.5	930.4	2,833.2
1958	44.0	10.9	255.0	190.5	131.6	56.1	30.2	117.9	24.9	257.0	187.7	138.9	1,444.7
1959	61.0	11.2	35.8	257.3	232.9	135.4	109.5	28.2	89.4	284.0	295.7	136.9	1,677.3
1960	118.1	243.3	5.1	261.1	120.4	84.3	310.9	2.3	50.3	292.4	583.7	136.9	2,208.8
1961	106.4	180.3	33.5	159.0	116.8	142.5	100.3	53.6	76.7	170.9	168.9	190.8	1,499.7
1962	110.2	66.8	93.7	175.5	261.9	27.7	78.0	103.1	113.5	458.7	140.7	241.8	1,871.6
1963	220.5	120.1	105.7	224.5	119.1	51.3	93.5	28.2	125.2	228.3	342.1	434.1	2,092.6
1964	180.3	242.6	47.0	70.1	75.7	73.4	189.2	37.3	87.4	155.7	283.5	151.4	1,593.6
1965	70.1	120.9	118.6	302.3	162.1	33.3	18.0	116.8	15.2	351.3	282.7	199.4	1,790.7
1966	143.0	6.1	106.9	129.5	5.1	47.0	37.3	8.4	284.0	378.0	400.1	246.4	1,791.8
1967	65.0	100.1	57.1	108.2	61.0	162.1	42.4	69.3	31.0	400.6	388.6	566.7	2,052.1
1968	101.6	2.8	76.5	165.9	29.0	144.5	93.5	6.1	73.2	381.8	268.0	202.4	1,545.3
1969	147.6	66.5	108.7	258.6	65.3	26.7	4.8	177.5	51.6	553.0	139.2	429.8	2,029.3
1970	224.8	297.2	52.8	322.3	106.2	30.0	67.3	6.4	108.5	275.3	413.0	258.8	2,162.6
1971	190.8	180.6	94.2	444.8	65.3	161.5	57.7	227.3	283.5	179.6	185.9	504.2	2,575.4
1972	60.2	0.0	20.8	145.3	326.1	47.2	26.4	11.4	94.7	260.4	483.1	320.0	1,795.6
1973	0.0	30.5	20.3	101.3	32.8	117.6	85.1	51.6	37.8	154.2	286.5	320.8	1,238.5
1974	0.0	65.5	100.1	111.3	147.3	54.9	141.2	61.5	100.8	53.3	153.2	187.5	1,176.6
1975	85.6	63.8	134.6	206.5	142.5	120.9	189.2	106.7	134.4	163.1	398.8	126.0	1,872.1
1976	157.2	0.0	63.0	274.6	2.3	20.1	42.9	87.4	17.8	359.4	360.4	190.5	1,575.6
1977	29.2	11.9	34.5	178.1	132.6	28.4	47.2	32.5	43.9	628.9	482.6	197.1	1,846.9
1978	21.8	34.0	98.3	41.1	145.5	28.7	72.1	19.8	102.1	298.4	422.1	221.2	1,505.1
1979	44.2	67.8	24.6	132.3	92.2	73.4	59.7	42.9	236.0	362.2	409.2	61.5	1,606.0
1980	0.0	0.0	193.0	148.1	151.6	62.8	45.0	41.7	238.0	264.2	297.9	169.4	1,611.7
1981	199.9	38.1	86.4	147.1	107.4	95.5	120.2	105.4	122.2	313.7	502.1	70.6	1,908.6
1982	11.7	0.0	94.0	260.6	129.5	124.2	33.4	61.2	35.3	44.6	385.7	398.9	1,579.1
1983	15.7	0.0	2.5	31.3	263.5	47.8	96.3	54.7	33.8	164.1	314.2	151.0	1,174.9
1984	278.6	306.6	277.1	229.3	29.9	17.9	106.1	23.8	166.1	131.2	303.7	246.1	2,116.4
1985	273.3	61.9	138.7	73.0	207.4	146.4	27.4	14.9	161.6	268.5	462.1	214.9	2,050.1
1986	304.1	139.9	155.3	136.4	62.9	4.3	16.3	65.5	38.9	358.8	105.9	108.1	1,496.4
1987	124.1	0.0	13.2	302.2	164.7	47.6	0.0	61.2	215.5	585.1	227.8	216.7	1,958.1
1988	0.0	0.0	178.2	618.0	49.1	54.6	69.7	164.1	145.7	101.9	235.0	167.6	1,783.9
1989	152.8	0.0	86.3	148.7	59.3	90.9	235.6	126.9	92.3	323.4	582.1	52.9	1,951.2
1990	313.8	108.0	227.8	85.7	225.7	6.5	28.2	58.8	50.5	396.4	286.2	192.1	1,979.7
1991	334.7	16.0	48.1	95.2	41.8	265.0	112.2	95.2	105.6	161.5	269.5	298.7	1,843.5
1992	79.4	0.0	0.0	356.1	159.4	46.8	47.4	25.8	38.9	203.8	495.9	90.4	1,543.9
1993	18.8	164.8	138.7	219.0	106.1	236.6	46.2	76.8	28.8	503.0	506.8	339.5	2,385.1
1994	246.5	292.5	53.5	79.8	67.1	63.9	18.3	58.4	89.4	498.1	377.5	157.6	2,002.6
1995	184.2	76.7	119.8	165.4	262.2	58.2	19.1	32.5	16.8	473.5	269.9	86.2	1,764.5
1996	47.3	50.5	41.5	295.8	0.0	128.1	74.5	83.2	127.3	290.6	162.8	109.8	1,411.4
1997	0.0	3.3	111.2	165.2	320.6	59.8	99.8	34.7	163.8	311.6	372.4	295.3	1,937.7
1998	84.3	13.0	38.4	65.6	230.3	38.1	68.5	173.2	117.7	188.4	74.3	267.6	1,359.4
1999	299.4	191.1	24.5	163.4	149.7	106.9	5.0	10.0	39.8	409.5	202.7	131.2	1,733.2
2000	140.4	362.8	20.8	268.5	32.1	73.1	0.0	205.2	41.4	110.6	287.9	245.2	1,788.0
2001	305.8	189.9	28.3	241.9	25.7	92.6	10.1	12.0	135.9	286.3	345.4	162.3	1,836.2
2002	88.5	30.6	26.5	345.2	30.5	7.2	0.0	16.8	88.5	350.6	454.7	293.0	1,732.1
2003	218.4	156.1	33.6	322.0	103.2	59.5	137.5	39.8	68.2	225.8	246.1	80.0	1,690.2
2004	49.5	6.5	58.3	145.4	100.4	66.5	16.3	3.0	132.9	465.3	438.8	468.2	1,951.1
2005	110.3	61.5	62.1	205.6	116.9	29.2	53.1	3.5	30.3	540.8	337.4	186.5	1,737.2
2006	386.4	3.5	206.3	220.6	45.0	80.7	44.0	41.7	47.5	383.4	420.0	121.0	2,000.1
2007	123.7	54.0	0.0	171.8	22.5	130.4	45.3	49.7	149.3	363.7	239.3	426.3	1,776.0
2008	193.3	142.0	345.4	206.6	54.0	26.4	150.8	33.0	12.5	308.6	243.4	195.4	1,911.4
Mean	142.9	85.9	84.4	194.9	114.1	75.3	73.6	59.7	99.4	303.2	322.0	238.2	1,793.5
Max	570	363	345	618	326	265	311	227	370	629	605	930	2,833
Min	0.0	0.0	0.0	31.3	0.0	0.0	0.0	2.3	12.5	44.6	74.3	52.9	1,163.2
Stdv	113.6	90.8	72.9	102.2	80.2	53.5	64.8	52.5	79.2	135.2	128.9	152.5	325.2
% Mean	8.0	4.8	4.7	10.9	6.4	4.2	4.1	3.3	5.5	16.9	18.0	13.3	

Rainfall (mm) **Minneriya Tank** **M382** Historic Data

Mahaweli Ganga *60* *Elev (m):* *95.0* *Lat:* *08.05N* *Long:* *80.90E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	199.0	67.0	15.0	104.0	0.0	0.0	86.0	34.0	4.0	249.4	195.1	372.1	1,325.6
1950	122.4	117.3	153.2	1.0	110.7	0.0	2.3	100.6	38.6	73.7	107.9	109.2	936.9
1951	475.5	35.3	40.1	189.7	108.5	4.1	19.6	88.1	125.7	89.2	508.3	218.2	1,902.3
1952	419.4	74.2	31.5	209.0	78.5	0.0	33.3	0.0	132.3	633.7	113.3	183.6	1,908.8
1953	172.5	65.0	34.5	140.5	0.0	20.3	212.3	48.8	52.6	336.0	171.4	377.7	1,631.6
1954	252.7	25.4	356.4	150.4	0.0	0.0	57.9	150.1	0.0	192.0	174.0	488.4	1,847.3
1955	285.7	74.2	28.2	216.4	40.6	0.0	0.0	58.7	160.8	65.8	154.2	220.2	1,304.8
1956	170.9	46.5	21.1	137.9	0.0	36.6	0.0	18.3	0.0	176.3	267.2	279.4	1,154.2
1957	119.9	259.6	0.0	29.0	155.7	2.3	71.6	45.2	70.9	166.9	600.5	1321.0	2,842.6
1958	186.9	97.0	180.8	152.7	79.8	0.0	0.0	107.7	121.2	87.6	147.3	208.0	1,369.0
1959	233.4	28.7	16.5	50.0	71.1	12.2	0.0	5.8	40.4	238.8	462.3	275.1	1,434.3
1960	208.8	380.5	59.4	187.7	156.7	0.0	242.6	0.0	28.4	95.0	424.7	136.7	1,920.5
1961	461.5	175.5	86.9	107.4	41.9	4.8	12.7	7.6	6.1	224.8	288.0	417.1	1,834.3
1962	227.1	50.8	85.9	156.0	35.6	0.0	1.8	147.3	50.0	130.8	178.3	230.4	1,294.0
1963	341.6	189.7	161.8	218.2	8.1	0.0	72.6	14.2	136.1	189.2	666.0	480.3	2,477.8
1964	157.0	152.4	85.6	93.5	122.7	0.0	111.5	2.3	54.4	139.4	179.1	156.0	1,253.9
1965	89.9	205.5	38.9	210.8	127.5	0.0	30.2	34.5	0.0	191.0	388.4	526.5	1,843.2
1966	226.3	55.4	88.4	161.3	2.5	0.0	1.5	65.0	147.6	470.7	341.4	198.4	1,758.5
1967	25.1	110.5	88.6	110.0	52.1	4.8	0.0	0.0	39.9	310.4	434.8	501.6	1,677.8
1968	154.9	0.0	113.5	58.9	48.0	0.0	0.0	56.9	136.4	278.6	253.2	211.8	1,312.2
1969	88.6	86.9	8.4	122.2	0.0	0.0	53.6	73.7	121.9	294.9	266.4	871.5	1,988.1
1970	131.1	200.9	43.4	280.4	61.7	47.5	0.0	51.6	70.4	60.2	255.8	321.6	1,524.6
1971	227.6	162.1	55.4	164.1	92.5	5.6	26.9	116.1	29.7	92.7	128.0	603.0	1,703.7
1972	81.0	0.0	35.8	68.3	164.8	0.0	0.0	0.0	512.8	214.9	372.1	282.2	1,731.9
1973	0.0	42.9	40.1	33.3	28.7	37.3	61.5	2.5	117.6	217.9	139.7	502.2	1,223.7
1974	0.0	35.3	11.7	73.7	37.3	0.0	0.0	40.1	88.9	9.7	192.5	341.6	830.8
1975	175.5	70.1	94.2	34.5	62.5	3.6	256.0	16.8	170.2	113.5	274.8	203.7	1,475.4
1976	49.3	10.7	12.4	143.3	0.0	0.0	30.0	47.2	118.4	108.7	464.1	275.3	1,259.4
1977	63.8	58.7	72.9	9.7	66.0	0.0	42.4	21.8	196.9	289.8	369.8	373.4	1,565.2
1978	98.6	19.1	44.7	80.8	2.0	0.0	74.9	0.0	0.0	428.0	472.9	542.5	1,763.5
1979	27.4	165.6	41.7	14.0	14.0	0.0	0.5	54.4	79.0	325.2	494.0	234.2	1,450.0
1980	3.0	0.0	11.7	173.0	67.6	4.1	0.0	0.0	55.4	278.4	360.7	171.7	1,125.6
1981	137.4	100.8	47.0	121.2	49.8	0.0	221.5	89.7	40.6	174.5	57.4	257.8	1,297.7
1982	0.0	0.0	50.8	79.0	180.3	4.1	0.0	0.0	99.6	334.5	488.5	402.5	1,639.3
1983	40.7	0.0	0.0	5.6	77.2	0.5	82.8	0.0	9.1	344.4	160.8	698.6	1,419.7
1984	405.0	567.6	133.6	128.9	12.2	0.0	56.1	53.8	244.8	105.1	178.7	125.2	2,011.0
1985	247.2	85.9	96.7	53.8	51.8	0.0	59.5	14.7	137.8	25.2	221.6	323.9	1,318.1
1986	142.0	31.8	179.0	39.7	44.2	14.5	17.8	45.2	0.0	326.0	84.8	220.5	1,145.5
1987	146.3	0.0	27.7	23.6	2.3	0.0	0.0	0.0	92.7	236.5	80.3	115.3	724.7
1988	23.1	9.9	86.3	131.1	21.6	0.0	117.4	33.0	61.7	46.2	126.7	99.6	756.6
1989	125.0	0.0	133.1	49.5	17.9	0.0	47.7	0.0	33.3	45.7	69.6	43.5	565.3
1990	92.2	38.3	126.0	60.7	184.3	0.0	0.0	122.8	51.5	140.0	132.2	417.6	1,365.6
1991	187.5	0.0	30.5	51.3	83.8	13.2	4.8	21.3	19.4	76.2	254.0	382.5	1,124.5
1992	33.8	0.0	0.0	-1.0	59.2	-1.0	0.0	0.0	161.1	28.9	491.7	409.8	-1.0
1993	30.3	54.5	24.6	61.8	143.0	1.8	126.2	19.8	39.3	239.1	586.8	706.6	2,033.8
1994	384.2	284.4	72.8	-1.0	19.7	0.0	0.0	0.0	275.5	270.0	319.6	233.4	-1.0
1995	207.2	94.9	0.8	74.7	120.0	0.0	105.0	75.0	55.0	217.0	338.0	79.0	1,366.6
1996	175.0	77.0	0.0	178.0	10.0	30.0	0.0	190.0	30.0	201.0	317.0	315.0	1,523.0
1997	0.0	10.0	67.0	200.0	248.0	0.0	30.0	0.0	142.2	315.0	507.0	243.0	1,762.2
1998	170.3	29.0	0.0	4.0	76.0	0.0	48.9	139.5	0.0	37.7	143.5	338.5	987.4
1999	432.4	219.8	0.0	101.2	0.0	0.0	0.0	0.0	48.5	278.3	243.6	175.8	1,499.6
2000	212.7	152.9	83.4	20.0	0.0	0.0	0.0	27.5	45.3	38.0	503.2	261.9	1,344.9
2001	277.8	104.0	165.1	165.1	17.0	29.5	45.1	0.0	65.8	86.9	96.0	303.6	1,355.9
2002	89.0	134.8	24.6	114.7	25.2	0.0	0.0	142.8	8.5	208.0	458.7	484.5	1,690.8
2003	260.5	136.7	32.0	100.3	50.3	48.0	39.5	142.0	20.7	32.2	421.3	86.5	1,370.0
2004	77.4	16.5	79.6	35.0	82.3	0.0	0.0	0.0	83.3	358.3	400.0	365.3	1,497.7
2005	122.3	0.0	12.0	166.4	158.5	0.0	61.5	14.5	0.0	144.3	264.7	87.5	1,031.7
2006	233.5	5.7	151.4	67.9	73.1	0.0	0.0	0.0	75.3	346.9	272.2	204.3	1,430.3
2007	108.4	169.3	0.0	154.7	0.0	13.2	8.7	31.6	48.0	319.1	180.0	751.3	1,784.3
2008	69.9	133.7	194.5	183.7	0.0	0.0	63.0	134.2	0.0	120.5	204.1	268.5	1,372.1
Mean	165.1	92.0	66.3	107.8	60.7	5.7	44.0	45.1	79.9	197.8	290.8	333.9	1,484.3
Max	476	568	356	280	248	48	256	190	513	634	666	1,321	2,843
Min	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	9.7	57.4	43.5	565.3
Stdv	121.4	102.8	65.6	67.1	58.1	12.0	61.9	50.6	84.7	126.2	153.8	218.7	402.7
% Mean	11.1	6.2	4.5	7.3	4.1	0.4	3.0	3.0	5.4	13.3	19.6	22.5	

Rainfall (mm) **Nachchaduwa** **M404** Historic Data

Malwathu Oya *90* *Elev (m): ----* *Lat: 08.25N* *Long: 80.47E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	147.8	54.1	20.8	201.7	68.1	0.0	61.5	84.6	0.0	144.3	211.3	202.7	1,196.9
1950	61.7	34.8	79.8	45.5	56.6	0.0	0.0	14.2	18.0	162.8	165.6	183.9	822.9
1951	281.4	63.5	27.2	217.4	136.4	0.0	22.4	20.3	158.0	259.6	437.9	122.2	1,746.3
1952	157.7	23.6	127.0	317.5	34.5	0.0	99.8	0.0	43.7	175.8	61.0	104.6	1,145.2
1953	113.0	35.8	24.6	370.3	0.0	0.0	133.9	118.4	49.3	397.3	180.6	224.3	1,647.5
1954	97.5	1.0	177.5	307.6	30.7	0.0	119.4	43.2	7.6	140.0	124.5	435.6	1,484.6
1955	184.7	21.3	52.8	246.6	109.0	0.0	16.0	78.7	112.0	125.7	102.6	127.8	1,177.2
1956	46.2	16.3	102.4	158.7	0.8	73.9	2.5	59.2	1.5	220.5	207.5	149.6	1,039.1
1957	59.7	114.0	36.3	173.0	167.9	18.0	7.9	3.3	6.4	288.0	550.9	960.1	2,385.5
1958	59.4	17.8	84.6	237.5	127.5	0.0	0.0	66.3	0.0	187.2	258.1	58.4	1,096.8
1959	73.7	10.2	54.6	140.7	97.8	19.1	0.0	0.0	86.4	124.7	163.3	96.5	867.0
1960	84.8	57.7	17.3	139.7	58.4	5.1	147.3	0.0	36.8	114.3	422.9	81.3	1,165.6
1961	104.1	55.9	15.2	58.4	10.2	68.6	0.0	2.5	20.3	207.0	79.5	111.5	733.2
1962	69.9	20.8	75.7	180.8	189.2	6.4	27.9	64.8	31.8	586.7	148.1	143.0	1,545.1
1963	273.3	119.6	173.7	122.4	26.7	8.9	2.5	10.2	15.2	215.9	435.6	493.0	1,897.0
1964	41.1	44.4	74.9	110.5	92.7	3.8	82.6	11.9	64.8	261.9	157.0	141.0	1,086.6
1965	27.9	59.7	256.5	215.9	193.0	0.0	0.0	222.2	0.0	283.7	349.5	307.3	1,915.7
1966	109.0	10.2	81.3	223.8	12.2	2.5	15.2	56.4	240.0	209.8	277.4	160.5	1,398.3
1967	11.9	144.5	83.3	55.1	65.0	4.0	0.8	8.6	18.3	304.0	222.0	329.9	1,247.4
1968	37.3	1.5	125.0	105.7	32.0	13.5	3.3	0.0	69.6	195.8	158.0	134.6	876.3
1969	73.7	55.9	63.0	184.4	51.6	0.0	4.6	72.4	100.8	449.1	132.1	332.7	1,520.3
1970	107.2	88.1	20.6	111.5	103.4	0.0	2.8	2.5	68.8	290.3	319.8	206.8	1,321.8
1971	197.9	140.0	23.6	176.5	50.3	16.8	29.7	267.7	38.9	170.9	116.8	466.9	1,696.0
1972	52.1	0.0	0.0	198.1	177.3	5.1	53.1	0.0	56.1	351.0	120.4	129.0	1,142.2
1973	0.0	8.6	32.0	66.8	71.6	4.8	20.3	54.9	64.0	106.7	195.6	440.2	1,065.5
1974	0.0	80.0	42.2	120.4	46.5	0.0	5.3	8.4	74.2	49.0	127.5	210.3	763.8
1975	44.4	10.4	144.0	150.1	250.7	3.6	27.7	4.8	30.5	192.3	227.6	78.2	1,164.3
1976	4.1	0.0	100.6	189.7	7.9	0.0	1.0	1.0	9.1	370.3	324.6	125.5	1,133.8
1977	15.7	26.9	35.8	201.9	147.1	0.5	47.0	59.4	31.0	402.6	401.3	152.4	1,521.6
1978	21.3	4.6	27.2	87.4	144.0	0.0	76.2	0.0	27.0	134.4	357.9	213.0	1,093.0
1979	15.0	34.3	0.8	132.9	31.2	0.0	10.2	39.4	128.8	399.0	289.0	51.8	1,132.4
1980	0.0	0.0	11.9	63.0	53.6	13.0	2.0	9.2	95.2	225.6	130.3	115.0	718.8
1981	44.4	23.4	16.0	112.8	35.3	0.0	33.8	94.0	59.2	177.5	107.4	81.3	785.1
1982	0.0	0.0	32.3	89.4	103.6	0.0	7.9	0.0	37.3	213.4	331.5	107.2	922.6
1983	0.0	0.0	9.9	51.8	48.3	24.6	45.5	30.5	14.2	20.1	126.7	262.6	634.2
1984	298.7	372.3	218.7	210.4	28.2	0.0	48.4	0.0	101.1	38.8	152.9	67.6	1,537.1
1985	125.8	130.6	11.1	14.9	133.1	6.1	41.3	0.0	119.7	84.0	313.7	108.5	1,088.8
1986	114.2	3.5	162.3	162.1	19.2	0.0	28.4	0.0	0.0	243.9	90.1	100.0	923.7
1987	38.5	0.0	45.8	228.2	78.1	0.0	0.0	0.0	198.4	286.9	129.1	53.7	1,058.7
1988	17.8	10.2	19.5	283.2	11.0	0.0	34.8	97.1	14.2	45.2	103.4	28.2	664.6
1989	24.1	0.0	16.2	53.9	29.7	22.3	88.9	0.0	28.2	116.4	93.7	19.2	492.6
1990	169.0	21.6	61.8	19.0	181.6	0.0	0.0	46.4	39.1	346.8	134.7	144.3	1,164.3
1991	80.9	7.4	54.7	182.8	92.3	62.6	11.0	0.0	16.3	144.3	291.7	157.5	1,101.5
1992	20.6	0.0	0.0	137.5	125.5	27.0	33.0	13.8	24.2	128.2	364.8	150.3	1,024.9
1993	1.5	0.0	65.0	75.9	33.0	0.0	31.2	0.0	4.2	260.4	340.6	432.3	1,244.1
1994	103.3	321.8	20.8	211.0	0.0	0.0	0.0	0.0	95.5	221.9	295.4	33.1	1,302.8
1995	115.0	31.4	3.3	173.6	107.3	0.0	0.0	0.0	0.0	94.6	206.5	0.0	731.7
1996	0.0	60.1	3.0	124.9	15.0	65.5	0.0	104.0	61.0	251.2	204.1	41.2	930.0
1997	34.0	1.5	5.0	87.0	103.3	2.0	16.0	0.0	65.0	227.0	324.9	197.8	1,063.5
1998	30.5	0.0	3.0	164.0	187.0	0.0	90.0	109.0	0.0	35.0	159.1	157.0	934.6
1999	127.0	58.0	17.0	55.0	0.0	0.0	0.0	0.0	69.4	162.9	155.2	119.0	763.5
2000	115.5	100.0	22.0	24.0	0.0	0.0	0.0	123.0	94.5	42.0	265.0	-1.0	-1.0
2001	97.0	90.0	0.0	262.0	0.0	60.0	41.0	0.0	9.0	98.0	119.0	105.0	881.0
2002	18.0	34.0	6.0	140.0	0.0	0.0	0.0	19.0	51.0	215.0	167.0	255.0	905.0
2003	90.0	26.0	6.0	127.0	54.0	0.0	19.0	21.0	35.0	133.0	174.0	5.0	690.0
2004	25.5	0.0	34.0	149.0	152.0	0.0	0.0	0.0	115.0	376.0	72.0	291.0	1,214.5
2005	56.0	0.0	35.0	104.3	18.0	0.0	5.0	32.0	0.0	16.2	212.0	4.7	483.2
2006	57.0	32.7	148.0	76.0	12.0	0.0	0.0	0.0	9.0	170.5	291.0	75.5	871.7
2007	28.0	52.0	5.0	177.0	0.0	5.0	52.0	84.0	0.0	459.2	267.6	240.2	1,370.0
2008	54.9	103.0	332.0	128.0	0.0	0.0	0.0	47.6	0.0	111.4	172.2	380.0	1,329.1
Mean	74.3	47.3	59.1	148.9	70.2	9.0	27.5	36.8	49.4	207.8	218.7	181.5	1,133.2
Max	299	372	332	370	251	74	147	268	240	587	551	960	2,386
Min	0.0	0.0	0.0	14.9	0.0	0.0	0.0	0.0	0.0	16.2	61.0	0.0	483.2
Stdv	69.7	68.8	68.2	76.9	63.3	18.7	36.0	53.6	50.6	120.5	109.0	159.5	365.9
% Mean	6.6	4.2	5.2	13.1	6.2	0.8	2.4	3.2	4.4	18.3	19.3	16.0	

Rainfall (mm) **Nalanda (Exper. Station) M409** Historic Data

Mahaweli Ganga *60* *Elev (m): 256.0* *Lat: 07.67N* *Long: 80.63E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	195.1	35.8	59.2	204.0	115.8	68.6	66.8	88.4	18.5	172.5	360.2	445.3	1,830.2
1950	195.8	59.4	154.2	49.8	104.4	39.1	49.3	43.9	43.2	157.7	189.0	199.1	1,284.9
1951	840.5	89.2	44.2	164.6	38.1	45.0	49.8	58.9	270.8	175.3	453.9	422.4	2,652.7
1952	365.0	108.2	30.2	205.7	154.2	15.0	3.6	7.4	117.6	160.5	177.3	287.3	1,632.0
1953	195.3	83.6	68.8	205.2	0.0	0.5	161.5	17.8	61.0	377.4	338.8	338.1	1,848.0
1954	234.7	208.5	196.6	251.2	8.1	6.1	75.7	63.2	4.8	349.5	336.3	573.8	2,308.5
1955	428.2	131.3	158.2	197.9	140.2	58.7	2.3	16.8	397.5	139.4	89.7	190.5	1,950.7
1956	110.0	56.4	37.3	24.9	43.9	69.9	7.4	6.1	6.1	193.3	474.7	367.3	1,397.3
1957	208.3	258.1	0.0	166.4	111.8	49.5	56.1	0.0	13.0	348.0	486.7	1106.7	2,804.6
1958	153.7	54.4	366.3	205.5	108.7	26.4	40.1	93.5	9.9	118.1	229.4	250.7	1,656.7
1959	97.0	42.2	34.8	278.1	219.2	72.1	106.7	9.4	79.8	299.0	287.3	210.8	1,736.4
1960	222.8	385.6	107.9	157.0	94.2	37.8	225.3	34.3	67.1	192.8	395.5	221.5	2,141.8
1961	241.6	160.0	69.3	62.2	124.0	70.4	68.3	300.0	53.3	262.6	262.1	374.1	2,047.9
1962	212.3	115.8	42.2	229.4	124.2	9.4	81.0	88.9	54.6	325.6	220.2	217.7	1,721.3
1963	345.4	234.7	157.7	299.0	18.3	35.1	73.4	10.4	64.3	179.6	354.6	498.9	2,271.4
1964	309.4	208.8	96.5	116.1	102.6	32.3	165.9	73.9	104.4	165.6	215.6	282.4	1,873.5
1965	128.5	198.6	124.5	377.2	213.1	6.1	2.3	137.2	2.5	406.9	413.5	377.7	2,388.1
1966	244.6	22.9	196.1	250.7	0.0	19.8	16.5	5.1	164.1	386.3	581.4	363.7	2,251.2
1967	130.6	141.2	79.2	24.1	59.9	74.0	29.0	48.0	37.0	356.0	492.0	588.0	2,059.0
1968	193.3	53.1	277.1	170.2	27.9	78.2	84.3	0.0	44.2	399.5	327.4	270.8	1,926.0
1969	145.3	98.6	16.0	184.9	31.8	1.3	0.0	249.4	77.0	449.3	77.5	458.2	1,789.3
1970	212.3	429.3	14.2	200.4	73.9	16.5	16.5	9.4	134.6	147.1	252.0	321.8	1,828.0
1971	365.8	151.9	96.3	195.8	41.4	138.4	32.3	119.6	179.8	253.2	189.2	686.8	2,450.5
1972	110.5	0.8	8.6	139.4	439.2	0.0	0.0	17.8	92.7	333.2	365.0	446.8	1,954.0
1973	12.7	59.2	8.9	153.4	39.1	67.6	131.6	45.7	20.1	106.4	118.6	629.4	1,392.7
1974	11.4	73.7	5.6	154.7	119.1	14.2	53.6	42.2	138.4	41.1	107.4	289.8	1,051.2
1975	160.5	138.7	103.1	226.8	200.7	57.4	185.2	67.1	123.7	54.1	356.4	190.8	1,864.5
1976	203.2	35.8	114.8	173.2	0.0	3.6	9.1	55.9	52.3	267.5	406.4	240.3	1,562.1
1977	37.8	35.8	103.1	132.6	88.9	7.4	35.1	62.0	4.8	511.3	443.0	246.6	1,708.4
1978	67.3	26.4	149.4	37.1	98.3	8.4	46.2	10.7	46.5	310.4	419.6	280.2	1,500.5
1979	108.5	127.0	12.5	195.3	90.4	56.3	57.5	81.6	139.2	195.3	349.3	166.9	1,579.8
1980	10.9	0.0	103.5	321.0	29.6	23.7	10.9	34.6	149.9	316.1	301.3	169.2	1,470.7
1981	158.4	187.9	45.3	187.9	71.0	41.0	119.0	60.5	19.0	187.0	310.8	130.4	1,518.2
1982	25.0	0.0	275.0	121.3	258.3	535.0	1.0	255.0	219.0	554.0	320.2	534.6	3,098.4
1983	134.0	7.0	110.0	41.2	168.9	18.9	121.7	24.4	11.5	151.2	290.9	455.8	1,535.5
1984	357.7	321.2	234.5	179.7	2.5	0.0	53.3	0.0	225.4	89.6	305.4	160.4	1,929.7
1985	374.9	111.5	110.4	98.3	137.3	91.0	17.2	13.4	78.0	183.6	289.0	254.8	1,759.4
1986	308.0	262.5	156.2	78.4	72.7	0.0	3.8	62.6	10.2	245.7	95.0	205.1	1,500.2
1987	183.4	5.5	8.4	143.3	83.6	10.1	0.0	12.3	107.8	423.0	73.1	106.8	1,157.3
1988	29.1	18.8	96.5	370.8	22.1	51.0	24.0	109.0	75.6	105.7	67.4	176.4	1,146.4
1989	76.3	0.0	0.0	207.1	24.1	21.0	219.2	0.0	41.5	153.8	608.5	110.0	1,461.5
1990	301.5	100.0	139.6	54.0	167.4	7.1	1.8	32.7	45.8	273.6	315.8	174.8	1,614.1
1991	228.0	1.0	0.0	185.0	0.0	130.2	72.9	60.8	114.7	304.4	-1.0	-1.0	-1.0
1992	-1.0	0.0	0.0	-1.0	9.0	0.0	17.7	40.8	12.4	86.6	329.1	111.4	-1.0
1993	35.3	116.4	17.5	173.9	37.0	53.7	21.0	3.2	0.0	328.3	500.2	233.8	1,520.3
1994	564.7	347.5	-1.0	50.4	-1.0	0.5	-1.0	0.0	58.2	342.7	-1.0	251.5	-1.0
1995	203.0	102.0	108.0	-1.0	84.0	0.0	0.0	0.0	0.0	445.3	-1.0	162.3	-1.0
1996	113.1	36.9	17.2	247.0	0.0	47.5	66.4	32.2	73.2	269.2	199.8	99.8	1,202.3
1997	0.0	19.0	102.6	283.5	111.0	0.5	32.5	-1.0	111.7	172.5	486.2	-1.0	-1.0
1998	141.3	0.0	64.9	53.2	139.9	30.8	59.9	53.8	71.8	98.4	122.6	-1.0	-1.0
1999	346.6	230.9	90.5	117.0	54.7	52.9	0.0	0.0	34.4	149.2	159.4	173.7	1,409.3
2000	291.7	362.5	77.5	211.9	0.0	28.3	0.0	132.0	38.2	51.5	333.0	306.6	1,833.2
2001	443.5	182.5	45.3	520.4	2.7	61.3	12.2	10.9	139.4	194.8	224.1	273.7	2,110.8
2002	166.9	101.3	63.8	285.7	97.7	4.1	0.0	94.9	27.0	368.0	453.9	386.2	2,049.5
2003	355.8	182.7	117.9	137.5	34.6	24.8	51.3	16.6	69.9	124.5	298.8	110.0	1,524.4
2004	106.2	45.1	42.9	196.1	88.3	52.0	2.5	0.0	189.1	282.9	444.6	632.7	2,082.4
2005	230.2	119.2	33.3	242.5	59.8	5.8	54.8	0.0	1.5	241.1	293.9	145.3	1,427.4
2006	552.0	43.1	180.3	86.5	41.4	53.8	29.2	26.5	32.3	343.4	499.6	205.0	2,093.1
2007	170.0	53.4	16.2	235.0	3.5	48.3	13.5	14.2	119.6	284.9	220.2	602.9	1,781.7
2008	261.4	87.4	464.0	301.1	0.0	1.4	91.8	65.5	17.8	345.4	348.1	214.5	2,198.4
Mean	214.5	114.5	95.8	182.1	81.9	43.0	51.4	51.2	78.6	249.2	309.8	314.6	1,812.7
Max	841	429	464	520	439	535	225	300	398	554	609	1,107	3,098
Min	0.0	0.0	0.0	24.1	0.0	0.0	0.0	0.0	0.0	41.1	67.4	99.8	1,051.2
Stdv	153.7	105.8	91.2	95.3	78.7	71.9	55.5	62.4	75.3	119.9	133.2	186.4	417.7
% Mean	11.8	6.3	5.3	10.0	4.5	2.4	2.8	2.8	4.3	13.7	17.1	17.4	

Rainfall (mm) **Niloomally Estate M427** Historic Data

Mahaweli Ganga *60* *Elev (m): 1097.0* *Lat: 07-26-38N* *Long: 80-43-15E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	264.9	40.6	27.4	226.3	208.5	348.5	514.1	396.7	282.7	457.5	369.3	597.2	3,733.7
1950	249.9	124.2	102.6	85.1	369.8	395.2	394.5	222.5	519.7	380.5	310.9	166.6	3,321.5
1951	908.8	156.0	114.8	319.0	193.8	584.2	512.8	105.7	654.8	329.4	551.7	651.0	5,082.0
1952	459.2	236.0	71.4	450.9	678.7	340.9	78.5	361.2	149.6	621.0	272.8	359.2	4,079.4
1953	106.7	106.2	185.7	566.4	36.6	162.6	564.1	115.6	154.2	541.5	310.9	299.0	3,149.5
1954	221.7	205.0	211.3	181.4	356.6	276.9	254.3	465.6	128.3	728.2	383.8	811.8	4,224.9
1955	774.7	207.0	265.9	248.4	340.9	951.2	210.3	147.1	475.0	337.1	303.0	119.4	4,380.0
1956	118.9	12.7	68.8	208.3	153.9	690.9	153.4	299.7	115.6	473.5	576.8	284.5	3,157.0
1957	259.3	284.7	8.9	193.5	297.7	509.5	458.7	256.5	152.4	410.5	755.9	1467.9	5,055.5
1958	114.8	26.9	258.3	287.0	256.3	270.3	195.1	645.9	108.5	769.4	540.8	373.6	3,846.9
1959	79.0	24.1	0.0	293.9	307.3	484.1	431.5	193.0	382.0	631.7	441.2	343.4	3,611.2
1960	471.4	547.1	18.0	482.3	300.2	298.7	439.9	163.3	557.0	295.7	602.7	122.9	4,299.2
1961	211.8	225.6	75.2	206.8	526.3	172.0	337.6	344.2	190.5	296.4	369.1	413.3	3,368.8
1962	267.7	132.6	153.7	240.3	404.9	117.3	265.2	246.6	271.8	802.4	344.7	284.2	3,531.4
1963	379.5	153.7	122.4	287.5	144.8	256.8	275.8	152.9	285.2	484.1	602.2	634.7	3,779.6
1964	487.9	326.1	102.9	31.0	186.4	175.5	353.6	167.1	266.4	349.0	355.9	367.8	3,169.6
1965	139.4	283.2	207.3	342.1	305.1	201.7	66.0	517.7	133.4	492.3	578.6	274.3	3,541.1
1966	162.3	65.8	138.9	191.3	35.8	207.0	99.6	180.8	603.8	509.5	367.5	174.5	2,736.8
1967	241.8	332.2	43.4	180.6	72.4	297.9	243.3	129.3	208.3	300.5	625.6	616.5	3,291.8
1968	128.8	56.1	112.5	101.1	80.5	341.9	411.0	157.0	313.2	276.6	335.0	431.5	2,745.2
1969	207.8	85.3	80.3	231.6	282.4	206.5	49.0	344.2	211.8	671.1	201.2	592.6	3,163.8
1970	190.0	489.2	75.7	263.4	199.4	150.9	193.5	170.4	249.9	409.7	410.2	495.3	3,297.6
1971	399.0	177.3	106.2	363.0	227.1	289.3	245.4	490.2	840.7	286.8	216.7	781.1	4,422.8
1972	83.3	2.5	23.6	236.2	432.6	123.4	318.5	169.2	219.7	620.3	459.7	567.4	3,256.4
1973	3.0	104.9	105.2	143.0	132.8	225.3	307.3	369.6	136.9	204.7	447.8	677.9	2,858.4
1974	0.5	105.2	126.0	295.7	438.7	218.7	511.8	459.2	633.2	307.3	182.6	483.4	3,762.3
1975	157.0	166.9	157.7	194.6	149.9	448.3	158.5	472.2	342.4	448.1	889.3	559.6	4,144.5
1976	285.2	24.4	70.4	162.1	3.0	69.6	203.7	231.9	161.3	555.2	588.0	215.4	2,570.2
1977	15.5	57.1	148.3	319.8	397.0	239.0	253.7	163.3	56.6	798.1	523.7	434.3	3,406.4
1978	26.2	69.3	23.9	60.5	458.7	202.2	451.9	305.3	317.2	540.5	678.2	348.5	3,482.4
1979	155.4	41.9	22.6	285.5	265.2	265.2	273.6	52.8	402.6	381.5	423.7	246.4	2,816.4
1980	45.7	0.0	49.8	306.3	68.6	115.0	176.0	184.4	114.8	321.3	441.2	148.8	1,971.9
1981	118.1	61.5	96.8	189.0	98.0	302.0	565.0	255.0	485.0	270.0	359.0	184.0	2,983.4
1982	7.7	4.5	100.8	141.0	460.4	260.0	253.5	214.0	208.5	748.8	596.0	579.4	3,574.6
1983	92.8	12.7	0.0	95.9	298.6	308.8	372.5	266.9	177.9	369.9	370.7	361.0	2,727.7
1984	469.5	317.0	216.8	330.2	94.3	217.0	819.1	97.4	766.3	319.8	289.9	250.5	4,187.8
1985	186.7	176.1	180.8	107.7	272.1	911.7	602.5	145.9	368.4	332.7	366.4	266.5	3,917.5
1986	565.8	187.3	41.0	382.9	230.1	144.8	101.9	280.8	297.2	795.9	330.6	269.9	3,628.2
1987	77.4	11.9	33.3	158.1	297.9	259.1	11.1	244.7	877.5	449.9	382.6	219.9	3,023.4
1988	20.0	189.4	124.8	399.6	342.1	152.5	193.2	575.4	529.2	183.2	391.1	342.0	3,442.5
1989	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1992	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1993	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1996	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1997	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1998	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1999	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2001	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2002	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2003	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2004	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2005	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2006	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2007	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2008	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Mean	228.9	145.8	101.8	244.7	260.1	304.8	308.0	269.0	333.7	462.5	438.7	420.4	3,518.6
Max	909	547	266	566	679	951	819	646	878	802	889	1,468	5,082
Min	0.5	0.0	0.0	31.0	3.0	69.6	11.1	52.8	56.6	183.2	182.6	119.4	1,971.9
Stdv	206.3	130.8	70.2	116.2	149.2	195.0	175.7	142.7	213.6	176.6	153.3	250.4	649.4
% Mean	6.5	4.1	2.9	7.0	7.4	8.7	8.8	7.6	9.5	13.1	12.5	11.9	

Rainfall (mm) **Nochchiyagama M429** Historic Data

Kala Oya *93* *Elev (m): ----* *Lat: 08.27N* *Long: 80.20E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	190.2	15.7	24.4	229.9	68.6	4.6	40.1	54.6	0.8	192.5	285.0	129.0	1,235.4
1950	51.6	20.3	90.4	57.1	73.2	19.6	0.0	21.8	49.3	171.4	161.8	165.9	882.4
1951	208.8	63.2	55.4	254.0	119.4	0.0	0.0	0.0	210.6	89.9	251.7	61.0	1,314.0
1952	132.6	63.2	82.8	240.8	23.9	0.0	0.0	0.0	110.0	133.1	90.4	125.5	1,002.3
1953	102.9	75.2	35.1	232.9	0.0	3.0	132.6	0.0	104.1	322.3	122.4	229.6	1,360.1
1954	110.5	0.0	132.1	103.9	94.7	0.0	37.3	84.8	0.0	241.3	104.6	247.1	1,156.3
1955	111.5	27.4	115.3	173.7	122.9	0.0	0.0	39.9	174.8	104.4	217.7	12.2	1,099.8
1956	87.6	20.3	133.9	41.7	8.6	32.8	0.0	50.8	0.0	115.8	284.0	189.0	964.5
1957	32.8	60.5	11.9	134.1	62.7	40.4	4.8	0.0	0.0	328.2	352.3	695.5	1,723.2
1958	100.6	2.5	185.7	326.4	123.4	0.0	0.0	137.4	0.0	239.3	168.1	72.4	1,355.8
1959	62.2	7.1	0.0	209.5	254.8	83.8	15.0	0.0	83.3	178.8	288.8	109.7	1,293.0
1960	36.8	56.4	11.9	215.6	90.7	7.1	85.3	10.9	31.2	161.8	697.2	55.9	1,460.8
1961	141.0	62.0	38.4	143.3	78.5	96.8	65.8	1.0	8.6	377.2	190.0	175.5	1,378.1
1962	173.0	35.1	103.6	295.7	246.4	16.8	4.8	6.1	91.4	278.4	92.5	152.1	1,495.9
1963	252.5	62.2	85.3	173.7	143.0	41.4	31.0	0.5	49.0	239.3	467.4	346.2	1,891.5
1964	49.5	19.8	22.9	115.6	32.8	1.0	75.7	16.8	137.9	129.0	321.1	124.7	1,046.8
1965	21.1	41.7	75.4	198.1	233.9	0.0	0.0	128.5	0.0	186.7	261.6	244.9	1,391.9
1966	54.6	8.4	5.6	181.9	-1.0	0.0	43.9	48.8	149.9	260.1	281.7	-1.0	-1.0
1967	18.0	63.8	45.7	91.2	27.2	12.4	-1.0	0.0	5.3	241.3	-1.0	-999.0	-1.0
1968	7.1	4.3	217.2	307.3	32.0	16.3	10.2	0.0	91.7	200.2	192.3	153.2	1,231.8
1969	16.3	0.0	26.7	218.9	80.8	0.0	0.0	74.4	0.0	338.6	199.9	253.5	1,209.1
1970	46.7	71.4	50.8	209.3	88.6	10.4	0.0	0.8	29.7	187.7	224.5	89.2	1,009.1
1971	156.0	16.0	22.9	199.4	88.9	11.2	0.0	56.1	38.4	79.0	121.4	286.8	1,076.1
1972	17.8	0.0	24.4	97.0	186.2	0.0	13.0	0.0	101.6	349.5	313.7	113.5	1,216.7
1973	-1.0	3.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-999.0	-1.0
1974	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1975	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1976	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1977	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1978	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1979	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1980	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1981	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1982	0.0	0.0	30.9	129.7	98.6	53.0	9.0	0.0	0.0	183.9	254.9	165.0	925.0
1983	0.0	0.0	0.0	36.4	161.8	0.0	2.0	0.0	10.0	128.5	115.9	327.7	782.3
1984	167.8	268.2	143.7	247.6	24.7	0.0	112.3	0.0	276.1	64.5	275.4	56.9	1,637.2
1985	86.9	27.9	132.0	106.0	95.2	13.0	22.7	0.0	119.4	157.0	234.9	38.2	1,033.2
1986	142.6	79.6	108.5	205.0	51.2	0.0	0.0	0.0	9.0	223.4	103.2	101.0	1,023.5
1987	9.8	0.0	25.8	240.5	153.7	5.3	0.0	0.0	108.5	213.1	132.9	23.5	913.1
1988	26.0	3.8	25.4	395.9	5.2	42.5	13.9	62.8	65.0	3.6	126.3	26.7	797.1
1989	35.8	0.0	59.4	41.2	26.2	8.2	47.3	0.0	55.2	124.4	253.7	22.2	673.6
1990	145.1	6.1	65.6	19.8	154.2	0.0	0.0	28.1	27.5	370.7	135.5	135.1	1,087.7
1991	70.7	5.2	88.1	147.8	125.7	79.8	13.6	0.0	8.2	291.0	310.0	211.0	1,351.1
1992	7.2	0.0	0.0	25.4	119.8	42.3	2.8	4.5	16.8	92.7	202.1	145.5	659.1
1993	1.8	0.0	114.9	117.6	67.1	0.0	138.8	0.0	3.6	398.8	299.1	395.1	1,536.8
1994	152.8	74.0	23.3	86.4	14.6	0.0	1.6	0.0	54.0	278.1	203.1	25.9	913.8
1995	70.3	36.2	13.2	196.6	143.6	3.3	0.0	0.6	0.0	291.2	256.6	5.4	1,017.0
1996	23.0	287.4	10.5	179.7	0.7	79.9	5.6	112.1	108.5	185.0	153.2	-1.0	-1.0
1997	0.0	2.6	10.2	107.3	155.7	0.0	11.5	0.0	127.6	331.3	330.2	151.4	1,227.8
1998	30.6	10.2	0.0	137.7	161.2	0.8	51.4	52.9	19.7	98.2	298.2	296.6	1,157.5
1999	113.4	84.5	4.4	122.0	41.9	24.3	0.0	0.0	33.3	156.9	201.3	106.8	888.8
2000	71.5	199.2	12.5	141.3	29.7	0.0	0.0	107.0	60.5	90.3	246.5	200.5	1,159.0
2001	64.7	103.5	0.0	319.4	0.0	86.6	0.0	0.0	29.6	168.2	91.0	219.5	1,082.5
2002	15.7	39.5	63.7	308.0	123.6	0.0	0.0	15.0	48.5	300.4	398.8	253.8	1,567.0
2003	143.1	40.6	169.6	241.2	47.0	22.2	89.4	5.0	1.6	172.5	141.9	88.3	1,162.4
2004	10.2	0.0	28.2	284.7	83.2	18.0	1.0	0.0	127.8	214.4	157.0	281.8	1,206.3
2005	109.3	0.0	56.5	242.3	89.8	31.9	14.6	0.0	0.0	228.6	319.6	61.8	1,154.4
2006	77.0	38.6	179.0	44.3	17.6	0.0	0.0	0.0	72.9	266.4	326.2	99.0	1,121.0
2007	57.0	32.2	0.0	327.7	19.9	16.9	3.2	0.0	29.1	258.9	138.4	204.9	1,088.2
2008	59.0	13.1	335.2	120.2	0.0	2.8	29.9	50.4	0.0	157.9	135.6	164.5	1,068.6
Mean	75.9	41.4	64.7	176.9	85.9	18.2	22.6	23.0	56.5	207.8	230.6	163.3	1,167.3
Max	253	287	335	396	255	97	139	137	276	399	697	696	1,892
Min	0.0	0.0	0.0	19.8	0.0	0.0	0.0	0.0	0.0	3.6	90.4	5.4	659.1
Stdv	62.2	60.4	68.2	90.5	65.8	26.4	35.8	37.2	61.9	90.6	110.7	123.2	258.9
% Mean	6.5	3.5	5.5	15.2	7.4	1.6	1.9	2.0	4.8	17.8	19.8	14.0	

Rainfall (mm) **Pallegama** **M452** Historic Data

Mahaweli Ganga *60* *Elev (m): 192.0* *Lat: 07-32-28N* *Long: 80-50-01E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	373.4	113.8	63.5	172.0	1.8	0.0	71.9	119.1	16.3	145.8	436.9	856.7	2,371.2
1950	334.8	129.8	291.6	59.7	81.3	0.0	9.7	20.3	24.4	92.7	307.8	257.8	1,609.9
1951	1399.8	117.6	115.1	184.7	72.1	0.0	20.6	69.9	238.0	102.4	525.8	636.3	3,482.3
1952	728.0	375.2	62.2	310.4	125.5	0.0	15.2	0.0	145.0	72.6	358.9	417.6	2,610.6
1953	356.4	254.0	177.8	238.0	0.0	0.0	107.2	0.0	72.6	618.2	438.9	665.2	2,928.3
1954	350.5	248.4	233.9	225.0	29.0	0.0	2.3	58.0	0.0	160.8	270.8	701.3	2,280.0
1955	636.8	387.1	178.1	216.0	47.8	8.0	0.0	50.5	136.4	47.8	114.0	240.8	2,063.3
1956	163.6	122.2	90.7	128.5	50.0	12.0	18.0	14.0	7.0	117.0	588.0	606.0	1,917.0
1957	477.0	627.0	59.9	181.4	119.6	21.6	48.5	1.5	55.6	206.8	726.9	1662.9	4,188.7
1958	395.0	171.2	250.7	228.3	120.4	4.6	0.0	54.6	64.5	101.1	226.3	587.8	2,204.5
1959	312.9	114.3	14.0	136.7	169.4	15.2	26.2	21.6	98.6	287.0	446.0	438.1	2,080.0
1960	507.7	939.3	238.8	71.1	100.1	6.4	90.7	62.0	13.7	210.6	381.3	317.8	2,939.5
1961	494.0	320.5	183.6	232.7	43.9	0.0	0.0	0.0	8.9	347.0	847.3	591.3	3,069.2
1962	411.5	325.4	163.3	325.1	106.9	0.0	0.0	55.6	28.7	176.0	484.1	460.2	2,536.8
1963	848.1	356.6	185.7	289.6	62.2	7.0	69.1	42.0	33.0	117.0	565.9	738.9	3,315.1
1964	462.3	406.4	171.7	151.1	90.2	0.0	161.5	52.8	28.2	33.8	100.3	457.2	2,115.5
1965	282.7	473.2	59.7	221.5	179.3	5.3	0.5	76.2	2.5	181.4	536.7	416.8	2,435.8
1966	449.3	139.4	398.8	252.0	10.2	0.0	0.0	94.0	259.1	381.8	366.0	320.0	2,670.6
1967	278.6	345.7	113.3	91.4	5.6	19.1	4.0	8.0	104.6	479.3	746.8	508.0	2,704.4
1968	370.8	107.4	311.9	93.0	5.8	13.7	0.0	0.0	63.5	303.3	635.8	563.1	2,468.3
1969	280.0	402.3	35.0	191.0	18.0	1.0	1.0	104.0	78.0	344.0	138.0	752.0	2,344.3
1970	657.0	760.0	76.0	258.0	44.0	2.0	7.0	5.0	83.0	153.0	369.0	664.0	3,078.0
1971	735.0	295.0	163.0	145.0	39.0	9.0	7.0	112.0	123.0	157.0	303.0	848.0	2,936.0
1972	214.0	4.0	43.0	112.0	219.0	1.0	4.0	3.0	107.0	440.0	585.0	707.0	2,439.0
1973	56.0	131.0	53.0	78.0	29.0	3.0	39.0	7.0	85.0	148.0	275.0	793.0	1,697.0
1974	6.0	167.0	51.0	192.0	81.0	2.0	17.0	32.0	103.0	41.0	120.0	506.0	1,318.0
1975	234.0	230.0	229.0	160.0	111.0	10.0	72.0	28.0	78.0	25.0	409.0	378.0	1,964.0
1976	605.0	80.0	60.0	125.0	0.0	0.0	4.0	22.0	34.0	138.0	418.0	386.0	1,872.0
1977	77.0	142.0	163.0	119.0	61.0	3.0	30.0	31.0	52.0	455.0	738.0	642.0	2,513.0
1978	256.0	114.0	210.0	40.0	61.0	0.0	36.0	10.0	25.0	358.0	630.0	549.0	2,289.0
1979	315.0	220.0	106.0	107.0	60.0	8.0	15.0	40.0	100.0	185.0	500.0	417.0	2,073.0
1980	69.0	0.0	106.0	199.0	26.0	1.0	1.0	16.0	59.0	206.0	588.0	254.0	1,525.0
1981	390.0	341.0	107.0	146.0	29.0	1.0	34.0	28.0	59.0	158.0	313.0	409.0	2,015.0
1982	75.5	0.0	167.9	145.0	280.7	75.2	7.7	10.3	135.9	682.5	531.6	855.6	2,967.9
1983	259.1	0.0	108.0	65.9	60.4	0.3	0.4	0.0	24.5	130.1	341.5	950.5	1,940.7
1984	545.0	545.3	277.9	104.9	14.1	0.4	8.4	2.2	191.1	146.0	536.5	228.7	2,600.5
1985	595.1	96.7	265.5	140.7	28.2	54.0	0.0	5.4	192.9	139.2	204.9	685.8	2,408.4
1986	832.2	455.2	108.6	135.5	61.9	0.1	4.8	0.7	0.0	163.0	147.0	623.3	2,532.3
1987	389.2	15.2	50.4	163.7	124.1	0.0	0.1	8.0	184.3	988.0	329.2	189.3	2,441.5
1988	106.1	85.7	212.3	451.0	34.7	0.0	244.5	8.5	87.0	146.0	281.1	363.7	2,020.6
1989	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1990	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1991	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1992	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1993	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1994	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1995	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1996	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1997	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1998	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1999	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2000	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2001	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2002	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2003	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2004	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2005	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2006	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2007	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2008	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Mean	408.2	254.0	148.9	172.2	70.1	7.1	29.5	31.8	80.1	234.6	421.6	566.1	2,424.2
Max	1,400	939	399	451	281	75	245	119	259	988	847	1,663	4,189
Min	6.0	0.0	14.0	40.0	0.0	0.0	0.0	0.0	0.0	25.0	100.3	189.3	1,318.0
Stdv	266.3	211.1	89.8	82.7	62.0	14.7	49.6	33.8	65.5	196.2	188.9	264.4	561.9
% Mean	16.8	10.5	6.1	7.1	2.9	0.3	1.2	1.3	3.3	9.7	17.4	23.4	

Rainfall (mm) **Pelwehera** **M473** Historic Data

Kala Oya *93* *Elev (m): 238.0* *Lat: 07.90N* *Long: 80.68E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	226.6	55.9	38.4	154.4	59.7	2.3	19.6	125.0	1.3	246.4	227.8	304.0	1,461.4
1950	78.5	75.2	149.1	71.1	53.1	10.7	20.1	12.2	30.0	62.7	152.7	226.8	942.2
1951	420.4	65.8	93.2	390.7	46.0	25.9	17.5	89.7	201.4	101.1	440.4	175.0	2,067.1
1952	348.2	100.1	46.2	99.8	89.2	2.3	50.5	0.0	72.6	117.9	79.8	157.2	1,163.8
1953	183.6	32.8	84.3	391.7	0.0	0.0	87.9	35.1	92.2	303.8	320.3	278.1	1,809.8
1954	229.9	56.1	172.5	209.6	4.8	0.0	23.9	31.0	21.6	275.1	251.5	574.0	1,850.0
1955	249.9	82.3	116.1	125.0	109.5	8.4	0.0	103.6	176.0	107.7	193.0	102.6	1,374.1
1956	104.1	32.5	35.8	126.7	10.2	64.0	0.0	1.0	0.0	108.7	378.2	242.3	1,103.5
1957	112.0	270.5	0.0	174.0	151.9	11.2	7.1	4.8	94.2	307.8	564.9	1182.1	2,880.5
1958	114.0	57.4	314.5	116.1	42.2	3.6	2.8	19.1	19.8	138.7	224.0	166.4	1,218.6
1959	197.1	15.2	54.6	157.2	55.1	5.6	14.2	3.0	94.7	306.8	326.6	241.0	1,471.1
1960	137.9	288.8	56.4	232.7	66.0	16.8	137.7	0.0	79.8	216.4	351.0	63.5	1,647.0
1961	192.3	148.6	90.9	56.4	108.5	56.4	28.4	11.9	25.7	319.5	224.8	262.1	1,525.5
1962	173.7	57.9	207.3	316.0	165.9	5.6	17.8	31.2	86.6	345.2	308.1	239.0	1,954.3
1963	280.7	168.9	288.5	161.5	94.5	18.5	17.0	8.1	20.6	195.8	395.2	542.5	2,191.8
1964	106.9	168.9	57.4	53.8	20.8	8.9	115.1	30.7	119.9	115.8	203.7	169.7	1,171.6
1965	36.3	207.0	129.8	176.0	233.9	4.8	20.6	118.1	0.0	182.9	442.2	528.8	2,080.4
1966	209.3	31.2	123.2	236.5	1.5	24.9	6.9	10.4	128.3	382.3	366.5	181.9	1,702.9
1967	54.9	90.2	68.1	136.9	78.2	39.6	3.6	6.9	41.9	499.4	257.3	432.8	1,709.8
1968	108.7	25.9	167.1	102.1	25.7	28.7	7.4	0.0	89.7	270.3	208.5	193.0	1,227.1
1969	92.2	47.5	50.0	148.8	10.9	0.0	0.0	84.1	88.6	368.8	125.0	641.6	1,657.5
1970	133.4	206.2	70.4	138.9	75.4	4.1	9.9	24.4	150.6	152.7	321.6	209.8	1,497.4
1971	249.7	69.3	113.3	308.9	8.6	29.7	8.9	128.8	138.2	231.4	83.6	576.3	1,946.7
1972	35.6	29.0	14.0	118.4	167.4	2.5	4.1	0.0	88.9	458.5	468.1	197.9	1,584.4
1973	13.7	63.5	4.8	63.5	31.2	8.4	43.2	26.7	57.9	171.4	228.3	596.1	1,308.7
1974	0.0	92.7	22.6	214.6	115.1	0.0	13.2	0.3	84.6	48.8	174.5	238.0	1,004.4
1975	97.8	67.3	102.6	134.4	104.9	16.5	148.8	6.9	101.3	62.2	244.9	259.6	1,347.2
1976	158.0	7.6	32.0	219.5	0.0	0.0	0.0	15.5	65.3	393.4	339.3	156.2	1,386.8
1977	76.7	68.6	33.8	464.6	106.2	0.0	50.8	11.2	61.7	605.0	196.6	312.4	1,987.6
1978	53.3	0.0	50.5	149.4	65.3	0.0	55.1	10.9	5.8	380.7	471.4	359.9	1,602.3
1979	77.5	71.1	95.5	159.5	42.2	7.6	15.2	76.2	147.1	138.9	401.6	213.4	1,445.8
1980	0.0	0.0	68.1	249.7	169.2	8.1	0.0	0.0	102.4	314.0	374.7	156.2	1,442.4
1981	138.2	33.0	104.6	206.2	12.7	2.5	37.6	58.4	23.6	289.6	152.4	153.7	1,212.5
1982	0.0	0.0	62.8	124.3	153.4	5.4	0.0	8.1	22.4	245.1	156.0	654.2	1,431.7
1983	0.0	0.0	34.3	8.0	63.9	0.5	38.1	0.0	8.5	123.4	92.2	517.2	886.1
1984	345.8	331.2	275.8	215.0	32.0	0.0	18.5	0.0	255.2	218.8	219.3	166.2	2,077.8
1985	179.7	92.7	62.7	87.0	121.3	9.0	0.0	0.0	71.0	107.5	317.1	221.3	1,269.3
1986	221.5	110.1	213.7	129.8	39.6	0.0	0.0	11.5	0.0	390.4	65.5	79.3	1,261.4
1987	96.0	0.0	23.3	148.4	161.1	1.9	0.0	13.5	58.9	409.9	240.5	98.1	1,251.6
1988	11.5	0.0	57.1	657.1	68.3	3.8	33.8	24.7	11.9	141.6	101.4	68.9	1,180.1
1989	157.2	0.0	67.4	193.1	53.5	105.0	154.6	8.0	36.0	262.3	272.3	70.9	1,380.3
1990	221.5	88.9	177.6	104.4	144.1	0.0	4.0	79.5	129.0	396.2	164.7	208.8	1,718.7
1991	244.7	0.0	28.3	27.0	88.6	90.2	0.0	76.9	29.0	-1.0	308.6	291.5	-1.0
1992	33.3	0.0	0.0	440.1	64.8	0.0	46.2	0.0	44.0	83.7	360.6	155.9	1,228.6
1993	15.0	44.1	108.9	71.2	188.9	26.2	79.4	0.0	0.0	348.7	408.0	570.1	1,860.5
1994	461.9	282.0	31.5	136.6	21.2	0.0	0.0	0.0	209.9	553.6	315.8	219.5	2,232.0
1995	144.3	147.9	164.3	185.5	128.0	2.2	0.0	13.3	2.6	124.5	383.7	-1.0	-1.0
1996	101.6	40.1	2.0	239.4	0.0	120.1	0.0	63.4	83.6	274.4	402.8	112.6	1,440.0
1997	17.6	0.0	81.7	184.8	182.2	50.6	14.0	0.0	149.3	461.5	461.5	362.3	1,965.5
1998	178.3	15.3	10.3	122.2	148.1	1.5	61.5	79.3	58.0	96.1	220.7	211.6	1,202.9
1999	242.1	210.4	4.7	74.6	25.2	34.9	0.0	0.0	36.1	120.9	249.3	187.4	1,185.6
2000	184.2	399.1	25.2	-1.0	-1.0	6.2	0.0	125.1	15.5	36.2	382.8	248.8	-1.0
2001	258.2	192.2	68.6	268.0	0.0	48.5	26.6	0.4	56.2	188.8	188.1	255.8	1,551.4
2002	104.8	139.6	91.8	407.6	0.0	0.0	0.0	16.9	5.7	280.3	330.6	376.6	1,753.9
2003	163.4	170.8	27.5	151.9	54.6	7.8	38.0	0.0	90.5	43.1	238.3	93.6	1,079.5
2004	63.6	41.0	115.4	242.8	80.9	16.2	1.2	0.0	70.5	201.6	300.7	282.7	1,416.6
2005	82.2	17.3	72.0	241.7	93.3	0.0	23.3	0.0	2.7	218.8	401.4	105.4	1,258.1
2006	270.5	50.0	154.0	77.5	21.9	14.0	0.0	11.4	54.4	361.0	231.8	157.3	1,403.8
2007	83.6	160.6	0.0	76.4	0.0	13.6	26.8	22.2	35.8	314.4	218.9	415.6	1,367.9
2008	165.2	121.3	257.0	123.8	0.0	0.0	33.0	63.0	0.0	210.8	271.5	227.8	1,473.4
Mean	145.6	90.7	87.9	183.1	72.2	16.3	26.4	28.4	67.5	244.6	280.0	282.9	1,523.7
Max	462	399	315	657	234	120	155	129	255	605	565	1,182	2,881
Min	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	36.2	65.5	63.5	886.1
Stdv	104.1	91.4	75.0	118.0	59.7	25.7	36.8	37.8	58.3	134.5	112.1	196.6	373.8
% Mean	9.6	6.0	5.8	12.0	4.7	1.1	1.7	1.9	4.4	16.1	18.4	18.6	

Rainfall (mm) **Polonnaruwa Agr.** **M487** Historic Data

Mahaweli Ganga *60* *Elev (m): ----* *Lat: 07.92N* *Long: 81.03E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	192.5	106.7	26.4	105.4	17.3	0.0	40.9	29.7	34.3	218.2	275.3	479.3	1,526.0
1950	134.4	150.6	168.9	14.0	61.7	0.0	0.0	82.3	18.0	117.6	171.7	178.6	1,097.8
1951	500.4	108.7	75.4	134.9	13.7	0.0	55.4	41.4	147.8	62.2	384.0	265.2	1,789.1
1952	463.8	127.5	46.5	133.3	97.0	0.0	52.8	0.0	105.4	179.1	185.7	227.1	1,618.2
1953	224.0	89.4	73.2	214.6	0.0	51.1	171.4	36.1	133.1	265.7	244.9	436.9	1,940.4
1954	296.9	97.5	211.6	112.5	0.0	0.0	90.9	64.8	0.0	199.6	184.4	578.1	1,836.3
1955	260.9	105.7	31.0	127.8	44.4	0.0	0.0	134.1	174.2	164.6	102.6	147.3	1,292.6
1956	125.5	63.8	69.7	104.9	0.5	111.0	12.2	55.1	4.3	224.0	311.9	300.7	1,383.6
1957	112.8	315.5	0.0	71.1	127.3	2.3	51.8	18.0	14.7	178.3	612.6	1218.7	2,723.1
1958	192.0	91.2	103.6	81.3	60.2	0.0	0.0	159.8	31.2	212.1	226.8	397.5	1,555.7
1959	268.0	15.2	9.1	96.5	29.2	21.6	0.0	30.0	118.9	371.3	338.6	269.5	1,567.9
1960	274.8	409.2	84.8	306.6	164.3	0.0	140.2	23.9	37.6	101.1	264.7	129.0	1,936.2
1961	422.9	259.8	103.6	115.6	140.7	6.9	0.0	0.0	9.1	144.5	348.7	513.3	2,065.1
1962	207.5	65.5	71.9	95.8	76.2	0.0	4.8	27.2	127.0	168.9	205.5	222.3	1,272.6
1963	488.7	257.3	101.6	216.9	39.4	1.8	47.8	5.1	134.1	186.2	490.5	432.1	2,401.5
1964	162.6	220.7	255.5	79.2	36.6	0.0	103.6	46.5	72.9	87.1	147.1	155.2	1,367.0
1965	105.4	412.2	2.3	181.9	158.7	21.6	0.0	151.9	0.5	241.3	595.4	574.0	2,445.2
1966	241.8	17.5	161.5	239.8	2.5	2.5	5.3	119.6	52.1	421.9	295.7	397.3	1,957.5
1967	65.5	180.1	52.8	87.6	10.9	0.0	0.0	0.8	15.0	259.8	466.6	505.5	1,644.6
1968	134.1	0.0	121.9	98.6	1.3	0.0	0.0	15.5	32.5	189.5	313.9	213.1	1,120.4
1969	111.0	42.2	28.2	271.0	0.0	0.0	96.5	87.4	34.3	269.7	109.2	709.4	1,758.9
1970	179.8	302.8	18.8	196.8	137.7	95.2	0.0	103.4	35.6	219.7	488.7	326.9	2,105.4
1971	176.3	101.6	160.5	168.1	30.2	0.0	148.8	282.7	2.5	200.2	180.1	798.1	2,249.1
1972	40.1	0.0	0.0	138.2	132.3	0.0	11.7	0.5	407.2	617.5	579.4	435.4	2,362.3
1973	20.3	116.8	44.4	36.8	88.9	66.0	348.0	44.7	382.3	183.9	391.4	1256.5	2,980.0
1974	0.0	55.4	33.0	144.8	65.0	0.0	0.0	7.6	151.1	25.4	192.3	236.7	911.3
1975	148.1	174.0	204.0	191.5	112.8	0.0	508.0	96.8	0.0	210.1	285.5	382.0	2,312.8
1976	230.1	15.2	3.8	58.9	0.0	44.7	17.3	78.7	105.4	126.2	606.6	685.8	1,972.7
1977	153.9	49.5	145.0	190.8	121.4	4.8	165.9	83.6	154.7	261.4	670.1	515.9	2,517.0
1978	57.7	70.4	108.5	14.0	8.1	0.0	23.6	0.0	0.0	333.0	383.3	468.4	1,467.0
1979	59.7	132.6	62.2	55.4	13.0	0.0	5.1	75.4	122.2	215.6	433.3	334.5	1,509.0
1980	16.0	0.0	3.2	147.0	47.3	0.0	0.0	0.0	70.3	233.2	252.1	206.5	975.6
1981	147.0	147.7	30.5	57.3	84.4	0.0	93.6	50.2	140.7	216.3	122.7	285.9	1,376.3
1982	0.0	0.0	92.0	67.0	163.0	12.0	10.0	81.4	194.2	140.3	274.8	331.0	1,365.7
1983	27.7	0.0	0.0	14.1	81.6	11.5	2.0	2.5	0.0	253.2	106.8	590.3	1,089.7
1984	607.3	689.9	258.8	241.8	0.0	0.0	14.8	11.6	337.3	93.6	303.5	135.9	2,694.5
1985	230.2	97.3	72.5	63.7	2.4	0.0	43.6	58.8	193.2	83.1	185.4	437.4	1,467.6
1986	312.5	82.5	138.1	45.5	53.4	7.5	44.7	25.0	7.3	348.3	117.2	348.7	1,530.7
1987	93.7	14.6	46.2	97.1	26.8	0.0	0.0	0.0	133.3	356.3	170.8	38.8	977.6
1988	49.8	47.4	79.8	140.8	36.0	0.0	52.6	92.4	171.2	108.9	276.4	239.1	1,294.4
1989	183.9	0.1	39.7	87.1	50.9	26.0	55.5	7.0	162.4	165.6	115.0	71.8	965.0
1990	225.3	80.1	154.0	29.9	102.4	0.0	47.0	118.9	114.2	254.8	122.2	307.6	1,556.4
1991	207.9	9.2	69.1	24.0	87.1	5.3	2.9	26.0	113.5	141.8	196.2	496.6	1,379.6
1992	42.8	0.0	0.0	20.0	53.3	0.0	3.2	2.4	151.7	14.0	608.4	313.5	1,209.3
1993	20.3	-1.0	74.6	26.6	168.2	0.0	31.0	4.4	51.7	-1.0	631.4	640.7	-1.0
1994	333.6	473.2	73.1	43.0	81.2	0.0	0.0	30.6	162.0	-1.0	-1.0	294.7	-1.0
1995	207.9	96.7	10.5	121.8	19.0	0.0	6.5	0.8	248.3	214.9	92.2	129.5	1,148.1
1996	183.7	144.2	0.0	70.1	0.0	52.4	0.0	125.3	-1.0	-1.0	185.7	140.8	-1.0
1997	4.1	0.0	70.0	147.6	66.4	76.0	8.8	0.0	139.3	320.3	429.1	375.6	1,637.2
1998	292.5	12.8	12.9	3.3	78.4	0.0	77.3	251.5	10.1	60.7	131.5	379.6	1,310.6
1999	301.1	204.2	0.0	29.6	0.0	0.0	0.0	0.0	46.8	203.3	268.4	143.9	1,197.3
2000	260.0	232.3	37.3	0.0	27.4	3.5	3.5	49.7	107.4	34.3	451.1	203.1	1,409.6
2001	312.0	157.0	0.0	234.3	0.0	30.4	78.8	0.0	89.8	125.5	154.4	365.5	1,547.7
2002	98.0	187.8	27.3	57.9	66.4	0.0	0.0	100.1	12.2	160.8	531.4	434.9	1,676.8
2003	237.0	220.8	72.4	49.3	31.9	45.7	20.6	45.1	2.5	30.0	497.1	74.1	1,326.5
2004	164.4	35.1	109.0	19.0	-1.0	0.0	2.2	0.0	119.5	348.1	516.6	428.4	-1.0
2005	203.6	17.6	55.7	129.4	99.5	0.0	62.0	104.7	0.0	393.4	204.7	174.8	1,445.4
2006	288.9	106.0	139.3	134.6	97.1	0.0	0.0	17.7	75.7	292.7	310.3	134.9	1,597.2
2007	102.9	97.7	3.7	171.4	0.0	0.0	0.0	7.2	86.9	304.0	140.7	580.4	1,494.9
2008	133.4	133.6	174.8	44.3	23.5	0.0	78.5	140.7	-1.0	262.2	350.4	231.5	-1.0
Mean	189.0	126.1	73.7	106.7	56.6	11.7	47.4	54.3	96.5	207.3	309.0	372.1	1,642.9
Max	607	690	259	307	168	111	508	283	407	618	670	1,257	2,980
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	92.2	38.8	911.3
Stdv	131.4	132.5	65.9	73.2	50.6	24.6	85.4	60.8	92.2	110.9	164.0	236.2	487.3
% Mean	11.5	7.7	4.5	6.5	3.4	0.7	2.9	3.3	5.9	12.6	18.8	22.6	

Rainfall (mm) **Wariyapola Estate (Matale)** **M610** Historic Data

Mahaweli Ganga *60* *Elev (m): 365.0* *Lat: 07.47N* *Long: 80.63E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	194.8	26.2	70.9	195.3	104.1	134.9	308.4	228.6	95.0	153.7	237.5	298.7	2,048.1
1950	135.4	137.7	66.8	77.2	176.3	121.7	156.0	135.4	145.8	136.1	144.5	75.2	1,508.1
1951	509.0	83.6	33.3	276.6	116.1	195.3	168.1	14.7	279.9	460.8	273.3	235.5	2,646.2
1952	261.4	120.4	81.8	262.4	339.1	75.9	18.8	104.6	73.9	274.1	253.7	86.4	1,952.5
1953	48.8	94.0	120.4	308.1	0.0	54.6	261.9	36.3	82.0	400.1	165.6	115.1	1,686.9
1954	227.8	133.9	184.4	161.0	109.7	67.3	131.3	154.7	15.7	316.2	202.9	439.9	2,144.8
1955	233.2	121.9	129.5	329.9	140.7	222.5	69.6	68.8	210.6	147.3	112.8	62.2	1,849.0
1956	44.4	3.6	65.0	173.5	86.1	289.8	38.4	62.2	43.9	241.8	501.9	205.0	1,755.6
1957	206.8	140.5	0.0	249.9	214.9	212.9	129.3	41.7	65.5	295.7	618.2	996.4	3,171.8
1958	131.8	22.6	209.8	313.7	167.1	102.1	40.9	165.1	21.8	115.6	157.2	195.8	1,643.5
1959	198.9	31.2	0.5	227.8	219.2	189.0	308.1	51.8	132.1	385.8	188.5	148.8	2,081.7
1960	233.4	348.2	4.6	194.8	116.1	107.2	187.2	28.7	134.1	313.4	437.1	51.1	2,155.9
1961	91.9	138.2	42.2	194.8	120.6	111.8	119.1	128.3	70.4	204.2	290.3	226.3	1,738.1
1962	118.6	34.5	78.5	266.7	302.3	16.5	123.7	119.9	159.8	474.5	111.5	126.0	1,932.5
1963	262.6	70.1	67.6	227.8	79.0	68.6	97.5	85.3	138.2	202.7	378.2	252.5	1,930.1
1964	201.7	199.1	124.0	90.9	112.5	90.9	165.4	39.1	132.6	221.0	304.3	204.5	1,886.0
1965	74.9	156.5	36.6	268.0	168.1	67.8	33.5	176.3	51.1	334.8	347.2	285.0	1,999.8
1966	57.9	58.9	65.5	158.7	3.3	71.1	28.7	24.6	272.5	234.9	341.9	173.2	1,491.2
1967	108.2	220.0	98.8	142.2	57.1	133.1	72.4	45.2	33.8	332.0	429.0	339.3	2,011.1
1968	75.9	7.1	109.5	115.6	86.1	131.3	196.1	37.3	115.3	387.6	311.7	275.8	1,849.3
1969	100.8	30.7	55.1	237.7	101.9	82.0	17.3	137.2	99.1	381.0	78.7	301.8	1,623.3
1970	98.8	286.0	19.1	293.9	87.1	74.9	71.4	47.0	149.6	321.3	309.6	249.4	2,008.1
1971	158.7	138.9	32.5	380.7	98.6	174.5	68.8	227.6	320.8	130.0	130.3	468.4	2,329.8
1972	23.6	0.0	0.0	179.1	291.1	58.9	140.5	51.3	158.2	547.9	304.8	278.1	2,033.5
1973	0.0	35.3	105.2	118.6	64.3	115.6	95.5	83.8	85.6	137.7	237.0	389.4	1,468.0
1974	0.0	79.2	42.9	414.0	123.4	87.1	194.6	114.8	224.5	152.1	295.1	385.3	2,113.0
1975	109.5	53.3	146.3	179.1	164.3	196.3	182.9	185.7	199.4	221.5	470.4	193.0	2,301.7
1976	184.1	1.3	58.7	205.2	0.0	24.1	83.8	65.0	31.5	302.5	527.3	98.8	1,582.3
1977	0.0	0.0	50.3	178.1	140.2	32.3	16.3	36.1	7.4	471.4	281.7	67.3	1,281.1
1978	18.5	17.0	117.9	26.4	286.0	67.1	119.9	67.8	121.2	268.5	550.4	155.7	1,816.4
1979	23.9	45.5	35.8	110.0	136.1	158.0	82.6	18.8	231.4	182.1	449.1	138.7	1,612.0
1980	4.3	0.0	43.4	232.1	72.9	56.9	71.1	83.1	125.0	162.8	296.9	118.6	1,267.1
1981	120.9	32.3	28.7	120.7	73.2	99.8	213.4	139.2	207.3	150.4	192.3	76.7	1,454.9
1982	2.3	0.0	108.7	117.3	175.5	157.7	112.5	81.8	20.3	279.0	273.5	297.7	1,626.3
1983	26.9	0.0	0.0	4.6	191.3	52.8	69.6	38.9	45.7	218.2	208.8	292.3	1,149.1
1984	186.7	209.6	197.1	229.9	80.5	92.7	131.8	30.5	309.3	66.5	281.2	156.0	1,971.8
1985	45.7	73.2	87.6	72.6	190.0	355.8	55.3	21.3	114.8	235.7	272.8	196.1	1,720.9
1986	489.2	119.1	80.8	248.7	156.7	54.9	46.2	131.8	94.7	263.7	91.4	74.4	1,851.6
1987	70.1	0.0	39.9	176.0	173.2	100.8	0.0	57.9	276.3	360.2	282.7	51.0	1,588.1
1988	0.0	51.1	78.7	339.1	102.9	72.4	133.9	225.8	152.2	91.9	186.9	150.4	1,585.3
1989	234.7	2.0	54.6	127.0	74.9	115.8	215.1	86.1	117.6	245.9	370.9	39.4	1,684.0
1990	237.0	172.7	167.9	116.9	210.6	47.0	56.0	-1.0	109.7	406.3	232.3	232.9	-1.0
1991	199.5	3.8	63.7	140.9	92.3	202.6	86.1	67.3	103.9	245.5	146.7	211.8	1,564.1
1992	66.9	0.0	0.0	249.3	143.3	100.4	109.5	54.2	76.6	182.6	278.1	104.4	1,365.3
1993	52.3	48.3	44.4	113.8	245.8	205.9	131.7	26.8	5.9	408.3	347.4	403.4	2,034.0
1994	173.3	232.4	9.0	151.2	109.3	48.2	42.4	14.5	109.9	285.6	308.0	103.8	1,587.6
1995	185.1	42.9	50.4	321.0	324.5	90.4	36.1	70.8	41.9	424.1	222.9	60.7	1,870.8
1996	81.6	58.1	3.0	165.5	12.2	68.7	71.8	62.0	202.3	222.0	214.8	154.5	1,316.5
1997	0.0	44.0	25.1	246.2	256.4	49.8	60.6	41.2	215.7	257.2	357.2	153.2	1,706.6
1998	114.8	0.0	5.3	23.3	164.1	117.4	185.6	161.4	185.7	189.1	110.1	211.5	1,468.3
1999	413.8	163.2	12.4	163.1	164.8	135.7	37.7	41.6	113.8	226.4	154.6	165.7	1,792.8
2000	125.8	200.6	41.0	134.3	35.3	73.7	12.3	165.7	56.7	103.7	236.1	222.7	1,407.9
2001	297.7	129.3	156.9	306.9	26.2	91.3	137.7	16.7	205.6	200.8	104.9	249.4	1,923.4
2002	34.2	36.2	39.0	482.4	84.1	106.9	40.0	118.8	101.9	342.7	404.8	109.5	1,900.5
2003	220.6	122.7	139.6	270.6	79.7	89.1	138.5	57.9	48.9	124.9	246.9	22.4	1,561.8
2004	41.3	26.2	65.6	207.5	139.5	101.3	68.0	52.6	187.5	182.5	223.2	262.7	1,557.9
2005	64.3	40.4	21.5	252.6	29.3	113.1	110.8	30.8	113.1	296.4	433.2	144.2	1,649.7
2006	346.6	37.3	190.7	226.3	94.8	77.6	39.2	81.5	93.1	367.6	539.0	223.3	2,317.0
2007	138.4	4.2	0.0	343.1	44.0	187.0	61.6	18.0	205.4	203.7	118.3	168.5	1,492.2
2008	197.3	120.9	256.0	190.0	-1.0	0.0	130.9	38.9	55.0	253.0	206.4	75.8	-1.0
Mean	138.4	80.1	71.1	205.5	131.5	110.0	105.6	81.4	126.6	262.4	279.7	204.2	1,794.3
Max	509	348	256	482	339	356	308	229	321	548	618	996	3,172
Min	0.0	0.0	0.0	4.6	0.0	0.0	0.0	14.5	5.9	66.5	78.7	22.4	1,149.1
Stdv	116.3	79.7	60.1	95.1	80.6	65.4	70.4	57.5	78.2	107.7	126.2	147.2	349.5
% Mean	7.7	4.5	4.0	11.5	7.3	6.1	5.9	4.5	7.1	14.6	15.6	11.4	

Rainfall (mm) **Wiharagama Estate** **M628** Historic Data

Mahaweli Ganga *60* *Elev (m): 1067.0* *Lat: 07.50N* *Long: 80.65E*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	216.0	32.0	39.0	175.0	101.0	93.0	231.0	168.0	83.0	160.0	261.0	331.0	1,890.0
1950	154.0	128.0	67.0	80.0	143.0	85.0	117.0	84.0	135.0	121.9	197.1	131.3	1,443.3
1951	621.3	88.1	52.6	222.0	114.0	123.2	139.4	12.2	285.2	452.1	302.0	313.4	2,725.5
1952	313.4	67.8	43.2	126.0	327.7	47.0	12.4	36.1	88.6	291.1	172.5	111.0	1,636.8
1953	117.1	68.1	52.1	278.1	0.0	18.8	237.7	40.6	41.1	439.7	161.5	157.5	1,612.3
1954	263.1	160.0	178.8	212.9	54.6	36.6	93.5	128.0	5.3	298.2	184.4	509.3	2,124.7
1955	274.6	119.6	73.2	234.7	115.6	131.1	37.8	57.7	232.9	116.8	120.4	69.6	1,584.0
1956	65.3	10.7	88.4	146.1	67.6	375.9	24.4	29.7	21.1	208.3	461.3	207.0	1,705.8
1957	198.9	147.8	0.0	79.5	243.3	191.0	99.1	16.8	27.2	408.2	589.8	990.1	2,991.7
1958	145.8	45.0	191.3	260.4	165.9	51.1	31.8	134.9	29.7	343.2	206.5	224.5	1,830.1
1959	56.6	35.3	7.9	192.5	207.5	149.4	221.0	57.7	119.6	306.1	205.5	206.2	1,765.3
1960	210.8	380.5	7.4	236.5	128.8	99.1	219.7	23.1	118.1	254.5	447.0	84.8	2,210.3
1961	126.0	167.1	60.2	142.5	181.4	85.1	115.6	122.9	85.1	157.7	219.7	269.5	1,732.8
1962	170.4	47.2	88.4	291.8	369.6	19.3	47.5	81.3	124.0	379.0	91.2	138.2	1,847.9
1963	249.2	47.0	37.3	128.8	19.8	42.9	81.3	35.6	20.6	89.2	419.1	230.6	1,401.4
1964	215.9	228.1	76.2	89.2	75.2	67.1	187.5	49.3	162.6	185.9	229.6	236.0	1,802.6
1965	92.5	160.0	55.4	315.0	244.6	51.8	53.3	210.3	41.4	455.2	290.8	245.6	2,215.9
1966	72.4	11.2	100.6	190.0	2.5	61.2	33.0	32.3	290.1	286.3	423.2	251.7	1,754.5
1967	136.1	259.1	96.8	141.2	59.7	165.4	94.5	37.0	55.0	388.4	636.5	384.0	2,453.7
1968	0.0	0.0	104.9	37.8	38.9	115.3	228.3	60.2	95.8	407.9	285.2	384.0	1,758.3
1969	166.4	74.7	81.3	227.6	138.9	93.7	6.1	224.3	120.6	469.1	176.5	560.1	2,339.3
1970	286.8	278.4	27.0	288.0	97.0	55.6	71.0	36.0	131.0	279.0	525.8	414.8	2,490.4
1971	268.0	233.9	2.5	390.4	84.1	128.8	41.1	194.1	329.4	181.9	105.4	510.5	2,470.1
1972	27.9	0.0	0.0	167.4	329.7	59.7	81.5	34.0	141.2	498.3	356.1	289.3	1,985.1
1973	0.0	40.9	56.4	158.5	60.5	58.2	97.5	50.3	76.7	151.6	195.8	435.9	1,382.3
1974	0.0	93.5	24.1	316.7	121.2	86.1	127.5	95.0	176.5	208.5	144.3	398.0	1,791.4
1975	73.9	89.7	83.6	123.7	133.9	151.4	156.5	156.5	154.9	203.5	414.5	163.8	1,905.9
1976	157.0	0.0	58.2	189.7	0.0	15.2	75.7	59.2	33.8	276.4	441.7	90.4	1,397.3
1977	0.0	0.0	71.6	173.7	120.4	27.4	13.0	34.5	6.6	416.3	251.2	50.8	1,165.5
1978	12.2	13.5	88.9	21.1	246.4	56.4	105.7	49.5	93.2	210.8	511.0	132.3	1,541.0
1979	14.2	31.8	30.0	87.9	101.4	119.1	59.9	19.8	200.7	149.4	412.8	112.5	1,339.5
1980	0.0	0.0	36.6	175.3	57.9	48.0	55.9	64.3	111.2	139.2	269.0	106.9	1,064.3
1981	101.6	26.2	20.3	79.5	53.6	79.2	147.1	107.2	152.9	114.8	153.7	55.9	1,092.0
1982	1.5	0.0	78.5	110.5	152.4	134.9	95.0	60.5	16.5	251.5	223.5	234.9	1,359.7
1983	18.0	0.0	0.0	2.8	141.2	43.9	49.3	29.7	35.6	161.5	179.1	236.7	897.8
1984	166.1	191.8	158.5	188.7	64.8	66.5	104.9	23.4	263.9	62.3	248.2	130.8	1,669.9
1985	36.8	63.0	66.3	56.6	160.0	330.0	114.5	20.3	116.3	238.7	282.2	200.4	1,685.1
1986	489.5	118.1	86.6	256.3	160.3	57.9	48.5	135.1	97.8	269.8	95.8	76.7	1,892.4
1987	69.6	0.0	40.1	175.0	174.2	103.9	0.0	61.5	281.4	364.5	287.0	55.6	1,612.8
1988	0.0	53.9	78.5	341.9	105.2	70.1	138.2	235.2	155.7	94.2	190.5	156.5	1,619.9
1989	237.7	2.5	60.0	131.8	79.3	122.7	225.8	89.4	122.4	264.1	376.9	41.4	1,754.0
1990	239.0	173.7	173.5	122.7	219.1	50.3	58.0	42.2	114.2	411.1	231.1	257.6	2,092.5
1991	267.5	11.2	50.7	129.0	97.4	184.3	57.0	71.7	33.8	257.9	180.5	248.4	1,589.4
1992	85.1	0.0	0.0	176.3	170.6	77.3	100.6	49.1	96.8	305.9	325.7	135.1	1,522.5
1993	35.9	32.6	95.2	99.9	190.1	205.8	99.5	25.6	2.1	420.0	375.1	500.8	2,082.6
1994	223.0	279.6	35.5	130.4	99.9	43.1	34.7	34.5	184.4	303.5	323.3	147.7	1,839.6
1995	223.7	45.2	68.6	304.8	251.7	98.0	12.9	87.0	28.5	346.9	213.4	108.2	1,788.9
1996	69.5	127.9	3.6	274.5	11.1	49.5	66.7	50.5	170.3	291.6	200.7	26.7	1,342.6
1997	0.0	44.8	33.7	217.7	313.8	20.9	28.3	11.8	190.9	296.8	250.5	196.5	1,605.7
1998	102.7	7.5	50.0	36.8	177.4	54.8	136.6	171.6	138.8	206.0	137.6	231.0	1,450.8
1999	454.9	193.0	95.0	151.4	129.8	158.9	45.9	55.3	128.4	197.6	186.4	205.0	2,001.6
2000	131.7	234.4	82.9	157.8	44.5	96.8	23.4	192.2	149.9	137.0	295.3	193.0	1,738.9
2001	198.5	156.4	105.4	348.2	51.7	119.0	165.5	26.1	262.0	242.1	179.8	277.9	2,132.6
2002	69.7	47.7	69.7	469.3	104.2	134.5	58.8	144.2	40.5	387.2	466.2	182.7	2,174.7
2003	271.5	167.2	176.7	339.3	112.3	78.4	155.0	77.7	69.4	140.7	277.5	39.1	1,904.8
2004	60.6	33.7	80.2	246.5	187.3	133.1	93.3	77.4	222.2	210.9	267.4	311.2	1,923.8
2005	93.7	59.0	32.0	274.5	47.0	133.5	133.3	38.2	129.6	347.5	485.6	198.0	1,971.9
2006	337.5	48.3	202.4	236.6	117.1	85.1	41.5	96.7	112.8	406.5	585.1	260.5	2,530.1
2007	150.5	-1.0	0.0	142.1	38.5	196.8	64.9	23.0	-1.0	-1.0	-1.0	-1.0	-1.0
2008	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Mean	149.9	89.3	66.5	188.2	128.9	99.0	93.2	75.8	119.9	270.1	288.4	231.9	1,804.1
Max	621	381	202	469	370	376	238	235	329	498	637	990	2,992
Min	0.0	0.0	0.0	2.8	0.0	15.2	0.0	11.8	2.1	62.3	91.2	26.7	897.8
Stdv	130.2	89.7	49.3	96.4	85.1	67.6	63.1	57.9	80.6	112.3	133.6	164.0	409.4
% Mean	8.3	4.9	3.7	10.4	7.1	5.5	5.2	4.2	6.6	15.0	16.0	12.9	

Appendix B-2
Inflow Data

Incremental Inflow (mcm) **Bowatenna** Extended Data

Amban Ganga *Catchment Area (km2):* *520.0*

Hydrological Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1968 / 1969	17.9	40.8	69.4	49.2	28.6	15.6	22.4	13.5	10.2	5.1	10.0	8.2	291.0
1969 / 1970	34.2	25.9	65.2	57.0	74.0	16.4	25.5	15.5	7.4	5.4	3.7	5.8	335.9
1970 / 1971	14.1	24.1	50.6	60.6	21.0	14.8	23.2	18.8	12.3	7.3	15.4	26.4	288.5
1971 / 1972	19.9	17.8	117.1	24.5	12.0	2.9	9.2	27.3	7.1	8.9	4.7	3.6	255.0
1972 / 1973	32.9	35.5	76.5	13.1	12.8	6.5	7.8	5.8	4.4	3.7	3.2	2.7	205.0
1973 / 1974	4.5	14.5	62.7	29.3	5.5	4.5	12.8	6.6	6.1	9.0	11.6	17.0	184.0
1974 / 1975	10.9	8.1	34.6	28.4	13.5	15.7	7.6	8.1	9.9	7.9	10.4	9.7	164.7
1975 / 1976	14.6	36.1	39.9	17.6	4.8	21.1	12.8	10.4	6.3	15.7	4.5	5.7	189.5
1976 / 1977	19.2	42.5	40.4	9.7	11.2	8.7	14.8	6.8	6.6	7.2	9.1	3.1	179.1
1977 / 1978	18.8	40.0	56.4	16.4	27.7	14.1	18.2	3.5	10.7	2.4	8.4	3.5	220.1
1978 / 1979	23.7	38.4	27.3	24.6	46.0	14.5	18.0	19.2	9.7	9.8	13.7	20.9	265.8
1979 / 1980	26.4	24.8	14.9	16.1	24.7	15.0	18.1	6.0	8.9	3.8	3.4	4.1	166.1
1980 / 1981	19.5	30.9	64.7	38.9	23.7	15.8	7.8	6.6	1.7	4.4	5.6	9.3	228.9
1981 / 1982	16.3	18.1	33.0	11.0	10.8	9.1	9.0	6.3	7.4	14.1	13.1	6.8	155.1
1982 / 1983	18.7	38.6	82.3	10.2	9.3	10.9	8.6	7.3	6.4	4.0	4.5	2.3	203.2
1983 / 1984	10.4	16.3	46.4	76.5	70.6	36.5	38.0	12.4	9.0	9.5	8.1	17.8	351.5
1984 / 1985	31.4	34.3	39.6	34.2	26.6	31.4	15.4	7.8	8.2	16.9	8.9	4.5	259.3
1985 / 1986	15.5	19.5	44.1	153.6	33.6	20.1	22.5	17.7	11.7	5.6	11.7	5.5	361.2
1986 / 1987	18.5	19.9	36.5	28.1	12.6	10.9	11.9	10.7	12.4	3.8	5.8	5.5	176.5
1987 / 1988	20.1	23.4	27.7	17.4	32.9	13.4	29.5	6.4	5.6	6.3	5.1	6.2	194.1
1988 / 1989	7.1	30.6	48.0	44.8	8.6	6.6	7.8	10.4	5.6	24.4	8.7	11.3	214.1
1989 / 1990	10.5	44.9	34.3	72.0	24.2	31.2	23.6	27.3	22.9	12.6	14.1	9.1	326.7
1990 / 1991	24.7	43.0	67.7	48.8	16.5	6.6	7.2	5.6	5.6	5.4	10.9	7.9	250.0
1991 / 1992	12.6	44.3	45.4	25.9	10.5	8.1	13.2	11.0	9.9	6.7	6.1	6.1	200.0
1992 / 1993	13.8	55.8	31.8	11.5	24.8	21.8	13.6	19.3	6.8	6.8	3.4	2.2	211.5
1993 / 1994	27.0	29.2	67.0	42.6	62.4	24.0	15.0	7.9	4.7	3.6	5.7	4.7	293.8
1994 / 1995	21.7	37.5	79.9	28.3	15.9	14.1	32.8	26.6	13.3	8.2	8.5	5.1	291.8
1995 / 1996	19.6	41.2	26.4	23.7	32.5	18.4	18.8	7.3	10.4	6.9	7.8	12.0	224.9
1996 / 1997	16.9	34.2	19.2	11.7	10.4	10.5	26.5	39.8	16.1	13.6	10.7	13.9	223.3
1997 / 1998	18.0	70.7	74.5	29.6	15.4	15.4	8.2	9.6	9.7	11.8	12.0	15.8	290.7
1998 / 1999	12.3	20.2	33.7	30.6	33.5	27.7	15.7	15.4	5.4	3.7	1.7	2.7	202.6
1999 / 2000	15.3	12.2	32.5	39.8	25.0	15.9	25.7	12.5	9.2	7.4	12.0	9.1	216.5
2000 / 2001	6.3	49.1	50.8	54.5	38.9	26.4	22.9	9.9	10.9	8.0	4.2	7.1	289.0
2001 / 2002	11.5	28.6	35.7	19.0	21.8	25.2	20.7	16.1	4.5	3.5	3.7	3.0	193.2
2002 / 2003	18.3	25.3	51.6	64.0	24.2	22.5	39.6	21.1	11.3	14.2	9.4	7.5	309.1
2003 / 2004	8.1	50.4	22.7	26.0	24.1	22.4	16.5	12.2	9.9	5.8	5.1	9.1	212.3
2004 / 2005	12.6	50.9	61.1	17.9	18.2	21.6	15.3	14.4	4.2	5.4	2.0	3.9	227.4
2005 / 2006	19.0	21.1	31.2	161.6	26.2	25.8	32.4	19.4	10.5	9.4	9.3	6.6	372.7
2006 / 2007	19.0	76.7	49.0	20.7	21.3	12.4	14.2	7.6	8.8	5.1	4.0	7.9	246.9
2007 / 2008	12.6	32.6	48.9	19.4	21.6	41.2	25.7	16.2	3.7	5.8	3.7	3.3	234.4
Mean	17.4	33.7	48.5	37.7	24.4	17.4	18.2	13.2	8.6	8.0	7.6	7.9	242.6
Max	34.2	76.7	117.1	161.6	74.0	41.2	39.6	39.8	22.9	24.4	15.4	26.4	372.7
Min	4.5	8.1	14.9	9.7	4.8	2.9	7.2	3.5	1.7	2.4	1.7	2.2	155.1
Last 10 years Average	13.5	36.7	41.7	45.4	25.5	24.1	22.9	14.5	7.8	6.8	5.5	6.0	250.4
Last 40 years Average	17.4	33.7	48.5	37.7	24.4	17.4	18.2	13.2	8.6	8.0	7.6	7.9	242.6

Incremental Inflow (mcm) **Moragahakanda (Elahera)** Extended Data

Amban Ganga *Catchment Area (km2):* *254.0*

Hydrological Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1968 / 1969	16.9	52.1	95.7	70.6	52.8	13.7	23.8	10.8	7.6	5.4	10.7	9.1	369.2
1969 / 1970	36.3	28.9	94.3	115.1	105.6	27.3	29.0	15.1	6.2	4.8	3.9	5.5	472.0
1970 / 1971	13.9	24.0	81.7	114.6	27.9	24.3	18.2	20.3	9.9	7.0	18.2	23.4	383.4
1971 / 1972	22.0	25.4	158.0	47.1	24.6	8.9	9.1	28.0	5.4	7.6	4.2	3.8	344.1
1972 / 1973	40.6	47.5	121.6	42.3	24.3	9.3	6.9	6.1	3.4	4.2	3.5	4.2	313.9
1973 / 1974	5.7	17.9	87.7	33.8	7.4	6.9	13.7	7.7	5.2	8.3	13.7	18.8	226.8
1974 / 1975	10.6	7.8	50.3	43.5	21.7	24.3	8.5	8.9	10.2	6.9	10.2	9.7	212.6
1975 / 1976	12.8	40.8	66.9	37.8	12.3	23.3	12.0	10.6	5.3	13.1	4.7	8.0	247.6
1976 / 1977	18.0	45.3	66.0	24.0	44.1	17.0	15.4	7.1	7.6	10.2	10.4	6.2	271.3
1977 / 1978	22.3	60.0	143.7	58.8	61.5	22.1	21.3	3.0	9.5	2.8	10.0	3.4	418.4
1978 / 1979	31.7	46.3	52.3	67.7	79.0	30.9	20.2	20.7	9.7	10.3	18.1	19.5	406.4
1979 / 1980	29.2	27.9	30.4	107.2	10.5	17.9	19.5	4.2	6.8	3.1	3.2	3.3	263.2
1980 / 1981	22.7	44.5	91.3	61.1	46.1	28.4	9.0	6.0	1.5	4.2	5.3	8.8	328.9
1981 / 1982	18.0	28.4	46.9	31.9	17.0	15.5	9.7	8.4	5.5	11.4	10.9	6.7	210.3
1982 / 1983	21.0	51.7	155.7	38.9	12.1	15.5	9.3	6.3	6.8	3.3	6.0	4.3	330.9
1983 / 1984	11.8	27.0	85.4	122.8	77.5	61.0	48.9	22.9	11.0	12.8	11.7	15.1	507.9
1984 / 1985	28.5	47.0	52.6	66.5	48.7	47.9	17.8	10.7	14.2	15.2	10.8	4.0	363.9
1985 / 1986	16.8	38.4	85.8	193.1	62.2	31.3	26.4	17.9	13.1	4.8	9.3	5.7	504.8
1986 / 1987	21.2	13.7	59.3	70.6	19.4	17.8	14.3	9.6	12.7	3.1	6.0	7.3	255.0
1987 / 1988	25.8	17.6	41.4	34.3	40.2	24.4	49.1	12.6	5.3	9.5	5.2	9.4	274.8
1988 / 1989	7.9	31.4	53.8	63.0	18.6	17.1	8.4	10.6	4.3	15.3	16.3	12.9	259.6
1989 / 1990	12.6	64.7	61.2	76.8	27.0	32.2	20.6	20.9	19.9	17.3	21.1	14.6	388.9
1990 / 1991	24.6	61.1	102.3	68.7	27.8	15.4	7.3	6.6	4.9	7.1	11.8	7.8	345.4
1991 / 1992	13.4	50.0	80.7	61.5	9.0	8.6	15.1	11.8	10.5	7.5	6.9	10.4	285.4
1992 / 1993	13.2	76.7	64.4	38.0	25.9	25.8	11.4	9.3	6.8	13.4	4.0	3.7	292.6
1993 / 1994	28.8	42.5	127.4	74.4	77.3	27.0	12.9	11.7	6.5	3.2	6.3	4.3	422.3
1994 / 1995	24.8	65.4	108.7	58.2	44.3	29.2	36.9	35.7	13.9	10.4	9.8	6.9	444.2
1995 / 1996	18.9	45.7	42.6	56.0	32.2	20.3	22.9	11.3	13.5	7.6	9.9	14.7	295.6
1996 / 1997	17.0	47.0	38.9	34.9	32.3	20.6	27.3	38.9	18.3	17.0	9.8	13.6	315.6
1997 / 1998	19.0	83.5	111.7	68.9	13.2	17.0	9.3	8.3	9.5	11.7	12.7	20.1	384.9
1998 / 1999	11.9	25.2	58.1	74.9	36.0	27.7	12.6	8.9	5.2	5.3	1.7	3.9	271.4
1999 / 2000	16.9	14.8	62.9	80.3	72.5	26.7	23.8	16.9	7.9	11.6	13.2	11.8	359.3
2000 / 2001	5.8	62.9	73.8	107.8	34.1	22.1	30.1	15.7	12.8	10.0	4.8	10.7	390.6
2001 / 2002	11.7	39.6	73.2	54.6	23.6	31.3	19.0	10.7	4.3	6.3	4.5	4.4	283.2
2002 / 2003	20.7	32.6	99.3	116.7	64.3	37.7	43.8	32.6	10.4	17.8	12.4	10.7	499.0
2003 / 2004	7.4	62.5	42.3	63.0	21.6	25.9	19.5	13.7	9.2	6.3	4.1	12.3	287.8
2004 / 2005	12.8	71.4	113.2	52.4	17.8	22.3	14.9	9.7	4.0	9.2	4.5	5.3	337.5
2005 / 2006	20.5	28.2	54.4	313.1	59.1	40.9	32.6	27.5	8.9	11.4	8.6	9.5	614.7
2006 / 2007	19.1	87.3	80.1	48.6	18.3	14.2	16.0	8.9	8.1	7.5	4.3	11.8	324.2
2007 / 2008	12.8	45.8	92.9	51.5	18.7	51.4	26.9	12.7	4.0	10.0	5.7	4.5	336.9
Mean	18.6	43.3	80.2	73.6	36.7	24.5	19.8	14.0	8.5	8.8	8.7	9.3	346.1
Max	40.6	87.3	158.0	313.1	105.6	61.0	49.1	38.9	19.9	17.8	21.1	23.4	614.7
Min	5.7	7.8	30.4	24.0	7.4	6.9	6.9	3.0	1.5	2.8	1.7	3.3	210.3
Last 10 years Average	14.0	47.0	75.0	96.3	36.6	30.0	23.9	15.7	7.5	9.5	6.4	8.5	370.5
Last 40 years Average	18.6	43.3	80.2	73.6	36.7	24.5	19.8	14.0	8.5	8.8	8.7	9.3	346.1

Incremental Inflow (mcm) **Angamedilla** Extended Data

Amban Ganga *Catchment Area (km2):* *590.0*

Hydrological Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1968 / 1969	15.6	71.4	148.6	168.5	129.5	54.0	25.8	5.5	8.6	12.5	9.9	13.8	663.8
1969 / 1970	21.9	15.0	291.0	73.5	263.0	60.8	71.8	22.2	5.8	13.4	7.4	5.0	850.7
1970 / 1971	16.2	56.8	132.7	169.4	74.6	34.6	25.7	18.6	9.9	11.7	12.5	19.0	581.7
1971 / 1972	40.6	25.0	167.8	99.4	57.6	16.4	20.1	10.6	7.0	12.2	9.8	9.6	476.3
1972 / 1973	13.8	68.1	317.2	74.7	35.0	11.4	11.3	12.5	8.6	15.0	8.8	5.4	581.7
1973 / 1974	2.8	20.2	146.2	149.3	43.9	44.1	21.2	10.1	5.8	10.6	7.1	6.1	467.5
1974 / 1975	9.0	13.7	43.5	59.7	32.2	38.3	15.3	14.2	7.5	10.2	9.4	24.7	277.9
1975 / 1976	12.6	25.4	143.4	96.5	22.2	45.7	21.0	11.9	7.8	7.1	12.7	6.9	413.4
1976 / 1977	24.6	71.5	139.1	58.8	46.1	48.3	37.0	7.7	7.2	6.6	8.2	11.8	466.8
1977 / 1978	14.3	56.7	133.6	128.6	123.8	37.1	37.7	5.1	9.9	9.5	5.8	5.8	567.8
1978 / 1979	21.0	11.3	156.6	194.4	119.3	93.3	35.4	20.0	10.3	6.9	4.9	16.9	690.3
1979 / 1980	13.8	14.5	125.4	230.8	59.6	43.4	41.2	11.8	6.4	8.0	5.2	9.7	569.7
1980 / 1981	33.8	51.0	148.3	123.9	109.3	46.8	5.1	5.4	5.4	12.3	9.8	11.5	562.8
1981 / 1982	14.2	25.3	93.8	62.6	29.4	29.8	15.5	8.8	7.0	7.7	10.1	7.7	311.8
1982 / 1983	13.7	53.1	271.3	88.7	17.4	19.9	12.6	8.3	7.0	13.0	10.5	6.6	522.3
1983 / 1984	11.6	26.3	165.0	220.5	177.0	75.6	67.2	17.0	8.5	7.0	9.7	12.6	797.9
1984 / 1985	20.3	38.4	99.8	163.9	105.7	61.9	29.8	11.4	7.4	7.0	7.9	6.0	559.7
1985 / 1986	10.2	15.0	229.7	228.1	64.5	90.9	61.8	11.4	6.6	9.2	9.3	6.5	743.0
1986 / 1987	9.0	18.1	108.3	142.2	25.3	51.4	13.8	6.3	5.5	13.0	13.8	3.4	409.8
1987 / 1988	9.5	16.8	98.1	222.1	111.4	40.3	68.3	7.2	10.9	13.6	12.4	4.2	614.8
1988 / 1989	11.2	8.4	81.5	73.5	33.4	18.6	8.6	9.3	5.8	6.4	9.9	4.9	271.5
1989 / 1990	5.2	48.0	92.6	211.2	124.6	34.3	33.2	11.4	4.2	7.4	7.9	5.9	585.9
1990 / 1991	7.4	128.5	238.6	182.6	22.2	17.4	11.7	9.1	8.5	21.5	8.2	19.3	674.9
1991 / 1992	8.0	24.6	145.4	79.4	25.5	19.6	18.1	8.8	9.9	6.2	2.8	5.8	354.1
1992 / 1993	11.9	161.4	127.8	66.2	61.8	78.4	59.6	20.0	8.3	10.6	2.6	9.9	618.6
1993 / 1994	26.6	102.6	158.6	206.3	120.2	60.6	16.1	11.1	5.3	11.4	10.9	4.1	733.8
1994 / 1995	13.0	89.7	123.1	103.7	39.4	86.3	47.8	6.4	11.7	9.4	5.4	5.7	541.5
1995 / 1996	8.5	20.8	70.7	71.4	104.2	45.8	32.7	9.9	9.8	6.2	2.8	8.0	390.9
1996 / 1997	11.5	59.1	40.2	28.6	23.1	71.1	38.0	5.9	11.4	7.6	7.3	8.0	311.8
1997 / 1998	7.5	118.2	182.9	76.9	40.2	26.6	13.1	6.2	10.3	5.0	2.8	8.4	498.1
1998 / 1999	11.1	24.2	71.7	176.5	85.5	82.6	75.8	21.0	7.5	12.4	2.3	12.1	582.7
1999 / 2000	21.0	38.6	65.8	139.1	69.9	94.9	49.7	7.4	13.0	10.1	5.6	6.6	521.6
2000 / 2001	6.2	67.7	111.3	180.4	121.5	43.4	40.5	9.6	10.5	6.0	2.4	6.4	605.8
2001 / 2002	10.3	55.4	90.6	99.7	56.5	84.4	106.9	25.5	7.2	13.8	2.2	13.2	565.7
2002 / 2003	28.9	61.9	98.2	152.6	67.7	99.6	74.3	7.9	13.1	7.4	3.8	6.2	621.5
2003 / 2004	6.2	54.2	62.2	75.4	74.0	42.4	28.6	7.9	11.1	6.5	2.6	7.0	378.3
2004 / 2005	9.8	144.3	114.6	103.9	39.0	72.2	67.7	22.3	7.0	11.8	1.0	14.7	608.4
2005 / 2006	25.3	65.7	40.3	190.0	63.9	103.8	58.2	7.0	14.0	8.2	4.6	6.2	587.2
2006 / 2007	7.8	94.0	123.4	85.4	61.7	31.3	27.4	8.5	11.4	7.2	1.7	6.7	466.4
2007 / 2008	9.4	70.6	98.2	145.7	49.4	86.4	113.4	28.6	6.9	11.1	1.7	14.4	635.7
Mean	14.4	53.3	132.4	130.1	73.3	53.6	39.0	11.7	8.5	9.8	6.8	9.2	542.1
Max	40.6	161.4	317.2	230.8	263.0	103.8	113.4	28.6	14.0	21.5	13.8	24.7	850.7
Min	2.8	8.4	40.2	28.6	17.4	11.4	5.1	5.1	4.2	5.0	1.0	3.4	271.5
Last 10 years Average	13.6	67.6	87.6	134.9	68.9	74.1	64.2	14.6	10.2	9.4	2.8	9.4	557.3
Last 40 years Average	14.4	53.3	132.4	130.1	73.3	53.6	39.0	11.7	8.5	9.8	6.8	9.2	542.1

APPENDIX C

REVIEW OF DESIGN OF FACILITIES OF THE PROJECT

PREPARATORY SURVEY

ON

MORAGAHAKANDA DEVELOPMENT PROJECT

FINAL REPORT

APPENDIX C REVIEW OF DESIGN OF FACILITIES OF THE PROJECT

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APPENDIX C-1 REQUIRED DAM CREST LEVEL

1) Criteria

The dam crest level is required to meet the following requirements referring to the Japanese dam design criteria:

Case 1 (normal operation with earthquake): CL = Hn + hw + he + 0.5 (+1.0)

Case 2 (design flood time): CL = Hf + hw + 0.5 (+1.0)

Where, CL = Dam crest level or top of clay core in case of fill dam (m asl)

Hn = Full supply level in reservoir (m asl)

Hf = Design flood level in reservoir (m asl)

hw = Wave run-up in wind storm (m)

he = Height of water surface wave caused by earthquake (m)

0.5 = Additional safety margin (m)

(+1.0) = Further additional safety margin (m) for embankment dam

2) Wave run-up (hw)

$$h = 0.00077V\sqrt{F}$$

where, h: Wave height above static water surface (m)

V: 10 minutes wind velocity (m/s)

Referring to the FS 2001, V=53.4 km/h = 14.8 m/s, say 20 m/s

F: Wind travel distance (m) over reservoir

F = 5.6 km (at main dam and saddle-1 dam)

6.0 km (at saddle-2 dam)

h = 1.15 m (at main dam and saddle-1 dam)

1.19 m (at saddle-2)

Wave run-up: Concrete dam 1.15 * 100% = 1.15 m

Riprap-faced slope 0.95 m (saddle-1), 0.85 m (saddle-2)

3) Water surface wave caused by earthquake (he)

$$he = 0.5Kt\frac{\sqrt{gH}}{\pi}$$

where, K: Seismic coefficient (=0.1)

t: Seismic vibration cycle time (= 1 sec)

H: Reservoir water depth (= 185-135 = 50 m)

he = 0.35 m

4) Dam crest level to satisfy the criteria

The dam crest level to meet the criteria is calculated below.

		Normal operation	Max. flood time
(a)	Reservoir water level (m asl)	185.00	185.60
(b)	Concrete dam		
	• Storm wind run-up (m)	1.15	1.15
	• Earthquake wave (m)	0.35	=
	• Additional safety margin (m)	0.50	0.50
	(b1) Total	2.00	1.65
	Required dam crest level: (a)+(b1)	187.00	187.25
	Adopted dam crest level (m asl)	==	**187.50**
(c)	Rockfill dam		
	• Storm wind run-up (m)	0.95	0.95
	• Earthquake wave (m)	0.35	=
	• Additional safety margin (m)	1.50	1.50
	(c1) Total	2.80	2.45
	Required level of core top: (a)+(c1)	187.80	188.05
	Protective layer on core (m)	0.45	0.45
	Adopted dam crest level (m asl)	==	**188.50**

APPENDIX C-2 RESERVOIR SEDIMENTATION

1. SEDIMENT INFLOW DATA

1.1 Introduction

When the river is in spate during the wet months it carries a heavy bed load of sediments into the reservoir. Boulders, coarse and fine fractions of sediments are brought to the reservoir, due to the high tractive forces of the river flow, causing the formation of a graded deltaic bed at the head end of the reservoir. The delta so formed is unstable, as the increase of the sediment load and the variation of the water level in the reservoir, thus the fore-set slope of the delta tends to erode and slide progressively into the deeper reaches of the reservoir. The finer fractions of sediment settle at the deeper section of the reservoir where the water is more tranquil, while boulders and coarse sediments settle pivot point and top-set of the delta near the head of the reservoir.

A small percentage of sediments are evacuated from the reservoir through the spill at times of spillage and through the other outlets such as power intake, bottom outlet etc. when water is released. It is mainly the finer fractions that escape through those outlets.

A bottom outlet has been provided at the present river bed level across the dam to de-silt the area in the vicinity of the dam and for reducing the water level in the reservoir if so required. A certain percentage of the coarse sediments together with the fine sediments would be evacuated through the bottom outlet. However, this is only a very small fraction when compared to the sediments brought into the reservoir and is ignored in the determination of the life span of the reservoir.

The useful life of a reservoir decreases due to sedimentation, causing a reduction in its storage capacity. This unavoidably happens from the very beginning of the project operation at the head of the reservoir where the delta formation starts due to sudden reduction in the velocity of flow. The rate at which the capacity of a reservoir is reduced by sedimentation is dependent on sediment load, reservoir trap efficiency and density of the deposited sediments.

1.2. Reservoir Sedimentation Studies in Sri Lanka

In Sri Lanka, erosion processes taking place in the river basins and sediment transport in the river systems have not been studied in sufficient detail to obtain direct and reliable estimates for these processes, perhaps due to the general geological conditions of the country which do not show obvious signs of erosion and deposition compared with countries where soils are of volcanic or sedimentary origin.

Over the past three decades, a number of major river development works consisting of either large reservoir or diversion weirs have been undertaken in the country. A review of documentation of these projects shows that the estimation of erosion rates and sediment yields have been a problem to the planners of each project. In all these projects, estimates of sediment yields have been made based on

judgment using limited available information rather than on the basis of measured sediment transport in rivers and / or sediment accumulation in rivers. Some of these study documents are presented below.

A. Sedimentation Studies - Upper Kotmale Reservoir

(Report on Detailed Design of Main Dam, 1994-95)

A report by MDB/NEDECO (Mahaweli Ganga Development Program, Implementation Strategy Study, September 1979) stated that sediment discharge measurements had been carried out a Peradeniya (5km upstream of Kandy) and the resulting total sediment yield amounted to about 330 m^3/km^2/year.

After the above report, Sir William Halcrow and Partners, and Kennedy and Donkin conducted an intensive geomorphological survey for the Kotmale Project under the Mahaweli authority and prepared a report "Geomorphological Survey Volume II - Sedimentation" by Dr. J. R. Russel in April 1980. Dr. Russel's report concludes that suspended sediment yield at Kotmale dam site is 180 m^3/km^2/year and that bed load is 8% of suspended sediment, as a result of review of previous studies and estimation by the Fournier equation and soil infiltration analysis.

The Russel's report provided clarification of suspended sediment yield for each area of 26 sub-catchments in the Kotmale basin showing Fournier values contoured at m^3/km^2/annum. From this Fournier value, Talawakelle dam basin's suspended sediment yields are estimated at approx. 200 m^3/km^2/annum while average of the whole Kotmale basin is estimated at 317 m^3/km^2/year by the Fournier value method.

Subsequently, Dr. Russel carried out analysis of sediment load in the Kotmale basin by using soil infiltration / runoff factors. He concluded that sediment yield for the Kotmale basin is 130 m^3/km^2/year.

According to the above two methods of analysis, it was concluded that the sediment load for the Kotmale Project was 180 m^3/km^2/year.

As the result of examination of previous studies and the above Dr. Russel's study, the figure of 180 m^3/km^2/year was adopted for sediment yield for Upper Kotmale pond, and the bed load for the Upper Kotmale scheme is assumed at 10% of suspended load considering the safe side, while under the Kotmale Project this was assumed at 8% of the same.

The adopted 180 m^3/km^2/year is confirmed in its soundness or safety by sediment load measurement conducted by the Irrigation Department under the Engineering Services in year1994.

B. Reservoir Sedimentation in Sri Lanka (RESCON Report)

(Reservoir Conservation, Volume I, The RESCON Approach, Country Report, World Bank, 2003)

Reduced reservoir storage capacities caused by sedimentation result in less reliable water and

power supply. This is particularly true of the reservoirs in the upper Mahaweli basin, which make significant contributions to the economy of the country. These reservoirs also play an important role in managing floods. Management of sediment in existing reservoirs can potentially lead to more economical solutions that may also result in sustainable use of both the water resources and the water resource infrastructure of the country.

The Mahaweli river cascade consists of several major dams that were constructed between 1976 and 1991. These include: Kotmale, Polgolla, Victoria, Randenigala, Rantambe and a weir on the main Mahaweli River. These facilities provide approximately 45 percent of the country's power requirements. A post evaluation study of the Victoria Project that was carried out in 1987 showed that 110 to 940 tons of sediment per square kilometer of river basin flows in Mahaweli River annually. Results of a hydrographic survey carried out in 1993 indicated that more than 4 MCM of storage had been lost since the project was commissioned in 1985.

In August 2002, several hydrographic surveys were undertaken by RESCON team in two regulating reservoirs; Polgolla and Rantambe to assess the amount of silt accumulation. Results indicated that 45 percent and 32 percent of reservoir storage have been lost respectively due to sediment deposition in these reservoirs. The studies also revealed that Polgolla Reservoir has reached a regime condition. At present silt inflows into this reservoir spill to Victoria Reservoir, located downstream and it was also found that a certain amount of suspended silt passed through the power tunnel and turbines. Removal of deposited silt in the reservoir has not been done due to estimated high cost. Sediment inflow data presented in the RESCON report are shown in Table C2.1.

Table C2.1 Sedimentation in Major Reservoirs on Mahaweli Ganga

Parameter	Units	Ramtambe	Polgolla	Randenigala	Kotmale	Victoria
Commissioning year	-	1991	1976	1985	1985	1986
Initial storage capacity *	MCM	10.759	4.681	835	176.8	722.0
Existing storage capacity *	MCM	6.687	2.558	768.8	170.1	713.1
Storage capacity loss	%	37.8	45.4	7.9	3.8	1.2
Average annual inflow of sediment (weight) *	10^3 ton	1,383	878	5,405	522	728
(volume)	MCM	1.152	0.732	4.504	0.435	0.606
Catchment area	km^2	3,118	1,292	2,330	544	1,891
Sediment yield	$m^3/km^2/y$	369	567	1,933	800	321

Notes: Sediment type 650, fine grained sediments, density = 1.2 t/m^3 (RESCON Report)

*: Presented in RESCON Report 2003

A hydraulic flushing exercise was carried out on the Rantambe Reservoir, with the intent of flushing out the deposited sediment during high floods. It was observed that 10-15 percent of

deposited silt was removed.

C. Erosion and Sedimentation - Moragahakanda Reservoir

(Feasibility Study of Moragahakanda Development Project, Lahmeyer International, 2001)

Sediment transport measurements have been undertaken in the past by the Department of Irrigation at several river gauging stations located around the island. Sometimes, these measurements have been inadequate to arrive at reasonable estimate and due to this reason special sediments measurements campaigns had been undertaken for the design of some river development projects. However, these measurements campaigns were undertaken only for short durations of about one year. Since no such sediment measurements have been undertaken during this study, estimates of sediment yields for the project will be made essentially based on the results of previous studies.

The most comprehensive and detailed study was the measurement programme undertaken by NEDECO and the Department of Irrigation during a 4-month period in 1983 and applied to the reviewed flow data of the Elahera station from 1950-82. The study yielded a total sediment yield of 156 m^3/km^2/year. Other studies have also given values ranging from 100 to 250 m^3/km^2/year, which indicates the possible range of data.

However, it shall be noted that the former study used a very high value of sediment density of 2.67 t/m^3. The weight/volume figures of sediment (t/m3) used in other studies varies widely with possible values ranging between 1.36 and 1.98. If a more realistic value of 1.3 t/m^3 was used this would give a sediment yield value of 320 m^3/km^2/year at Peradeniya.

The FAO/UNDP/ID (1968) study established a sedimentation rate of 335 m^3/km^2/year. For the design of Bowatenna reservoir, the study (MDB, 1972) elaborated a sediment flow diagram which took into consideration not only the sediment yield of the Bowatenna catchment of 511 km^2 drainage area but also the sediment brought in from Mahaweli basin via the transbasin diversion from Polgolla. The total sediment yield, expressed as a ratio based on the self catchment, was 482 m^3/km^2/year.

The feasibility study of Kalu Ganga Development Project (CECB, 1992) used a sediment yield of 240 m^3/km^2/year based on the recommendations of the Department of Irrigation and the WMS.

Although many of the large and small reservoirs constructed during the last few decades have now been in operation for about decade, only limited data on actual sediment deposition in these reservoirs is available.

One such sediment deposition measurement has been made in the Victoria reservoir in 1993. The measurements, which had certain limitations in the methodologies adopted, indicated a sediment yield rate of 480 m^3/km^2/year, which compared well with the estimated rate of 490 m^3/km^2/year at the design stage. A density of 1 t/m^3 was assumed in the above study.

Another sediment measurement carried out after 10 months of commissioning of Rantembe

regulation pond has shown that it has lost nearly 14% of its original volume.

Compared with an estimated forest cover of 70% of the country in 1900, the existing forest cover has reduced to about 17%. The statistics available shows that this trend is still continuing. The loss of forest cover in certain districts is more pronounced.

Considering the above factors it was noted that the figure of 240 m^3/km^2/year adopted for Samanalawewa and Kalu Ganga studies would be insufficient in the case of Moragahakanda catchment, which receives water from Mahaweli Ganga basin as well. Based on the measurements made at Peradeniya of 320 m^3/km^2/year, the UNDP/FAO/ID (1968) estimate of 335 m^3/km^2/year, the rate estimated for the Victoria reservoir of 370 m^3/km^2/year and considering the loss rates of forest cover in Matale district where the catchment is located, a sediment yield of 340 m^3/km^2/year is recommended for the Moragahakanda reservoir. Expressed in weight this is equivalent to a rate of 442 t/km^2/year.

D. An Abstract of Available Sediment Data on Various Rivers in Sri Lanka

(Feasibility Study of Kalu Ganga Development Project, CECB, 1992)

Results of various sediment studies undertaken before 1992 are given in the report (see Table C2.2 below).

Table C2.2 Sediment Inflows Estimated in Various Projects in Sri Lanka

	River basins	Catchment area (km^2)	Sediment (m^3/km^2/year)	Source
(1)	**Mahaweli Ganga** 6005 Gurudeniya	1,418	112 112 329	FAO study 1968 Bowatenna study 1972 MDB/NEDECO study 1979
	6004 Peradeniya	1,167	156	ID/NEDOCO Field report. 1984
	6008 Elahara	774	49 100 95	Bowatenna study 1972 MDB/NEDOCO 1979 Moragahakanda project 1979
	6012 Kandakanduthurai		185 91	Three basins study 1968 Bowatenna study 1972
(2)	**Kalani Ganga** 0103 Matiyadola		238 145	Three basins study 1968 Bowatenna study
(3)	**Walawe Ganga** 1801 Embilipitiya		714 132	Three basins study 1968 Bowatenna study 1972
	1806 Samanalawewa		243 238	ID Field report 1972 ID Field report 1986
(4)	**Kirindi Oya** 2201 Lunugamwehera		190 65 180	Three basins study 1968 Bowatenna study 1972 ID Field report 1986

Design sediment inflows applied for major dam projects in Sri Lanka are shown in Table C2.3.

Table C2.3 Design Sediment Inflows for Past Projects

No.	Reservoir	Sediment yield used for study/design stage ($m^3/km^2/year$)
1	Bowatenna	335
2	Victoria	490
3	Kotmale	180
4	Samanalawewa	240
5	Upper Kotmale	180
6	Kalu Ganga	240

1.3. Sediment Inflow into Moragahakanda Reservoir

According to the previous sediment flow studies conducted for Sri Lankan rivers, it is highly reasonable to adopt a sediment yield of 340 $m^3/km^2/year$ as mentioned in the 2001 FS report (*Lahmeyer International*), for the proposed Moragahakanda reservoir.

The total catchment covered by the Moragahakanda dam is 768 km^2. Since the Bowatenna reservoir is located within the Moragahakanda catchment, the catchment area below the Bowatenna reservoir is 254 km^2. The total sediment yield from this sub-catchment below Bowatenna is directly coming into the Moragahakanda reservoir with the inflow of 10.9 m^3/s. Apart from that, any water release through Bowatenna dam into the Moragahakanda reservoir (through outlets, spillways etc) also contain sediments. These sediments can be considered as suspended sediments. According to the previous studies, the suspended sediment portion can be considered as 90% of total sediment yield. It is assumed that the balance 10% of sediments as bed load will be retained in Bowatenna reservoir and all suspended particles will enter into Moragahakanda reservoir via outlets. So, the both of these sediment inflows into Moragahakanda reservoir are considered for sediment quantification.

For the calculation of suspended sediments coming from Bowatenna reservoir, same sediment yield of 340 $m^3/km^2/year$ is used. The catchment covered above Bowatenna dam is 514 km^2. The summary of data is given in following Table C2.4.

Table C2.4 Estimate of Sediment Inflow into Moragahakanda Reservoir

Catchment		Inflow		Annual Sediment Inflow	
	km^2	MCM	m^3/s	$m^3/km^2/year$	$m^3/year$
Below Bowatenna	254	344	10.9	340	86,360
Above Bowatenna	514	653	20.7	306 (90%)	157,284
Total	768	997	31.6		243,644

2. SEDIMENT DEPOSITION IN RESERVOIR

2.1 General

Empirical methods are available to evaluate sedimentation quantity and its distribution pattern within reservoir. They were mainly produced by the use of observations and field data collected at a large number of reservoirs all over the world several decades ago. Reliable and accurate field data are

required in order to establish the potential loss of reservoir capacity due to sedimentation over the design life.

2.2 Reservoir Sedimentation Estimate by Trap Efficiency

The percentage of the inflowing sediment which is retained in a reservoir is called the trap efficiency, and it is a function of the ratio of reservoir capacity to total annual sediment inflow. A large reservoir has more detention time for the suspended silt to settle, and the trap efficiency is high. The relation between trap efficiency and capacity-inflow ratios have been derived by Brune (1953). The trap efficiency will keep on reducing with time as the capacity-inflow ratio reduces.

According to the trap efficiency method, the amount of sediment deposited in the Moragakanda reservoir in 100 years of design life is 23.26 MCM (see Table C2.5). This quantity corresponds only to 4.1% of the original capacity of the reservoir before sedimentation. Further, as indicated in Table C2.5, average 95.4% of incoming sediments are retained (trapped) in the reservoir during 100 years of time.

Long-term average inflow	=	31.6 m^3/s
Annual river flow	=	997,000,000 m^3
Annual sediment volume	=	243,644 m^3 (see Table C2.4)
Original capacity of reservoir	=	561,400,00 m^3 (see Fig. 4.4.1 in main report)

Table C2.5 Sedimentation Volume in Reservoir in 100 Years

Time	Reservoir Capacity (C)	Annual Inflow (I)	C/I	Trap Efficiency (E)	Sediment Deposit	Cumu. Sediment Deposit
Year	m3	m3		%	m3	m3
0 - 5	561,400,000	997,000,000	0.572	95.50	1,163,346	1,163,346
5- 10	560,236,654	997,000,000	0.570	95.49	1,163,265	2,326,611
10- 15	559,073,389	997,000,000	0.569	95.48	1,163,185	3,489,796
15- 20	557,910,204	997,000,000	0.568	95.48	1,163,104	4,652,900
20 - 25	556,747,100	997,000,000	0.567	95.47	1,163,023	5,815,923
25 - 30	555,584,077	997,000,000	0.566	95.46	1,162,941	6,978,864
30 - 35	554,421,136	997,000,000	0.565	95.46	1,162,860	8,141,724
35 - 40	553,258,276	997,000,000	0.563	95.45	1,162,778	9,304,502
40 - 45	552,095,498	997,000,000	0.562	95.44	1,162,696	10,467,197
45 - 50	550,932,803	997,000,000	0.561	95.44	1,162,613	11,629,810
50 - 55	549,770,190	997,000,000	0.560	95.43	1,162,530	12,792,340
55 - 60	548,607,660	997,000,000	0.559	95.42	1,162,447	13,954,788
60 - 65	547,445,212	997,000,000	0.558	95.41	1,162,364	15,117,151
65 - 70	546,282,849	997,000,000	0.556	95.41	1,162,280	16,279,431
70 - 75	545,120,569	997,000,000	0.555	95.40	1,162,196	17,441,627
75 - 80	543,958,373	997,000,000	0.554	95.39	1,162,112	18,603,739
80 - 85	542,796,261	997,000,000	0.553	95.39	1,162,027	19,765,766
85 - 90	541,634,234	997,000,000	0.552	95.38	1,161,942	20,927,708
90 - 95	540,472,292	997,000,000	0.551	95.37	1,161,857	22,089,566
95 - 100	539,310,434	997,000,000	0.549	95.37	1,161,772	23,251,337

Trap Efficiency $E = 100 \times 0.97^{0.19 \log(C/I)}$

Cumulative sediment deposition at the end of 100 yrs	=	23.25 MCM
Capacity loss at the end of 100 years	=	4.1 %

2.3 Sediment Distribution in Reservoir

Sediment distribution in reservoirs can be estimated applying the area-increment method (AIM) or the empirical area reduction method (EARM), both developed by US Bureau of Reclamation. AIM assumes that the total incoming sediment in a certain period of time get deposited in two portions, the first is reservoir bottom below the new zero elevation and the second is uniformly distributed over the height above the new zero elevation with constant sediment area A_o (see Fig. C2.1). To find the new zero elevation, trial and error method is used.

By estimating only the sediment load likely to deposit in the reservoir is not enough since it is interested to know the elevations of the accumulated sediment in important locations such as intakes, outlets, penstock gates etc. New zero elevation is an important factor to determine the sill level of an intake in the design stage of a reservoir project in terms of sedimentation. New zero elevation is defined as the elevation up to which the sediment is assumed to completely fill the reservoir at dam.

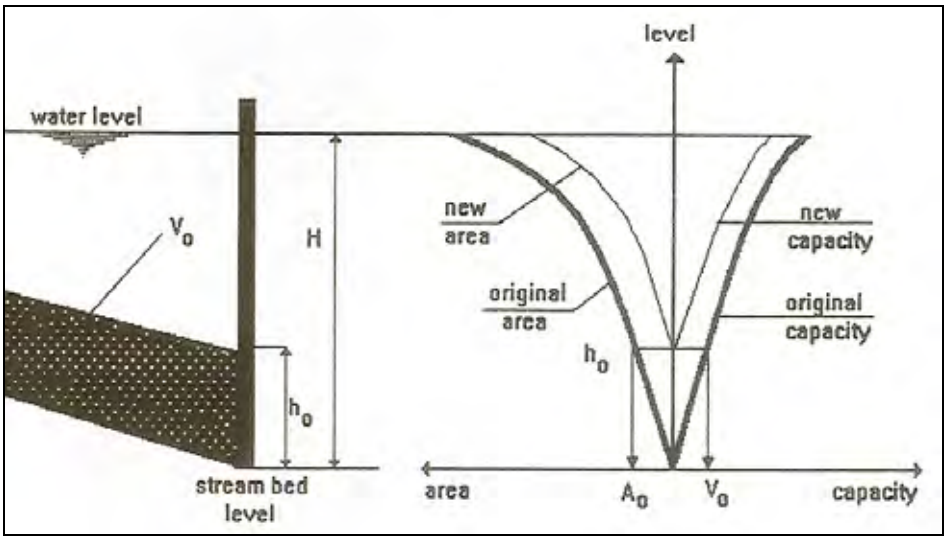


Fig. C2.1 Illustration for New Zero Elevation due to Sedimentation

In this study, the new zero elevation of Moragahakanda reservoir after 100 years of sedimentation was calculated by using AIM. Final result of trail and error calculations is shown below.

- Equation for sediment volume to be distributed: Vs = Ao(H-ho)+Vo

  where: Vs = Sediment volume in 100 years = 23.25 MCM (see Table C2.5)

  Ao = Storage area at new zero elevation

  H = Maximum reservoir depth (= 185 - 137 = 48 m)

  ho = Thickness of sediment deposit at upstream face of dam after 100 years (assume for trial and error calculations). Top elevation of this deposit is regarded as new zero elevation.

  Vo = Storage volume (or sediment volume) below new zero elevation.

- Storage area and volume curves refer to Fig. 4.4.1 in main report.

- Calculated result of new zero elevation is as follows:

  When ho = 3.9 m, value of Vs approximates 23.25 MCM. Therefore, new zero elevation is decided to be EL.140.9 m (=137.0 + 3.9). Storage volume (Vo) below El. 140.9 m is 0.87 MCM.

  It is assumed that sedimentation near the dam completely fills up to the new zero elevation of 140.9 m.

Sediment distribution in the reservoir in 100 years is calculated applying the empirical area reduction method (see Table C2.6). Storage volume curves before sedimentation and after 100 years sedimentation are illustrated in Fig. C2.2.

Table C2.6 Sediment Deposit Distribution in Reservoir after 100

1	2	3	3'	4	5	6	7	8	9	10
Elevation m asl	Original Area km^2	Original Capacity MCM	Depth m	Relative depth (p)	Relative sediment area (a)	Sediment area km^2	Sediment volume MCM	Accum. sediment volume MCM	Revised storage area km^2	Modified reservoir capacity MCM
185	29.121	561.40	48	1.000	0.000	0.000	1.14	23.26	29.12	538.14
180	24.500	425.10	43	0.896	0.924	0.457	2.56	22.11	24.04	402.99
175	20.238	311.01	38	0.792	1.144	0.566	2.96	19.55	19.67	291.46
170	16.335	217.55	33	0.688	1.247	0.617	3.12	16.59	15.72	200.96
165	12.790	143.59	28	0.583	1.278	0.632	3.13	13.47	12.16	130.12
160	9.060	88.07	23	0.479	1.251	0.619	3.00	10.34	8.44	77.73
155	6.486	48.50	18	0.375	1.173	0.580	2.74	7.34	5.91	41.16
150	4.150	22.02	13	0.271	1.038	0.514	2.31	4.61	3.64	17.41
145	2.051	6.62	8	0.167	0.831	0.411	1.43	2.29	1.64	4.33
140.9	0.507	0.87	3.9	0.081	0.574	0.284		0.87	0.22	0.00

Notes: Column 4 = Column 3' divided by (max. depth 48m)
Relative sediment area (a) refers to sediment distribution type II indicated in USBR Design of Small Dams (1987).
$a = 2.487\ p^{0.57}\ (1-p)^{0.41}$
Column 6 = 5 * K
K = 0.495 (obtained by trial and error to reach accumulated sediment of 23.25 MCM in Column 8)
Column 7 = Average sediment area multiplied by elevation difference
Column 9 = Column 2 - Column 6
Column 10 = Column 3 - Column 8

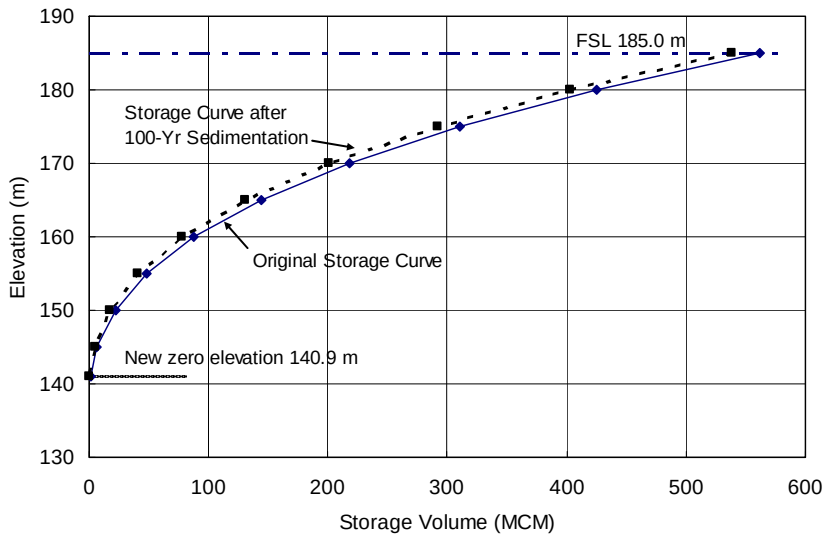


Fig. C2.2 Reservoir Storage Volume Curves Before and After Sedimentation

2.4 Conclusion on Reservoir Sedimentation

Total sedimentation in the Moragahakanda reservoir after 100 years of operation is estimated to be 23.25 MCM which corresponds only to 4.1 % of the initial reservoir capacity. Therefore, the sediment deposit in the reservoir will have minimal effect on the live storage capacity or the life of the reservoir. In all practical purposes, the effect of sedimentation in the reservoir can be ignored.

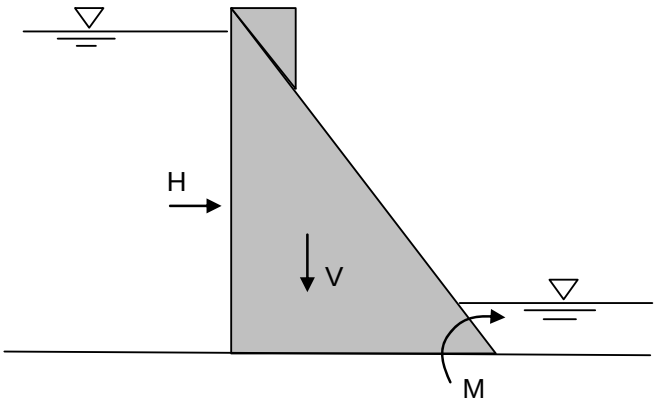
APPENDIX C-3 STABILITY OF CONCRETE GRAVITY DAM IN SADDLE-1

1) Criteria

The concrete gravity dam is designed to meet the following requirements in the Japanese dam safety criteria for concrete dams:

- Tensile stress should not occur at upstream face of dam body and dam base.
- The dam should be sufficiently safe against shear friction loads at dam base (or at weak plane in foundation). The safety can be checked by Henny's equation. The factor of safety should be 4 or more.
- Stress in dam body should not exceed the allowable stress of concrete used.

Pseudo-static method is applied to analyze safety.



2) Loads

Combination of the following external loads are considered:

Loads	Case-1 Normal operation with earthquake	Case-2 Flood time (10,000-yr flood)	Case-3 Under construction (no reservoir water)
Reservoir water level (m asl) Tail water level (m asl)	185.0 138.0	185.6 145.2	= =
Dead load	O	O	O
Weight of water and sediment on dam body	O	O	
Uplift water pressure at base	O	O	
Static water pressure (u/s and d/s)	O	O	
Static sediment pressure	O		
Seismic loads (inertia force)	Toward d/s		Toward u/s
Seismic loads (dynamic water pressure)	O		

	Unit	Dam concrete	Water	Sediment
• Unit weight of dam concrete:	t/m^3	2.4	1.0	1.0

- Seismic coefficient: k=0.1 (Case 1 loading), k=0.05 (Case 3)
- Uplift coefficient at foundation drain: 0.2
- Sediment pressure coefficient: 0.5

3) Strength of foundation rock

Internal friction angle (ϕ) = 45° Cohesion (τ) = 200 t/m^2 (see Section 3.2.1 in main report)
Uniaxial compression strength = 200 kgf/cm^2

Compressive strength of concrete (RCC) = 200 kgf/cm^2 (Assumed)

4) Dam shape under consideration

- Dam crest level: 187.5 m asl
- Dam base level: 136.0 m asl
- Dam crest width: 8.0 m
- Slope of upstream face Vertical
- Slope of downstream face 1:0.8 (v:h)

5) Stability calculations

Loading Case-1 (Normal operation with earthquake)

Loads	Vertical load (t)	Horizontal load (t)	Moment around d/s toe (t-m)
1) Dead weight (concrete)	2,642		73,378
2) Uplift pressure	-416		-12,156
3) Static water pressure		1,273	-21,570
4) Sediment pressure		20	-61
5) Dynamic water pressure		149	-3,005
6) Dam inertia force in earthquake		265	-4,833
Total	2,226	1,707	31,753

Location of resultant force (distance from center of base) = 6.33 m (within middle third) ok
Compression stress: 103.8 t/m^2 (d/s), 4.2 t/m^2 (u/s) → No tensile stress at u/s end ok
Safety factor against sliding = 6.1 ok

Loading Case-2 (Flood time)

Loads	Vertical load (t)	Horizontal load (t)	Moment around d/s toe (t-m)
1) Dead weight (concrete)	2,642		73,378
2) Uplift pressure	-667		-16,798
3) Static water pressure		1,246	-21,655
4) Sediment pressure		20	-61
5) Dynamic water pressure		0	0
6) Dam inertia force in earthquake		0	0
Total	1,975	1,266	34,862

Location of resultant force (distance from center of base) = 2.95 m (within middle third) ok
Compression stress: 69.6 t/m^2 (d/s), 27.3 t/m^2 (u/s) → No tensile stress at u/s end ok
Safety factor against sliding = 8.1 ok

Loading Case-3 (During construction)

Loads	Vertical load (t)	Horizontal load (t)	Moment around d/s toe (t-m)
1) Dead weight (concrete)	2,642		73,378
2) Uplift pressure	0		0
3) Static water pressure		0	0
4) Sediment pressure		0	0
5) Dynamic water pressure		0	0
6) Dam inertia force in earthquake		-132	2,417
Total	2,642	-132	75,795

Location of resultant force (distance from center of base) = 8.09 m (not within middle third)

Compression stress: -11.4 t/m^2 (d/s), 139.7 t/m^2 (u/s) → No tensile stress at u/s end ok

Tensile stress of 11.4 t/m^2 at d/s end is instantaneous and lower than permissible tensile stress of 50 t/m^2.

Safety factor against sliding = 82 ok

6) Conclusion

The concrete dam having vertical upstream face and sloping downstream face with slope of 1:0.8 (v:h) and having dam crest level of El. 187.5 m is judged to be structurally stable because:

- No tensile stress occurs at upstream face of dam body even when receiving full water pressure from upstream side as well as horizontal earthquake force.
- Factor of safety against sliding at dam base is sufficiently large (> 4).
- Maximum compression stress at base is 14.0 kg/cm^2 that is sufficiently lower than allowable stress (50 kg/cm^2 = 25% of 200 kg/cm^2) of foundation rock

APPENDIX C-4 SLOPE STABILITY OF ROCKFILL DAM IN RIVER VALLEY

1) Stability Considerations

The following load cases and minimum required safety factor in accordance with Japanese design criteria which have been considered are indicated in following Table 1.

Table 1 Load Cases and Required Minimum Safety Factor

Loading	Description	Without earthquake	With earthquake
Case-1	End of construction (upstream and downstream slopes)	1.2	1.2
Case-2	Reservoir at full supply level (upstream and downstream slopes)	1.2	1.2
Case-3	Reservoir at partially pool level (upstream slope)	1.2	1.2
Case-4	Sudden drawdown (upstream slope)	1.2	Not applicable

2) Method of Slope Stability Analysis

The slope stability investigation was done with the MS Excel Spreadsheets (based on the limit equilibrium method) and Modified Bishop method was used to obtain the factors of safety.

The pore pressures developed within the body of the dam under steady state seepage and under sudden draw down conditions have been considered. These pore pressures in terms of head have been incorporated in the slope stability analysis. Flow net for steady state condition is shown in Figure 1.

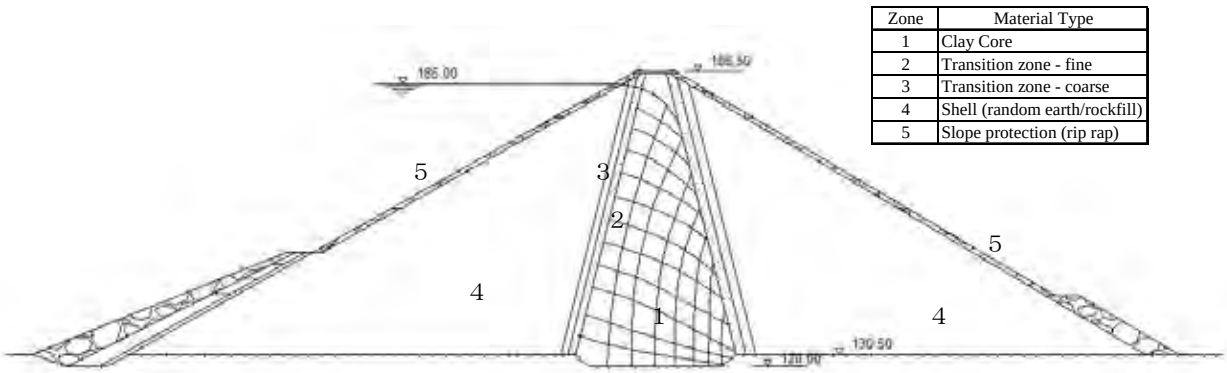


Figure 1 : Dam Zoning and Flow Net under Steady State Condition

3) Material Properties

Zoning of rockfill dam is shown in Figure 1. Type of material is different in embankment zones. The properties of the embankment materials considered in the analysis are tabulated below. To simplify the slope stability analysis, separate properties for Zone-2, Zone-3 and Zone-5 have not

been considered. Instead, the property of Zone-4 has been used in the analysis, which is a safe assumption.

Table 2 Properties of Embankment Materials

Zone	C	φ	γ_{dry}	γ_{sat}
	(kN/m^2)	(deg)	($kN/m^{3)}$	(kN/m^3)
Core	50	0	17	19
Shell	0	40	20	22

The slope stability investigation was done with the MS Excel Spreadsheets (based on the limit equilibrium method) and Modified Bishop method used to obtain the factors of safety.

4) Seismic Load

Based on the available information, Sri Lanka and in particular the project area have been affected by minor seismic activities only. Accordingly, horizontal seismic coefficient of kh = 0.1 have been considered in the stability calculation.

5) Stability Analysis Results

Slip circles considered for various radiuses ranging from 25-140 m on downstream and upstream slopes for different centre locations are shown in Figure 2 and Figure 3, respectively.

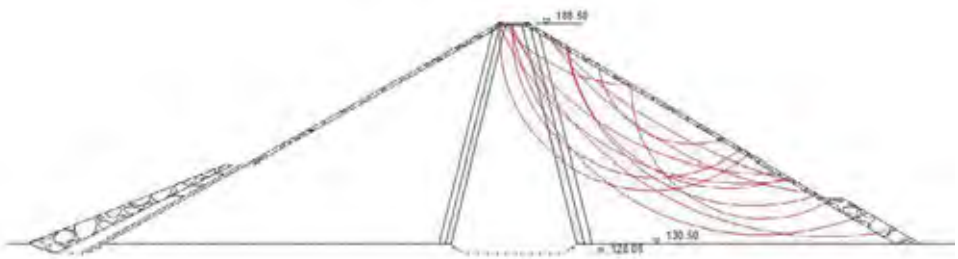


Figure 2 : Slip Circles Considered for Downstream Slope

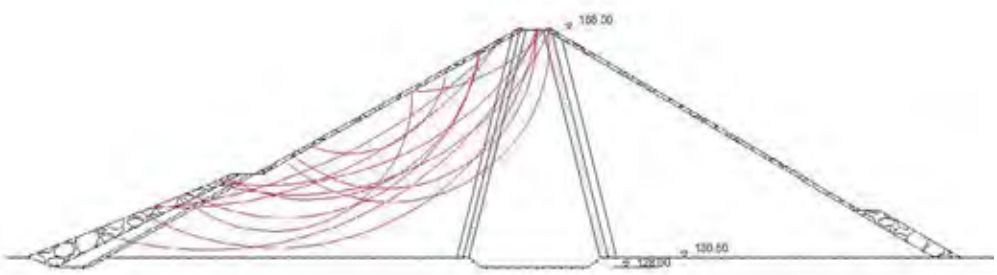


Figure 3 : Slip Circles Considered for Upstream Slope

Initially, three different slopes were selected for upstream and downstream sides and slope

stability of them were analysed. Minimum Factors of Safety (FOS) obtained for each slope with seismic loads against slope failures are listed in below Table 3.

Table 3 Minimum FOS for Different Slopes

Side	Slope		
	1 : 1.5	1 : 1.7	1 : 1.8
Upstream	1.05	1.15	1.21
Downstream	1.05	1.20	1.27

Minimum FOS required to prevent slope failures as mentioned in Table 1 is 1.2. From above results, it was decided to adopt 1 : 1.8 for upstream slope and 1 : 1.7 for downstream slope.

For the selected upstream and downstream slopes, detailed slope stability analyses were carried out for different load combinations. Minimum Factors of Safety (FOS) obtained against slope failures under the static and seismic loads are listed in Table 4.

Table 4 Minimum Factors of Safety (FOS) against Slope Failures

Case	Description	Side	Slope	Without earthquake	With earthquake
Case-1	End of construction	D/S	1 : 1.7	1.48	1.20
		U/S	1 : 1.8	1.58	1.27
Case-2	Reservoir at full supply level	D/S	1 : 1.7	1.48	1.20
		U/S	1 : 1.8	1.58	1.27
Case-3	Reservoir at partially pool level	D/S	1 : 1.7	1.48	1.20
		U/S	1 : 1.8	1.50	1.21
Case-4	Sudden drawdown	U/S	1 : 1.8	1.58	Not applicable

Note : Minimum FOS values indicated in Table 4 are always given by the slip circle having radius of 140 m (maximum layer thickness enclosed by the slip circle is 6.6m).

APPENDIX C-5 SPILLWAY DISCHARGE CAPACITY

1) Discharge Capacity

The spillway headwork is designed so as to have the outflow capacity of 3,797 m3/s under the reservoir water level of 185.0 m asl

Overflow crest level is decided to be 174.0 m asl taking into account the size of spillway gates and total overflow width.

2) Discharge Calculation Formulae

$$C_d = 1.971 + 0.498k + 6.63k^2$$

where, Cd: Discharge coefficient at design head

k: Coordinates y/Hd at x/Hd=0.5 of crest ogee curve "$y=0.086847x^{1.73}$"

Hd: Design head (185-174 = 11 m)

thus, k = 0.151

Cd = 2.197

Discharge coefficient (C) at different heads (H):

$$C = 1.60 \frac{1 + 2a\left(\frac{H}{Hd}\right)}{1 + a\left(\frac{H}{Hd}\right)} \qquad a = \frac{C_d - 1.6}{3.2 - C_d} = 0.595$$

Free overflow discharge (Q) at different heads (H):

$$Q = CLH^{1..5}$$

$$L = L' - 2(nK_p + K_a)H$$

where, L: Effective length of overflow crest (m)

n: Number of piers (= 4)

Kp: Pier contraction coefficient (= 0.01)

Ka: Abutment contraction coefficient (= 0.025)

L': Clear opening between piers (= 9.7 x 5 = 48.5 m)

3) Discharge Calculation Result

Res. WL (El. m)	Overflow H (m)	C	L (m)	Q (m3/s)
185.6	11.6	2.217	46.99	4,115
185	11	2.197	47.07	3,772
184	10	2.161	47.20	3,226
183	9	2.124	47.33	2,714
182	8	2.083	47.46	2,237
181	7	2.039	47.59	1,797
180	6	1.992	47.72	1,397
179	5	1.940	47.85	1,038
178	4	1.884	47.98	723
177	3	1.823	48.11	456
176	2	1.756	48.24	240
175	1	1.682	48.37	81
174	0	1.600	48.50	0

The discharge at FSL of 185.0 m asl is 3,772 m3/s that is practically equal to the design requirement 3,797 m3/s.

APPENDIX C-6 GENERATION SIMULATION RESULTS Case 1: 1x15MW Plant (1/2)

1) Month-end Reservoir WL (m asl)

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1968	1969	175.28	174.43	181.81	182.09	181.44	181.19	183.16	183.21	183.02	180.24	177.41	174.55
2	1969	1970	181.40	185.00	185.00	185.00	185.00	185.00	185.00	182.61	179.94	175.97	175.38	174.34
3	1970	1971	177.65	181.51	185.00	185.00	184.13	185.00	185.00	184.16	184.11	183.76	184.14	185.00
4	1971	1972	185.00	184.52	185.00	184.04	181.72	181.15	180.65	182.41	179.62	176.41	174.72	173.32
5	1972	1973	181.01	185.00	185.00	183.27	181.25	180.96	179.79	175.94	172.06	167.85	165.65	164.23
6	1973	1974	163.23	162.83	175.57	172.18	169.70	169.70	169.70	166.80	165.97	165.57	165.39	166.36
7	1974	1975	170.28	164.00	171.89	170.94	169.70	169.65	169.70	166.80	166.66	162.97	166.47	167.39
8	1975	1976	168.73	173.39	180.52	179.52	175.31	174.05	173.79	170.18	164.22	162.65	160.70	156.79
9	1976	1977	159.27	163.33	167.40	165.10	165.10	165.10	169.68	166.80	163.90	162.11	160.70	155.80
10	1977	1978	168.91	175.18	184.87	183.61	182.52	181.32	180.92	180.12	176.57	175.33	175.20	174.28
11	1978	1979	179.32	185.00	185.00	185.00	185.00	185.00	184.68	182.46	179.88	176.18	173.49	170.45
12	1979	1980	174.38	180.86	184.32	184.51	181.74	180.81	181.31	177.92	174.19	170.17	165.55	164.41
13	1980	1981	164.54	164.55	176.86	176.42	173.99	171.44	170.62	166.80	163.90	162.02	160.70	164.19
14	1981	1982	167.33	169.43	171.24	166.97	165.10	165.10	165.10	164.11	163.90	161.28	160.14	155.50
15	1982	1983	160.18	169.43	182.61	181.50	178.03	173.54	171.88	166.88	163.53	161.09	159.85	155.50
16	1983	1984	158.43	163.33	176.40	184.74	185.00	185.00	185.00	182.86	182.64	182.57	180.06	180.72
17	1984	1985	183.54	185.00	185.00	185.00	185.00	185.00	185.00	182.44	182.16	182.43	182.29	181.47
18	1985	1986	183.90	185.00	185.00	185.00	185.00	185.00	185.00	182.71	180.29	176.44	173.20	170.90
19	1986	1987	175.46	175.50	176.41	177.89	174.12	174.27	173.51	169.76	164.28	161.81	160.64	155.50
20	1987	1988	162.47	169.43	171.61	168.25	165.20	165.10	173.30	174.05	173.13	169.13	169.46	169.88
21	1988	1989	168.67	169.11	172.67	171.93	168.32	168.51	167.05	166.80	163.90	163.48	165.44	167.09
22	1989	1990	169.60	175.85	177.35	181.60	180.98	184.50	183.95	181.97	182.62	182.81	180.67	179.31
23	1990	1991	183.55	185.00	185.00	185.00	183.15	183.39	182.44	179.64	175.81	172.69	169.30	165.23
24	1991	1992	167.07	173.05	181.07	179.30	174.96	172.60	172.84	168.86	163.90	161.67	160.58	156.33
25	1992	1993	162.47	175.52	180.41	177.16	173.75	173.08	171.80	167.74	167.09	164.22	162.83	161.95
26	1993	1994	170.50	177.34	185.00	185.00	185.00	185.00	185.00	182.50	179.79	175.74	172.39	169.98
27	1994	1995	175.67	183.44	185.00	185.00	185.00	185.00	185.00	185.00	185.00	184.84	182.64	183.45
28	1995	1996	185.00	185.00	185.00	184.08	183.04	182.98	185.00	182.46	180.05	176.24	172.93	171.50
29	1996	1997	174.39	180.17	180.80	177.61	174.47	171.93	172.50	176.30	173.14	170.09	164.64	170.26
30	1997	1998	174.79	184.66	185.00	185.00	182.66	182.50	181.41	178.26	174.66	171.10	167.51	169.80
31	1998	1999	172.30	173.57	180.43	185.00	185.00	185.00	185.00	182.38	179.84	176.13	173.10	170.68
32	1999	2000	169.32	171.23	175.23	179.86	184.61	185.00	185.00	182.67	180.07	176.47	173.51	171.29
33	2000	2001	174.33	180.26	185.00	185.00	185.00	185.00	185.00	182.61	180.18	176.57	173.92	171.73
34	2001	2002	170.96	167.38	170.74	169.70	169.70	170.57	174.36	170.76	165.07	162.44	160.70	155.50
35	2002	2003	159.27	163.33	176.41	182.38	183.32	185.00	185.00	184.60	182.07	179.60	176.58	173.57
36	2003	2004	173.41	176.90	176.83	174.72	171.26	170.82	170.86	166.80	163.90	161.58	160.27	155.50
37	2004	2005	159.27	166.69	179.18	181.50	178.53	178.75	180.29	176.78	172.92	168.71	164.37	164.82
38	2005	2006	164.47	173.01	177.74	185.00	185.00	185.00	185.00	185.00	184.85	182.73	180.66	177.80
39	2006	2007	160.93	185.00	185.00	185.00	184.63	184.61	185.00	182.38	179.70	175.86	172.90	170.93
40	2007	2008	171.94	177.95	185.00	184.54	184.35	185.00	185.00	182.51	179.68	175.97	172.66	170.62
		max	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	184.84	184.14	185.00
		Min	158.43	162.83	167.40	165.10	165.10	165.10	165.10	164.11	163.53	161.09	159.85	155.50

2) Turbine discharge (more than 10.5m3/s when WL is higher than 165m) m3/s

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1968	1969	33.21	27.60	10.64	32.06	29.96	0.00	0.00	32.00	32.00	32.00	26.13	31.88
2	1969	1970	0.00	16.79	36.15	36.15	36.15	0.00	18.56	31.75	32.00	32.00	27.86	27.41
3	1970	1971	0.00	17.41	29.70	36.15	24.95	0.00	13.90	31.75	32.00	32.00	31.26	32.48
4	1971	1972	36.15	21.37	36.36	29.60	38.60	0.00	0.00	31.72	32.00	32.00	28.71	24.80
5	1972	1973	0.00	31.52	36.15	35.33	34.73	0.00	15.52	32.00	32.00	27.64	11.85	0.00
6	1973	1974	0.00	0.00	0.00	39.35	32.51	13.85	35.28	32.00	32.00	32.00	31.16	32.69
7	1974	1975	12.87	35.63	0.00	38.00	29.02	12.47	23.73	30.56	32.00	0.00	0.00	26.57
8	1975	1976	28.22	20.91	23.98	41.02	41.30	18.59	0.00	32.00	32.00	0.00	0.00	0.00
9	1976	1977	0.00	0.00	23.07	26.83	18.68	0.00	15.93	32.00	32.00	0.00	0.00	0.00
10	1977	1978	0.00	34.96	23.81	36.26	38.87	21.32	13.97	32.00	32.00	32.00	31.12	33.40
11	1978	1979	0.00	15.66	25.04	33.26	32.79	11.40	11.79	32.00	32.00	32.00	27.23	31.74
12	1979	1980	12.07	10.54	0.00	38.36	38.30	16.79	0.00	32.00	32.00	32.00	23.73	0.00
13	1980	1981	0.00	0.00	16.13	40.88	40.10	30.45	0.00	30.23	32.00	0.00	0.00	0.00
14	1981	1982	22.21	35.54	33.30	36.56	17.39	0.00	16.38	0.00	0.00	0.00	0.00	0.00
15	1982	1983	0.00	0.00	26.03	39.53	40.31	40.43	17.26	32.00	19.21	0.00	0.00	0.00
16	1983	1984	0.00	0.00	11.78	40.77	36.26	34.40	32.28	32.00	32.00	32.00	31.17	25.94
17	1984	1985	15.66	38.45	36.15	25.32	20.27	17.75	13.75	32.00	32.00	32.00	30.91	28.79
18	1985	1986	0.00	38.34	36.15	36.15	26.89	13.95	18.16	31.74	32.00	32.00	28.15	21.04
19	1986	1987	13.63	25.14	21.01	31.38	40.53	0.00	11.93	32.00	32.00	0.00	0.00	0.00
20	1987	1988	0.00	21.57	36.80	34.25	33.22	0.00	28.14	32.00	32.00	31.75	24.05	27.48
21	1988	1989	18.89	35.12	36.62	38.49	33.47	0.00	10.91	32.00	32.00	0.00	0.00	24.83
22	1989	1990	21.04	36.84	34.95	27.54	34.00	0.00	14.48	29.46	32.00	32.00	31.65	19.34
23	1990	1991	0.00	38.45	36.15	26.15	34.22	0.00	13.87	32.00	32.00	32.00	28.38	23.22
24	1991	1992	0.00	32.84	14.89	40.62	41.14	21.57	0.00	32.00	32.00	0.00	0.00	0.00
25	1992	1993	0.00	11.15	21.29	41.11	40.23	14.96	14.96	28.42	32.00	22.24	0.00	0.00
26	1993	1994	0.00	18.28	0.00	36.15	36.15	0.00	16.92	31.75	32.00	32.00	27.99	20.81
27	1994	1995	14.38	0.00	24.92	22.23	25.88	11.90	22.51	32.00	32.00	31.47	31.68	17.16
28	1995	1996	21.63	36.15	16.60	31.56	26.10	0.00	0.00	32.00	32.00	32.00	28.98	17.03
29	1996	1997	20.64	14.85	22.11	40.82	40.55	27.43	0.00	31.71	32.00	32.00	29.96	0.00
30	1997	1998	20.02	0.00	36.29	26.22	34.04	0.00	16.28	32.00	32.00	31.65	25.05	23.37
31	1998	1999	14.66	32.00	0.00	14.70	15.02	0.00	13.93	32.00	32.00	32.00	23.75	20.78
32	1999	2000	15.34	0.00	15.18	17.27	0.00	0.00	18.44	31.75	32.00	32.00	27.44	31.84
33	2000	2001	0.00	14.00	12.32	36.15	20.43	0.00	19.14	32.00	32.00	31.74	21.96	21.54
34	2001	2002	10.83	36.61	0.00	35.36	19.26	0.00	0.00	32.00	32.00	0.00	0.00	0.00
35	2002	2003	0.00	0.00	11.03	40.19	16.01	0.00	24.50	32.00	32.00	32.00	27.49	28.01
36	2003	2004	0.00	15.85	16.98	40.42	38.86	13.27	0.00	32.00	32.00	0.00	0.00	0.00
37	2004	2005	0.00	0.00	19.19	16.30	38.37	0.00	0.00	31.72	32.00	32.00	22.46	0.00
38	2005	2006	0.00	0.00	38.24	40.40	25.68	19.37	14.11	32.00	32.00	32.00	25.47	28.39
39	2006	2007	0.00	39.29	30.60	18.70	12.15	0.00	10.79	32.00	32.00	32.00	24.20	20.24
40	2007	2008	22.01	23.01	13.24	33.27	27.46	22.41	18.43	32.00	32.00	32.00	27.39	17.99

3) Generator output (MW), 15MW x 1 TWL= 138 m P=e g Q H MW

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1968	1969	10.68	9.00	3.76	12.39	11.54	0.00	0.00	12.71	12.69	12.27	9.45	10.63
2	1969	1970	0.00	6.75	14.66	14.66	14.66	0.00	7.76	12.79	12.17	11.23	9.29	8.94
3	1970	1971	0.00	6.44	11.83	14.66	10.31	0.00	5.75	13.01	12.98	12.93	12.64	13.30
4	1971	1972	14.66	8.88	14.67	12.13	14.92	0.00	0.00	12.14	12.10	11.25	9.49	7.91
5	1972	1973	0.00	12.48	14.66	14.07	13.27	0.00	5.79	11.20	10.11	7.81	2.97	0.00
6	1973	1974	0.00	0.00	0.00	12.11	9.38	3.86	9.61	8.33	7.81	7.64	7.37	7.83
7	1974	1975	3.40	8.91	0.00	10.91	8.24	3.48	6.66	7.97	7.91	0.00	0.00	6.64
8	1975	1976	7.32	6.14	8.29	14.81	13.97	6.06	0.00	9.53	8.04	0.00	0.00	0.00
9	1976	1977	0.00	0.00	5.47	6.55	4.39	0.00	4.07	8.33	7.52	0.00	0.00	0.00
10	1977	1978	0.00	10.24	8.88	14.47	15.08	8.32	5.30	11.96	11.34	10.66	10.18	10.58
11	1978	1979	0.00	6.09	10.44	13.51	13.55	4.72	4.87	12.82	12.14	11.25	8.87	9.45
12	1979	1980	3.66	3.68	0.00	15.34	14.89	6.46	0.00	11.70	10.69	9.59	6.14	0.00
13	1980	1981	0.00	0.00	4.69	13.55	12.80	9.28	0.00	8.00	7.52	0.00	0.00	0.00
14	1981	1982	5.34	9.27	9.27	9.76	4.24	0.00	3.86	0.00	0.00	0.00	0.00	0.00
15	1982	1983	0.00	0.00	8.77	14.98	14.47	13.11	5.33	8.80	4.53	0.00	0.00	0.00
16	1983	1984	0.00	0.00	3.31	14.91	14.67	13.97	13.34	12.93	12.59	12.55	11.87	9.75
17	1984	1985	6.08	15.33	14.66	10.56	8.47	7.42	5.69	12.87	12.46	12.46	12.06	11.12
18	1985	1986	0.00	15.35	14.66	14.66	11.20	5.77	7.59	12.80	12.23	11.35	9.12	6.36
19	1986	1987	4.22	8.35	7.08	10.79	13.21	0.00	3.77	9.44	7.99	0.00	0.00	0.00
20	1987	1988	0.00	5.23	10.27	9.41	8.20	0.00	7.71	10.01	9.99	9.22	6.67	7.69
21	1988	1989	4.97	9.01	10.34	11.32	9.25	0.00	2.83	7.96	7.52	0.00	0.00	6.07
22	1989	1990	5.54	10.99	11.63	10.12	12.71	0.00	5.89	11.66	12.46	12.58	12.17	7.22
23	1990	1991	0.00	15.33	14.66	10.90	13.62	0.00	5.49	12.10	11.16	10.18	8.23	5.88
24	1991	1992	0.00	9.22	5.12	14.72	13.81	6.85	0.00	9.21	7.81	0.00	0.00	0.00
25	1992	1993	0.00	3.01	7.56	14.40	12.93	4.66	4.53	7.93	8.10	5.33	0.00	0.00
26	1993	1994	0.00	5.84	0.00	14.66	14.66	0.00	7.07	12.78	12.13	11.18	8.93	6.13
27	1994	1995	4.41	0.00	10.22	9.28	10.79	4.93	9.40	13.23	13.23	12.99	12.75	6.88
28	1995	1996	8.88	14.66	6.94	12.92	10.55	0.00	0.00	12.87	12.17	11.28	9.32	5.18
29	1996	1997	6.40	5.13	8.34	14.44	13.23	8.54	0.00	10.13	10.31	9.43	7.58	0.00
30	1997	1998	6.14	0.00	14.67	10.93	13.48	0.00	6.37	11.76	10.80	9.68	6.94	6.21
31	1998	1999	4.26	9.81	0.00	5.79	6.21	0.00	5.77	12.86	12.12	11.24	7.71	6.25
32	1999	2000	4.32	0.00	4.70	6.07	0.00	0.00	7.71	12.80	12.20	11.32	8.98	9.61
33	2000	2001	0.00	4.84	4.84	14.66	8.53	0.00	8.00	12.89	12.20	11.26	7.26	6.66
34	2001	2002	3.18	9.79	0.00	9.79	5.42	0.00	0.00	9.70	8.24	0.00	0.00	0.00
35	2002	2003	0.00	0.00	3.10	14.30	6.39	0.00	10.22	13.17	12.76	12.05	9.76	9.14
36	2003	2004	0.00	5.18	5.87	13.10	11.66	3.86	0.00	8.50	7.52	0.00	0.00	0.00
37	2004	2005	0.00	0.00	5.95	6.14	13.87	0.00	0.00	11.30	10.35	9.20	5.55	0.00
38	2005	2006	0.00	0.00	12.28	15.06	10.71	8.09	5.84	13.23	13.21	12.89	9.87	10.30
39	2006	2007	0.00	15.21	12.66	7.82	5.01	0.00	4.45	12.86	12.10	11.18	7.80	6.09
40	2007	2008	6.53	7.54	5.07	13.45	11.30	9.29	7.70	12.88	12.12	11.19	8.80	5.38

4) Energy Output (GWH/month) 15MW x 1 GWH

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1	1968	1969	7.95	6.48	2.80	9.22	7.75	0.00	0.00	9.46	9.14	9.13	7.03	7.65	76.61
2	1969	1970	0.00	4.86	10.91	10.91	9.85	0.00	5.58	9.52	8.76	8.35	6.91	6.44	82.10
3	1970	1971	0.00	4.64	8.80	10.91	6.93	0.00	4.14	9.68	9.35	9.62	9.40	9.58	83.04
4	1971	1972	10.91	6.39	10.91	9.02	10.03	0.00	0.00	9.03	8.71	8.37	7.06	5.70	86.12
5	1972	1973	0.00	8.98	10.91	10.47	8.92	0.00	4.17	8.34	7.28	5.81	2.21	0.00	67.07
6	1973	1974	0.00	0.00	0.00	9.01	6.30	2.87	6.92	6.20	5.63	5.69	5.48	5.64	53.74
7	1974	1975	2.53	6.41	0.00	8.12	5.54	2.59	4.79	5.93	5.69	0.00	0.00	4.78	46.38
8	1975	1976	5.45	4.42	6.16	11.02	9.38	4.51	0.00	7.09	5.79	0.00	0.00	0.00	53.82
9	1976	1977	0.00	0.00	4.07	4.87	2.95	0.00	2.93	6.20	5.42	0.00	0.00	0.00	26.44
10	1977	1978	0.00	7.37	6.60	10.76	10.14	6.19	3.82	8.90	8.16	7.93	7.58	7.62	85.07
11	1978	1979	0.00	4.38	7.77	10.05	9.11	3.51	3.50	9.54	8.74	8.37	6.60	6.81	78.39
12	1979	1980	2.72	2.65	0.00	11.42	10.01	4.81	0.00	8.71	7.70	7.14	4.57	0.00	59.70
13	1980	1981	0.00	0.00	3.49	10.08	8.60	6.91	0.00	5.96	5.42	0.00	0.00	0.00	40.45
14	1981	1982	3.97	6.67	6.90	7.26	2.85	0.00	2.78	0.00	0.00	0.00	0.00	0.00	30.42
15	1982	1983	0.00	0.00	6.52	11.15	9.72	9.75	3.84	6.54	3.26	0.00	0.00	0.00	50.79
16	1983	1984	0.00	0.00	2.46	11.10	9.86	10.39	9.61	9.62	9.06	9.34	8.83	7.02	87.28
17	1984	1985	4.52	11.04	10.91	7.86	5.69	5.52	4.10	9.57	8.97	9.27	8.97	8.01	94.43
18	1985	1986	0.00	11.05	10.91	10.91	7.53	4.30	5.46	9.52	8.81	8.44	6.78	4.58	88.29
19	1986	1987	3.14	6.01	5.27	8.03	8.88	0.00	2.72	7.02	5.75	0.00	0.00	0.00	46.82
20	1987	1988	0.00	3.76	7.64	7.00	5.51	0.00	5.55	7.45	7.19	6.86	4.96	5.54	61.47
21	1988	1989	3.69	6.49	7.70	8.43	6.22	0.00	2.04	5.93	5.42	0.00	0.00	4.37	50.27
22	1989	1990	4.12	7.91	8.65	7.53	8.54	0.00	4.24	8.68	8.97	9.36	9.05	5.20	82.25
23	1990	1991	0.00	11.04	10.91	8.11	9.15	0.00	3.95	9.01	8.04	7.57	6.12	4.24	78.13
24	1991	1992	0.00	6.64	3.81	10.95	9.28	5.09	0.00	6.85	5.62	0.00	0.00	0.00	48.25
25	1992	1993	0.00	2.17	5.62	10.71	8.69	3.47	3.26	5.90	5.83	3.96	0.00	0.00	49.61
26	1993	1994	0.00	4.20	0.00	10.91	9.85	0.00	5.09	9.50	8.74	8.31	6.64	4.41	67.67
27	1994	1995	3.28	0.00	7.60	6.90	7.25	3.66	6.77	9.84	9.52	9.67	9.48	4.95	78.93
28	1995	1996	6.61	10.56	5.16	9.61	7.09	0.00	0.00	9.57	8.76	8.39	6.93	3.73	76.42
29	1996	1997	4.76	3.70	6.20	10.75	8.89	6.36	0.00	7.54	7.42	7.02	5.64	0.00	68.28
30	1997	1998	4.57	0.00	10.91	8.13	9.06	0.00	4.59	8.75	7.78	7.20	5.16	4.47	70.62
31	1998	1999	3.17	7.06	0.00	4.30	4.18	0.00	4.15	9.57	8.73	8.36	5.74	4.50	59.75
32	1999	2000	3.21	0.00	3.50	4.52	0.00	0.00	5.55	9.52	8.78	8.42	6.68	6.92	57.10
33	2000	2001	0.00	3.49	3.60	10.91	5.73	0.00	5.76	9.59	8.79	8.37	5.40	4.79	66.44
34	2001	2002	2.37	7.05	0.00	7.28	3.64	0.00	0.00	7.22	5.93	0.00	0.00	0.00	33.49
35	2002	2003	0.00	0.00	2.30	10.64	4.29	0.00	7.36	9.80	9.18	8.96	7.26	6.58	66.38
36	2003	2004	0.00	3.73	4.37	9.74	7.84	2.87	0.00	6.32	5.42	0.00	0.00	0.00	40.29
37	2004	2005	0.00	0.00	4.43	4.57	9.32	0.00	0.00	8.41	7.45	6.85	4.13	0.00	45.16
38	2005	2006	0.00	0.00	9.14	11.21	7.20	6.02	4.21	9.84	9.51	9.59	7.34	7.42	81.46
39	2006	2007	0.00	10.95	9.42	5.82	3.37	0.00	3.20	9.57	8.71	8.32	5.81	4.39	69.55
40	2007	2008	4.86	5.43	3.77	10.01	7.60	6.91	5.55	9.58	8.73	8.33	6.55	3.87	81.17
AVERAGE			2.05	4.64	5.75	9.00	7.32	2.39	3.39	8.13	7.40	5.82	4.61	3.73	64.24
MAX			10.91	11.05	10.91	11.42	10.14	10.39	9.61	9.84	9.52	9.67	9.48	9.58	94.43
MIN			0.00	0.00	0.00	4.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.44

APPENDIX C-6 GENERATION SIMULATION RESULTS Case 2: 2x7.5MW Plant (1/2)

1) Month-end Reservoir WL (m asl)

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1968	1969	175.28	174.43	181.81	182.09	181.44	181.19	183.16	183.21	183.02	180.24	177.41	174.55
2	1969	1970	181.40	185.00	185.00	185.00	185.00	185.00	185.00	182.61	179.94	175.97	175.38	174.34
3	1970	1971	177.65	181.51	185.00	185.00	184.13	185.00	185.00	184.16	184.11	183.76	184.14	185.00
4	1971	1972	185.00	184.52	185.00	184.04	181.72	181.15	180.65	182.41	179.62	176.41	174.72	173.32
5	1972	1973	181.01	185.00	185.00	183.27	181.25	180.96	179.79	175.94	172.08	167.85	165.65	164.23
6	1973	1974	163.23	162.83	175.57	172.18	169.70	169.70	169.70	166.80	165.97	165.57	165.39	166.36
7	1974	1975	170.28	164.00	171.99	170.94	169.70	169.65	169.70	166.80	166.66	162.97	166.47	167.39
8	1975	1976	168.73	173.39	180.52	179.52	175.31	174.05	173.79	170.18	164.22	162.65	160.70	156.79
9	1976	1977	159.27	163.33	167.40	165.10	165.10	165.10	169.68	166.80	163.90	162.11	160.70	155.80
10	1977	1978	168.91	175.18	184.87	183.61	182.52	181.32	180.92	180.12	176.57	175.33	175.20	174.28
11	1978	1979	179.32	185.00	185.00	185.00	185.00	185.00	184.68	182.46	179.88	176.18	173.49	170.45
12	1979	1980	174.38	180.86	184.32	184.51	181.74	180.81	181.31	177.92	174.19	170.17	165.55	164.41
13	1980	1981	164.54	164.55	176.86	176.42	173.99	171.44	170.62	166.80	163.90	162.02	160.70	164.19
14	1981	1982	167.33	169.43	171.24	166.97	165.10	165.10	165.10	164.11	163.90	161.28	160.14	155.50
15	1982	1983	160.18	169.43	182.61	181.50	178.03	173.54	171.88	166.88	163.53	161.09	159.85	155.50
16	1983	1984	158.43	163.33	176.40	184.74	185.00	185.00	185.00	182.86	182.64	182.57	180.08	180.72
17	1984	1985	183.54	185.00	185.00	185.00	185.00	185.00	185.00	182.44	182.16	182.43	182.29	181.47
18	1985	1986	183.90	185.00	185.00	185.00	185.00	185.00	185.00	182.71	180.29	176.44	173.20	170.90
19	1986	1987	175.46	175.50	176.41	177.89	174.12	174.27	173.51	169.76	164.26	161.81	160.64	155.50
20	1987	1988	162.47	169.43	171.61	168.25	165.20	165.10	173.30	174.05	173.13	169.13	169.46	169.88
21	1988	1989	166.67	169.11	172.67	171.93	168.32	168.51	167.05	166.80	163.90	163.48	165.44	167.09
22	1989	1990	169.60	175.85	177.35	181.60	180.98	184.50	183.95	181.97	182.62	182.81	180.67	179.31
23	1990	1991	183.55	185.00	185.00	185.00	183.15	183.39	182.44	179.84	175.81	172.69	169.30	165.23
24	1991	1992	167.07	173.05	181.07	179.30	174.96	172.60	172.84	168.86	163.90	161.67	160.58	156.33
25	1992	1993	162.47	175.52	180.41	177.16	173.75	173.08	171.80	167.74	167.09	164.22	162.83	161.95
26	1993	1994	170.50	177.34	185.00	185.00	185.00	185.00	185.00	182.50	179.79	175.74	172.39	169.98
27	1994	1995	175.67	183.44	185.00	185.00	185.00	185.00	185.00	185.00	185.00	184.84	182.64	183.45
28	1995	1996	185.00	185.00	185.00	184.08	183.04	182.98	185.00	182.46	180.05	176.24	172.93	171.50
29	1996	1997	174.39	180.17	180.80	177.61	174.47	171.93	172.50	176.30	173.14	170.09	164.64	170.26
30	1997	1998	174.79	184.66	185.00	185.00	182.66	182.50	181.41	178.26	174.66	171.10	167.51	169.80
31	1998	1999	172.30	173.57	180.43	185.00	185.00	185.00	185.00	182.38	179.84	176.13	173.10	170.68
32	1999	2000	169.32	171.23	175.23	179.86	184.61	185.00	185.00	182.67	180.07	176.47	173.51	171.29
33	2000	2001	174.33	180.26	185.00	185.00	185.00	185.00	185.00	182.61	180.18	176.57	173.92	171.73
34	2001	2002	170.96	167.38	170.74	169.70	169.70	170.57	174.36	170.76	165.07	162.44	160.70	155.50
35	2002	2003	159.27	163.33	176.41	182.38	183.32	185.00	185.00	184.60	182.07	179.60	176.58	173.57
36	2003	2004	173.41	176.90	176.83	174.72	171.26	170.82	170.86	166.80	163.90	161.58	160.27	155.50
37	2004	2005	159.27	166.69	179.18	181.50	178.53	178.75	180.29	176.78	172.92	168.71	164.37	164.82
38	2005	2006	164.47	173.01	177.74	185.00	185.00	185.00	185.00	185.00	184.85	182.73	180.66	177.80
39	2006	2007	180.93	185.00	185.00	185.00	184.63	184.61	185.00	182.38	179.70	175.86	172.90	170.93
40	2007	2008	171.94	177.95	185.00	184.54	184.35	185.00	185.00	182.51	179.68	175.97	172.66	170.62
		max	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	184.84	184.14	185.00
		Min	158.43	162.83	167.40	165.10	165.10	165.10	165.10	164.11	163.53	161.09	159.85	155.50

2) Turbine discharge (more than 5.25m3/s when WL is higher than 165m) m3/s

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1968	1969	33.21	27.60	10.64	32.06	29.96	7.82	9.02	32.00	32.00	32.00	26.13	31.88
2	1969	1970	7.75	16.79	36.15	36.15	36.15	10.05	18.56	31.75	32.00	32.00	27.86	27.41
3	1970	1971	9.15	17.41	29.70	36.15	24.95	7.41	13.90	31.75	32.00	32.00	31.26	32.48
4	1971	1972	36.15	21.37	36.36	29.60	38.60	9.51	9.46	31.72	32.00	32.00	28.71	24.80
5	1972	1973	6.46	31.52	36.15	35.33	34.73	6.71	15.52	32.00	32.00	27.64	11.85	0.00
6	1973	1974	0.00	0.00	0.00	39.35	32.51	13.85	35.28	32.00	32.00	32.00	31.16	32.69
7	1974	1975	12.87	35.63	0.00	38.00	29.02	12.47	23.73	30.56	32.00	0.00	0.00	26.57
8	1975	1976	28.22	20.91	23.98	41.02	41.30	18.59	7.08	32.00	32.00	0.00	0.00	0.00
9	1976	1977	0.00	0.00	23.07	26.83	18.68	6.68	15.93	32.00	32.00	0.00	0.00	0.00
10	1977	1978	0.00	34.96	23.81	36.26	38.87	21.32	13.97	32.00	32.00	32.00	31.12	33.40
11	1978	1979	10.02	15.66	25.04	33.26	32.79	11.40	11.79	32.00	32.00	32.00	27.23	31.74
12	1979	1980	12.07	10.54	6.02	38.36	38.30	16.79	0.00	32.00	32.00	32.00	23.73	0.00
13	1980	1981	0.00	0.00	16.13	40.88	40.10	30.45	10.42	30.23	32.00	0.00	0.00	0.00
14	1981	1982	22.21	35.54	33.30	36.56	17.39	6.12	16.38	0.00	0.00	0.00	0.00	0.00
15	1982	1983	0.00	0.00	26.03	39.53	40.31	40.43	17.26	32.00	19.21	0.00	0.00	0.00
16	1983	1984	0.00	0.00	11.78	40.77	36.26	34.40	32.28	32.00	32.00	32.00	31.17	25.94
17	1984	1985	15.66	38.45	36.15	25.32	20.27	17.75	13.75	32.00	32.00	32.00	30.91	28.79
18	1985	1986	9.58	38.34	36.15	36.15	26.89	13.95	18.16	31.74	32.00	32.00	28.15	21.04
19	1986	1987	13.63	25.14	21.01	31.38	40.53	5.65	11.93	32.00	32.00	0.00	0.00	0.00
20	1987	1988	0.00	21.57	36.80	34.25	33.22	9.90	28.14	32.00	32.00	31.75	24.05	27.48
21	1988	1989	18.89	35.12	36.62	38.49	33.47	5.71	10.91	32.00	32.00	0.00	0.00	24.83
22	1989	1990	21.04	36.84	34.95	27.54	34.00	0.00	14.48	29.46	32.00	32.00	31.65	19.34
23	1990	1991	9.33	38.45	36.15	26.15	34.22	0.00	13.87	32.00	32.00	32.00	28.38	23.22
24	1991	1992	9.80	32.84	14.89	40.62	41.14	21.57	5.75	32.00	32.00	0.00	0.00	0.00
25	1992	1993	0.00	11.15	21.29	41.11	40.23	14.96	14.96	28.42	32.00	22.24	0.00	0.00
26	1993	1994	10.09	18.28	7.80	36.15	36.15	9.94	16.92	31.75	32.00	32.00	27.99	20.81
27	1994	1995	14.38	10.09	24.92	22.23	25.88	11.90	22.51	32.00	32.00	31.47	31.68	17.16
28	1995	1996	21.63	36.15	16.60	31.56	26.10	8.10	10.10	32.00	32.00	32.00	28.98	17.03
29	1996	1997	20.64	14.85	22.11	40.82	40.55	27.43	8.18	31.71	32.00	32.00	29.96	0.00
30	1997	1998	20.02	10.10	36.29	26.22	34.04	8.06	16.28	32.00	32.00	31.65	25.05	23.37
31	1998	1999	14.66	32.00	7.09	14.70	15.02	10.20	13.93	32.00	32.00	32.00	23.75	20.78
32	1999	2000	15.34	9.20	15.18	17.27	6.15	8.11	18.44	31.75	32.00	32.00	27.44	31.84
33	2000	2001	5.39	14.00	12.32	36.15	20.43	9.23	19.14	32.00	32.00	31.74	21.96	21.54
34	2001	2002	10.83	36.61	9.76	35.36	19.26	6.08	0.00	32.00	32.00	0.00	0.00	0.00
35	2002	2003	0.00	0.00	11.03	40.19	16.01	10.32	24.50	32.00	32.00	32.00	27.49	28.01
36	2003	2004	0.00	15.85	16.98	40.42	38.86	13.27	7.62	32.00	32.00	0.00	0.00	0.00
37	2004	2005	0.00	0.00	19.19	16.30	38.37	6.68	0.00	31.72	32.00	32.00	22.46	0.00
38	2005	2006	0.00	10.13	38.24	40.40	25.68	19.37	14.11	32.00	32.00	32.00	25.47	28.39
39	2006	2007	9.32	39.29	30.60	18.70	12.15	5.43	10.79	32.00	32.00	32.00	24.20	20.24
40	2007	2008	22.01	23.01	13.24	33.27	27.46	22.41	18.43	32.00	32.00	32.00	27.39	17.99

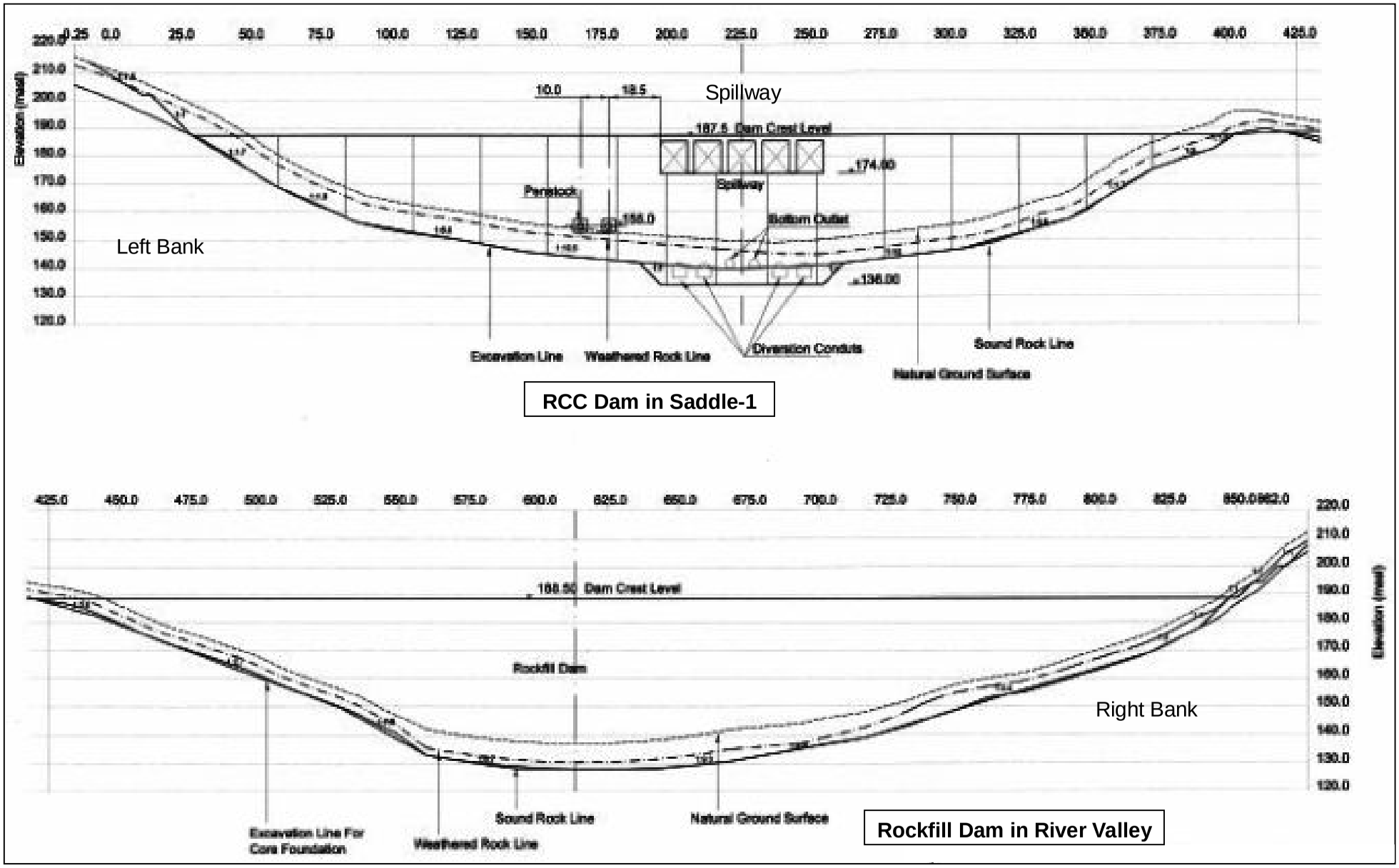
APPENDIX C-6 GENERATION SIMULATION RESULTS Case 2: 2x7.5MW Plant (2/2)

3) Generator output (MW), 7.5MW x 2 units TWL= 138 m P=e g Q H MW

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1968	1969	10.62	8.85	3.77	12.21	11.38	2.97	3.53	12.54	12.52	12.10	9.30	10.48
2	1969	1970	2.71	6.72	14.58	14.58	14.58	4.18	7.71	12.72	12.10	11.17	9.24	8.89
3	1970	1971	3.07	6.40	11.77	14.58	10.25	3.02	5.76	12.94	12.91	12.86	12.57	13.23
4	1971	1972	14.58	8.83	14.59	12.06	14.84	3.65	3.59	12.07	12.03	11.18	9.43	7.87
5	1972	1973	2.21	12.41	14.58	13.99	13.20	2.53	5.75	11.14	10.05	7.76	2.93	0.00
6	1973	1974	0.00	0.00	0.00	12.04	9.33	3.86	9.56	8.36	7.84	7.66	7.39	7.85
7	1974	1975	3.36	8.86	0.00	10.85	8.19	3.48	6.62	7.99	7.93	0.00	0.00	6.68
8	1975	1976	7.34	6.10	8.24	14.72	13.89	6.03	2.22	9.40	8.00	0.00	0.00	0.00
9	1976	1977	0.00	0.00	5.44	6.58	4.42	1.57	4.01	8.28	7.48	0.00	0.00	0.00
10	1977	1978	0.00	10.18	8.83	14.39	15.00	8.27	5.31	11.89	11.18	10.60	10.13	10.52
11	1978	1979	3.44	6.05	10.27	13.44	13.36	4.73	4.88	12.65	11.97	11.19	8.83	9.40
12	1979	1980	3.66	3.69	2.35	15.26	14.80	6.43	0.00	11.64	10.63	9.54	6.17	0.00
13	1980	1981	0.00	0.00	4.66	13.47	12.73	9.23	3.04	8.03	7.55	0.00	0.00	0.00
14	1981	1982	5.37	9.22	9.22	9.70	4.26	1.43	3.88	0.00	0.00	0.00	0.00	0.00
15	1982	1983	0.00	0.00	8.72	14.90	14.38	13.03	5.30	8.67	4.51	0.00	0.00	0.00
16	1983	1984	0.00	0.00	3.31	14.83	14.58	13.89	13.16	12.85	12.52	12.48	11.81	9.69
17	1984	1985	6.04	15.24	14.58	10.50	8.42	7.38	5.70	12.79	12.29	12.39	12.00	11.06
18	1985	1986	3.79	15.26	14.58	14.58	11.14	5.78	7.55	12.73	12.17	11.28	9.07	6.32
19	1986	1987	4.22	8.30	7.04	10.73	13.14	1.79	3.78	9.38	8.01	0.00	0.00	0.00
20	1987	1988	0.00	5.25	10.21	9.35	8.15	2.32	7.67	9.96	9.93	9.17	6.63	7.65
21	1988	1989	4.99	8.96	10.28	11.26	9.20	1.50	2.80	7.99	7.48	0.00	0.00	6.11
22	1989	1990	5.57	10.93	11.56	10.06	12.64	0.00	5.86	11.60	12.39	12.51	12.10	7.18
23	1990	1991	3.58	15.24	14.58	10.84	13.54	0.00	5.49	11.94	11.01	10.12	8.18	5.85
24	1991	1992	2.38	9.17	5.09	14.64	13.73	6.81	1.75	9.16	7.83	0.00	0.00	0.00
25	1992	1993	0.00	2.98	7.51	14.31	12.85	4.63	4.50	7.89	8.12	5.36	0.00	0.00
26	1993	1994	2.46	5.80	2.95	14.58	14.58	4.13	7.04	12.70	11.97	11.11	8.88	6.09
27	1994	1995	4.38	3.71	10.16	9.23	10.73	4.94	9.35	13.16	13.05	12.81	12.68	6.84
28	1995	1996	8.74	14.58	6.90	12.85	10.49	3.23	4.11	12.80	12.10	11.22	9.27	5.15
29	1996	1997	6.37	5.10	8.29	14.36	13.16	8.50	2.47	10.07	10.25	9.38	7.61	0.00
30	1997	1998	6.10	3.73	14.58	10.87	13.40	3.18	6.33	11.70	10.74	9.63	6.90	6.24
31	1998	1999	4.23	9.75	2.42	5.75	6.18	4.24	5.77	12.79	12.06	11.18	7.58	6.15
32	1999	2000	4.28	2.62	4.67	6.04	2.38	3.36	7.66	12.73	12.13	11.26	8.93	9.47
33	2000	2001	1.64	4.82	4.85	14.58	8.49	3.84	7.96	12.82	12.14	11.19	7.22	6.62
34	2001	2002	3.19	9.74	2.67	9.74	5.39	1.71	0.00	9.64	8.26	0.00	0.00	0.00
35	2002	2003	0.00	0.00	3.10	14.22	6.35	4.21	10.16	13.10	12.68	11.98	9.71	9.09
36	2003	2004	0.00	5.14	5.84	13.02	11.60	3.86	2.19	8.52	7.48	0.00	0.00	0.00
37	2004	2005	0.00	0.00	5.92	6.11	13.80	2.38	0.00	11.23	10.29	9.15	5.58	0.00
38	2005	2006	0.00	2.69	12.21	14.98	10.65	8.05	5.81	13.05	13.02	12.81	9.81	10.25
39	2006	2007	3.41	15.12	12.59	7.77	5.02	2.22	4.46	12.79	12.04	11.12	7.68	6.06
40	2007	2008	6.49	7.41	5.07	13.37	11.24	9.24	7.66	12.80	12.05	11.13	8.75	5.35

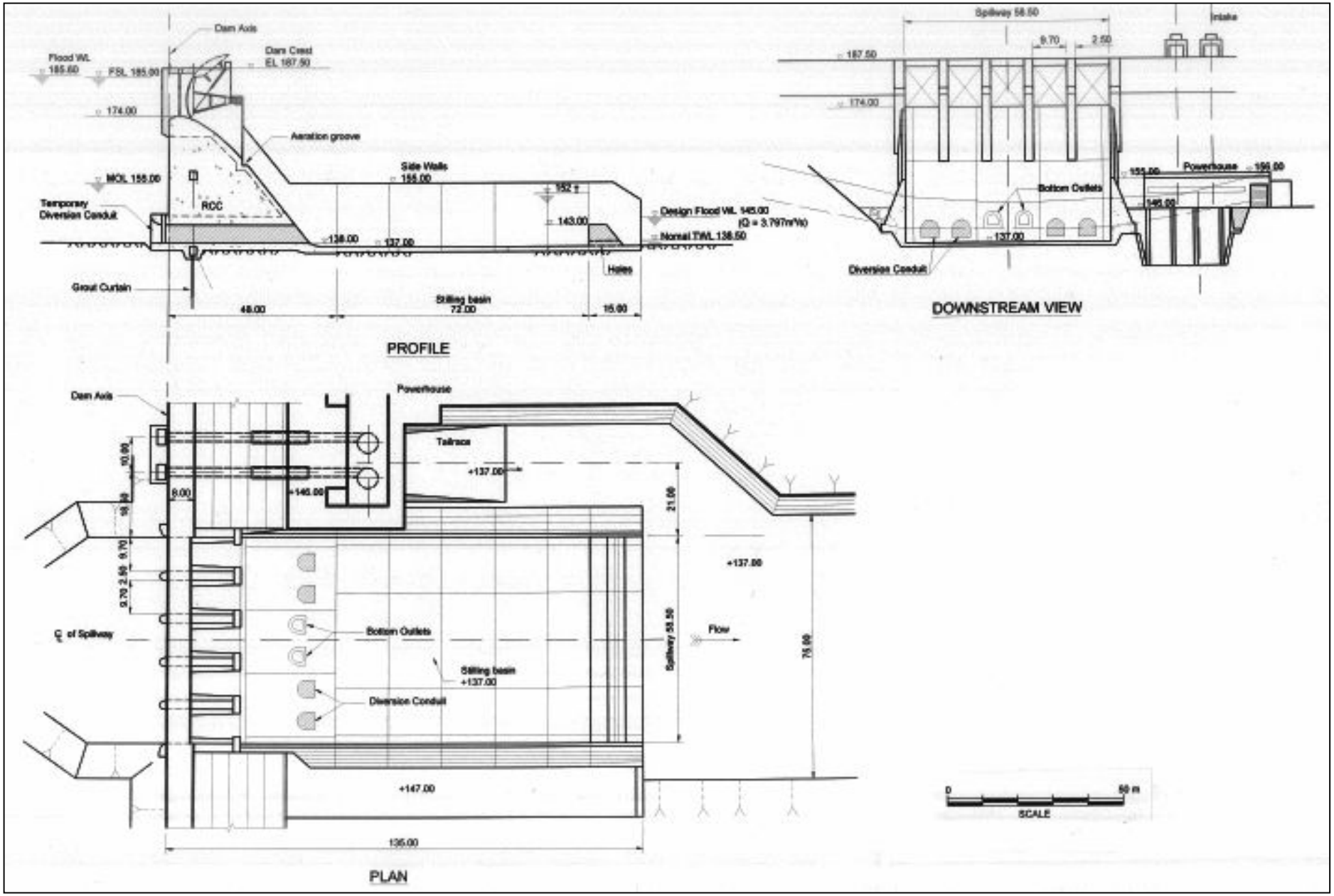
4) Energy Output (GWH/month) 7.5MW x 2 units GWH

	Beg.	End	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	1968	1969	7.90	6.37	2.81	9.09	7.65	2.21	2.54	9.33	9.01	9.00	6.92	7.55	80.38
2	1969	1970	2.02	4.84	10.85	10.85	9.80	3.11	5.55	9.46	8.71	8.31	6.87	6.40	86.77
3	1970	1971	2.29	4.61	8.75	10.85	6.89	2.25	4.14	9.63	9.30	9.56	9.35	9.52	87.14
4	1971	1972	10.85	6.36	10.85	8.97	9.97	2.72	2.58	8.98	8.66	8.32	7.02	5.67	90.95
5	1972	1973	1.65	8.93	10.85	10.41	8.87	1.89	4.14	8.29	7.24	5.78	2.18	0.00	70.21
6	1973	1974	0.00	0.00	0.00	8.96	6.27	2.87	6.88	6.22	5.64	5.70	5.50	5.65	53.69
7	1974	1975	2.50	6.38	0.00	8.07	5.50	2.59	4.77	5.95	5.71	0.00	0.00	4.81	46.27
8	1975	1976	5.46	4.39	6.13	10.95	9.33	4.48	1.60	7.00	5.76	0.00	0.00	0.00	55.11
9	1976	1977	0.00	0.00	4.04	4.90	2.97	1.16	2.88	6.16	5.39	0.00	0.00	0.00	27.51
10	1977	1978	0.00	7.33	6.57	10.70	10.08	6.16	3.82	8.85	8.05	7.69	7.54	7.57	84.55
11	1978	1979	2.56	4.35	7.64	10.00	8.98	3.52	3.51	9.41	8.62	8.32	6.57	6.77	80.25
12	1979	1980	2.72	2.65	1.75	11.35	9.95	4.78	0.00	8.66	7.65	7.10	4.59	0.00	61.21
13	1980	1981	0.00	0.00	3.47	10.02	8.55	6.87	2.19	5.97	5.43	0.00	0.00	0.00	42.51
14	1981	1982	4.00	6.64	6.86	7.22	2.86	1.07	2.79	0.00	0.00	0.00	0.00	0.00	31.43
15	1982	1983	0.00	0.00	6.49	11.09	9.67	9.70	3.81	6.45	3.25	0.00	0.00	0.00	50.45
16	1983	1984	0.00	0.00	2.46	11.03	9.80	10.33	9.47	9.56	9.01	9.28	8.79	6.98	86.73
17	1984	1985	4.50	10.98	10.85	7.81	5.66	5.49	4.10	9.52	8.85	9.22	8.93	7.97	93.86
18	1985	1986	2.82	10.99	10.85	10.85	7.49	4.30	5.43	9.47	8.76	8.39	6.75	4.55	90.64
19	1986	1987	3.14	5.98	5.24	7.99	8.83	1.33	2.72	6.98	5.77	0.00	0.00	0.00	47.97
20	1987	1988	0.00	3.78	7.60	6.96	5.48	1.72	5.52	7.41	7.15	6.82	4.93	5.51	62.89
21	1988	1989	3.71	6.45	7.65	8.38	6.18	1.12	2.02	5.94	5.39	0.00	0.00	4.40	51.24
22	1989	1990	4.14	7.87	8.60	7.48	8.49	0.00	4.22	8.63	8.92	9.31	9.00	5.17	81.84
23	1990	1991	2.67	10.98	10.85	8.06	9.10	0.00	3.95	8.88	7.93	7.53	6.09	4.21	80.24
24	1991	1992	1.77	6.60	3.78	10.89	9.23	5.07	1.26	6.82	5.64	0.00	0.00	0.00	51.06
25	1992	1993	0.00	2.14	5.59	10.65	8.64	3.44	3.24	5.87	5.85	3.99	0.00	0.00	49.41
26	1993	1994	1.83	4.18	2.19	10.85	9.80	3.07	5.07	9.45	8.62	8.27	6.61	4.39	74.31
27	1994	1995	3.26	2.67	7.56	6.87	7.21	3.67	6.73	9.79	9.39	9.53	9.43	4.92	81.03
28	1995	1996	6.50	10.50	5.14	9.56	7.05	2.40	2.96	9.52	8.71	8.35	6.90	3.71	81.28
29	1996	1997	4.74	3.67	6.17	10.69	8.84	6.32	1.78	7.49	7.38	6.98	5.66	0.00	69.72
30	1997	1998	4.54	2.68	10.85	8.09	9.01	2.36	4.56	8.70	7.74	7.16	5.14	4.49	75.32
31	1998	1999	3.15	7.02	1.80	4.28	4.15	3.15	4.15	9.51	8.68	8.31	5.64	4.43	64.29
32	1999	2000	3.18	1.89	3.47	4.49	1.60	2.50	5.52	9.47	8.73	8.37	6.65	6.82	62.71
33	2000	2001	1.22	3.47	3.61	10.85	5.70	2.85	5.73	9.54	8.74	8.33	5.37	4.77	70.17
34	2001	2002	2.37	7.01	1.99	7.24	3.62	1.27	0.00	7.18	5.95	0.00	0.00	0.00	36.64
35	2002	2003	0.00	0.00	2.31	10.58	4.27	3.13	7.32	9.75	9.13	8.91	7.22	6.54	69.16
36	2003	2004	0.00	3.70	4.34	9.69	7.79	2.87	1.58	6.34	5.39	0.00	0.00	0.00	41.70
37	2004	2005	0.00	0.00	4.41	4.54	9.27	1.77	0.00	8.36	7.41	6.81	4.15	0.00	46.72
38	2005	2006	0.00	1.93	9.08	11.14	7.16	5.99	4.19	9.71	9.38	9.53	7.30	7.38	82.79
39	2006	2007	2.54	10.89	9.37	5.78	3.37	1.65	3.21	9.51	8.67	8.27	5.71	4.36	73.34
40	2007	2008	4.83	5.34	3.77	9.95	7.55	6.87	5.51	9.53	8.68	8.28	6.51	3.85	80.68
AVERAGE			2.57	4.84	5.91	8.95	7.32	3.45	3.79	8.08	7.36	5.79	4.58	3.71	66.35
MAX			10.85	10.99	10.85	11.35	10.08	10.33	9.47	9.79	9.39	9.56	9.43	9.52	93.86
MIN			0.00	0.00	0.00	4.28	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.51



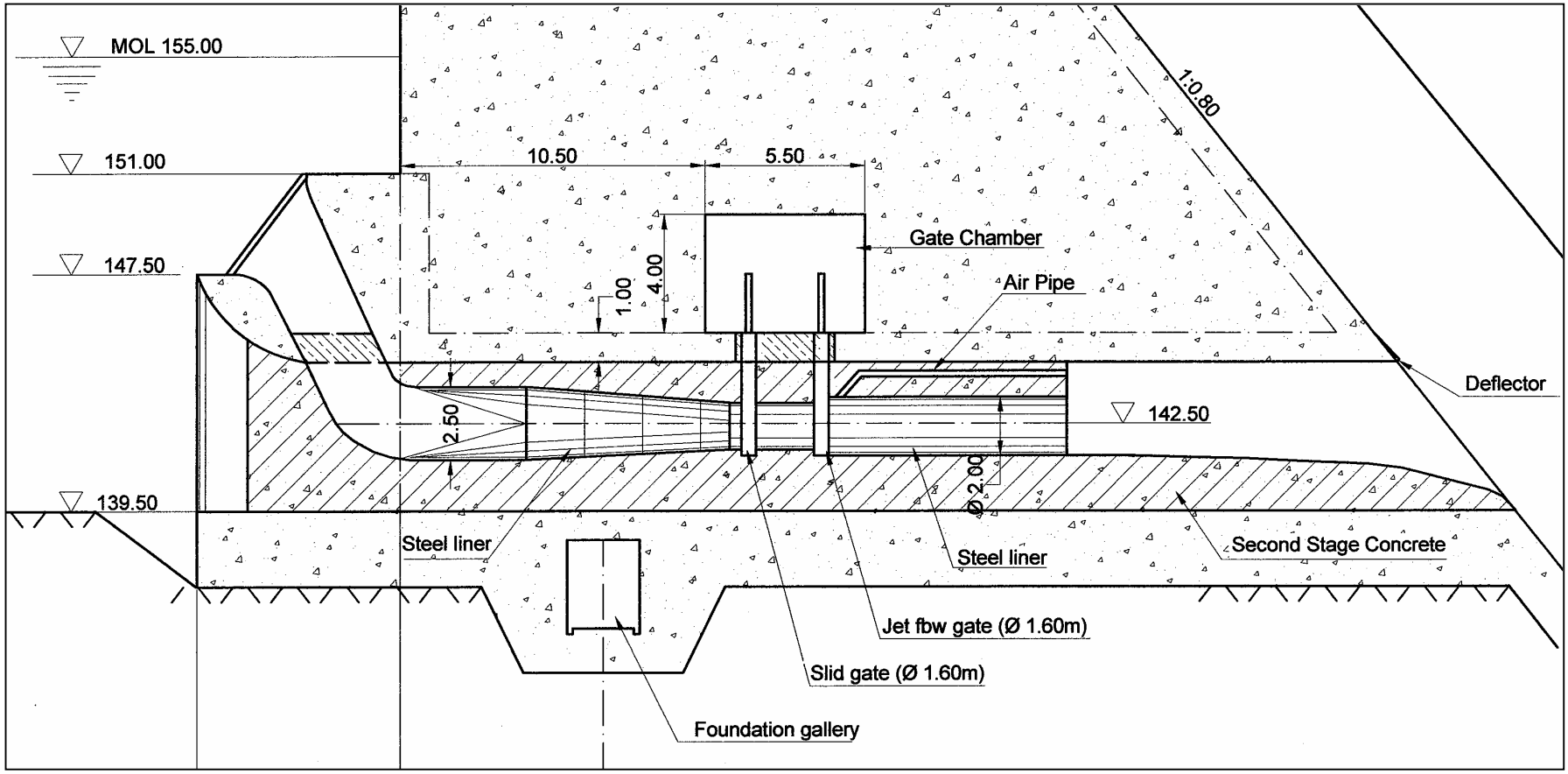
Prepared by the JICA survey team

Appendix C7-1 Dam Profile along Dam Axis



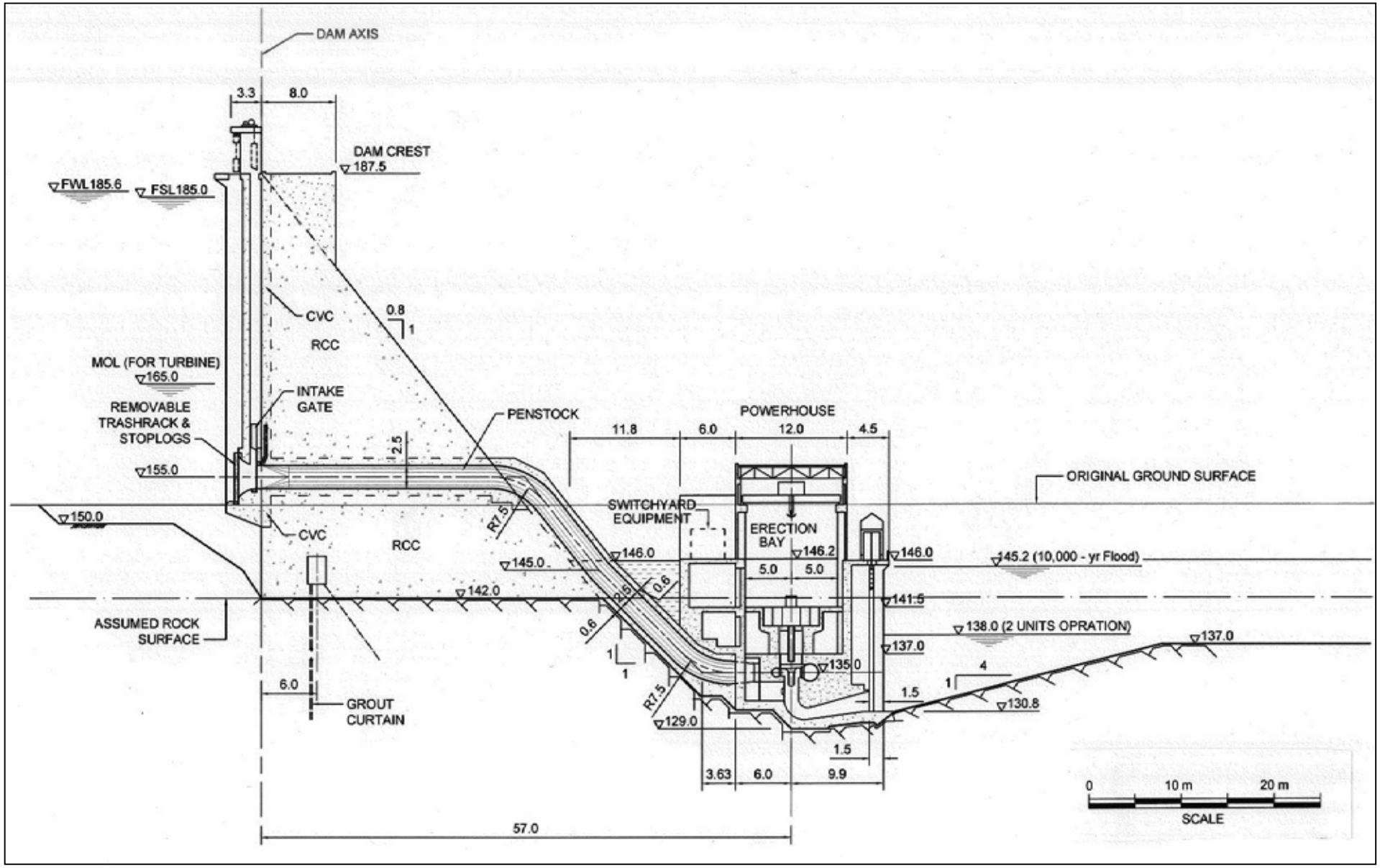
Prepared by the JICA survey team

Appendix C7-2 Spillway - Plan and Sections



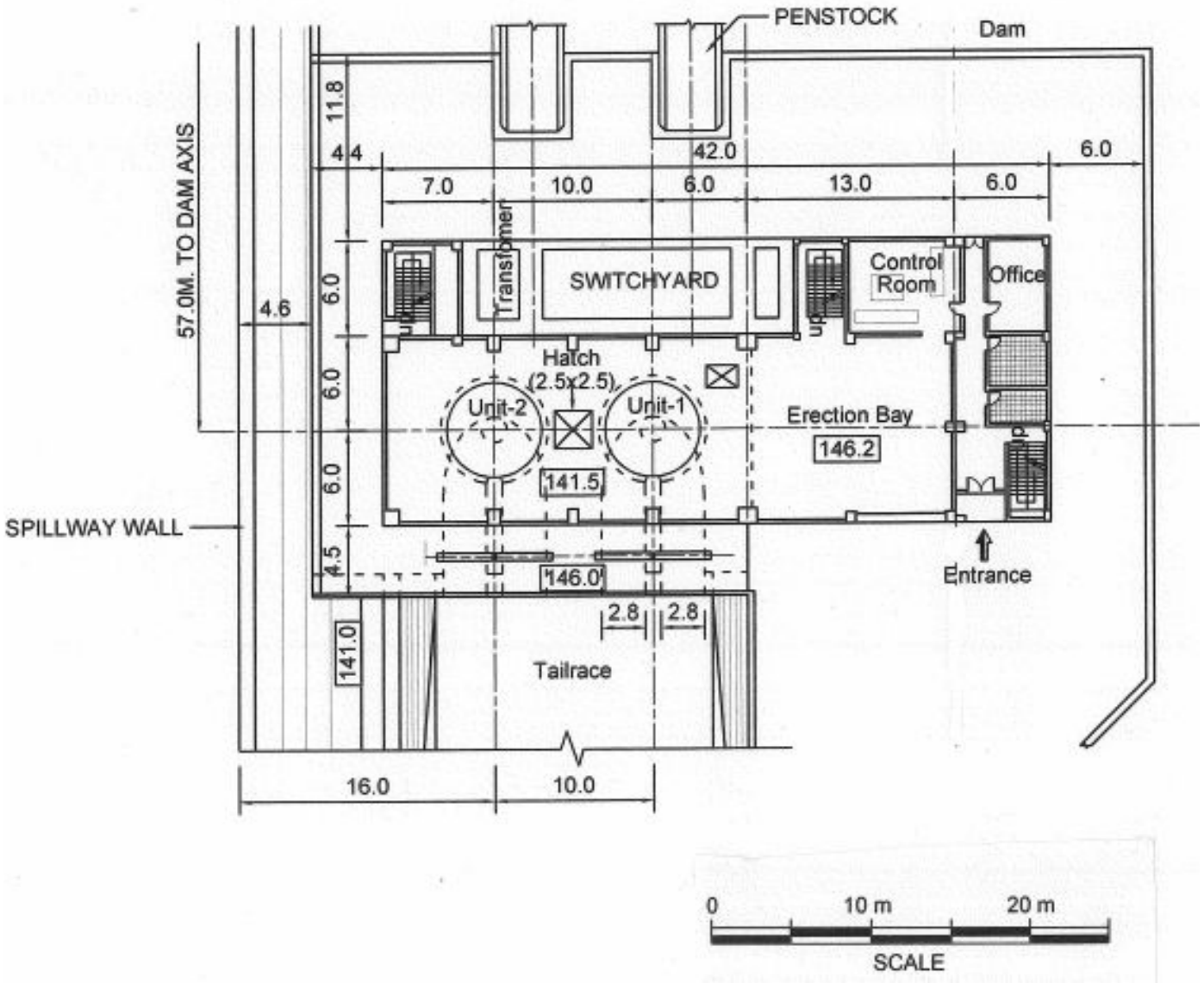
Prepared by the JICA survey team

Appendix C7-3 Bottom Outlet - Profile



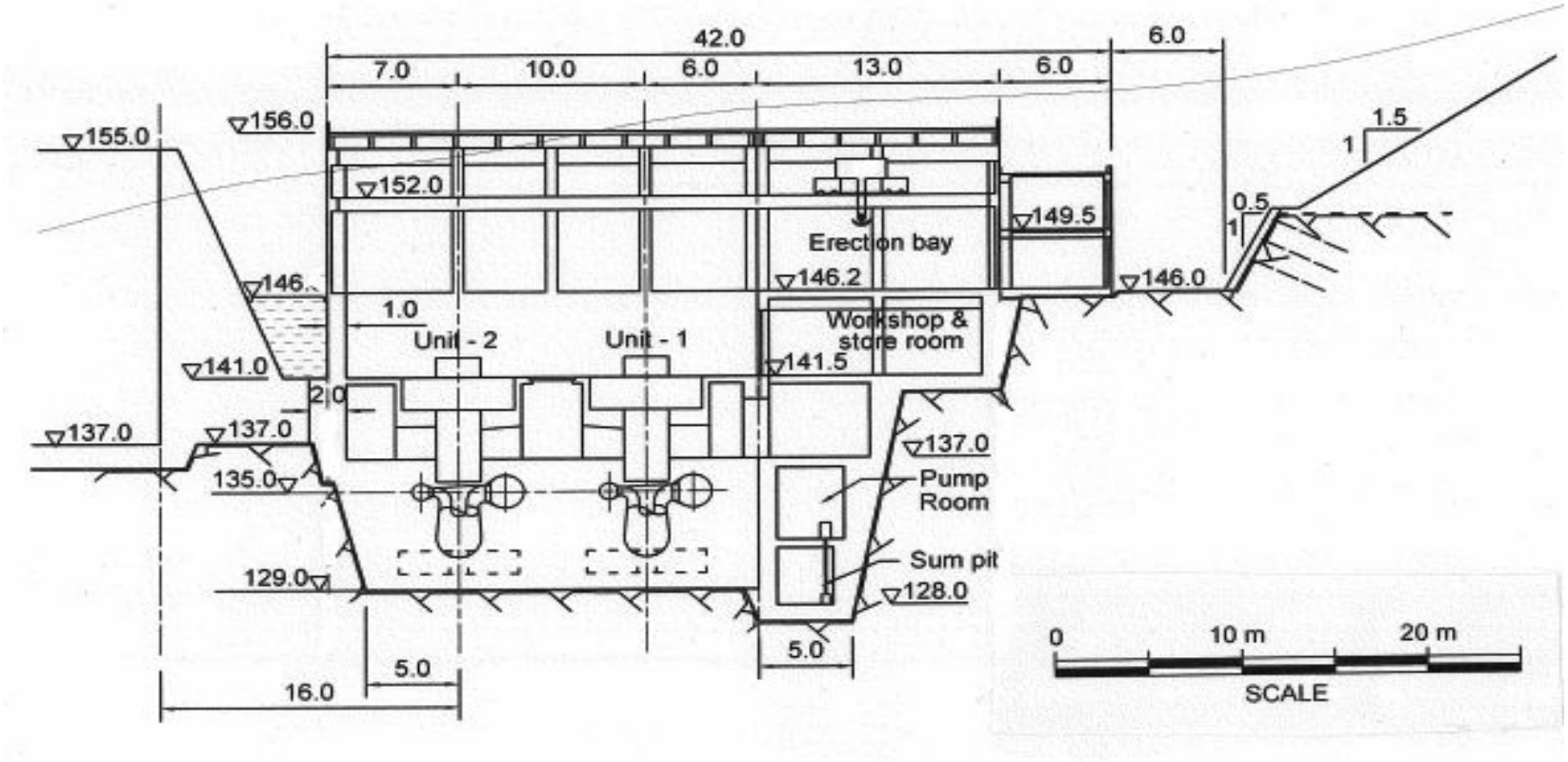
Prepared by the JICA survey team

Appendix C7-4 Intake and Powerhouse - Profile



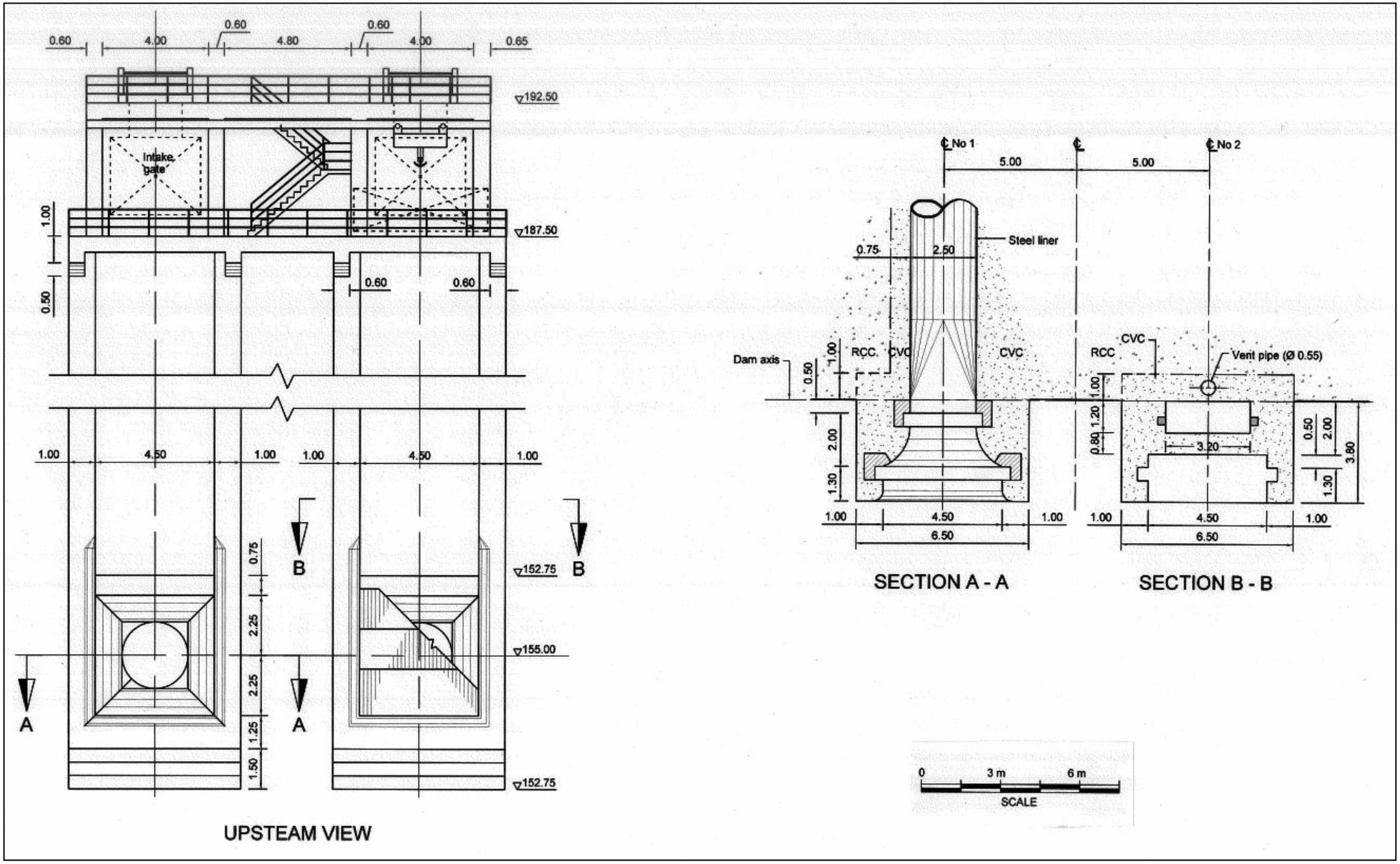
Prepared by the JICA survey team

Appendix C7-5 Powerhouse - Floor Plan



Prepared by the JICA survey team

Appendix C7-6 Powerhouse - Longitudinal Section



Prepared by the JICA survey team

Appendix C7-7 Power Intake - Front View and Horizontal Sections

Appendix C7-8 Calculation of construction shedule for Moragahakanda Dam

Workable days per month: 20 days/month

	Activity	Work schedule		Quantity	Unit	Capacity per day		Days	Num. of set	Duration	
		Item	Method							(days)	(months)
1.	**Diversion works**										
	Diversion channel	excavation	BH 1.5m^3	210,000	m^3	980.0	m^3	214.3	2	161	5.4
	Cofferdam										
	Foudation	excavation	BH 1.5m^3	40,000	m^3	980.0	m^3	40.8	1	62	2.1
	Primary cofferdam	embankment	BH 1.5m^3	15,000	m^3	980.0	m^3	15.3	1	23	0.8
	Secondary cofferdam	embankment	BH 3.1m^3	46,000	m^3	1370.0	m^3	33.6	1	51	1.7
2.	**Saddle No.1 dam**										
	Dam	excavation	BH 1.5m^3	160,000	m^3	980.0	m^3	163.3	2	123	4.1
		concrete	below EL146.0m	158,000	m^3	based on the H-V Curve					4.4
		concrete	above EL146.0m		m^3						22.4
								sub-total			26.8
	Foundation grouting	curtain		10,760	m	12.0	m	896.7	3	449	15.0
		consolidation		2,000	m	12.0	m	166.7	3	84	2.8
								sub-total			17.8
	Diversion gates & plug	concrete		2,100	m^3	150.0	m^3	14.0	1	21	0.7
3.	**Spillway**	excavation	BH 1.5m^3	341,000	m^3	980.0	m^3	348.0	2	261	8.7
	Structual	concrete		13,000	m^3	150.0	m^3	86.7	1	131	4.4
	Stilling basin	concrete		29,000	m^3	250.0	m^3	116.0	1	174	5.8
	Downstream channel	slope protection riprap		17,000	m^3	980.0	m^3	17.3	1	26	0.9
		concrete		4,200		150.0	m^3	28.0	1	42	1.4
	Bank protection	excavation	BH 1.5m^3	14,000	m^3	980.0	m^3	14.3	1	22	0.7
		concrete		8,300	m^3	150.0	m^3	55.3	1	83	2.8
		slope protection		6,000	m^3	980.0	m^3	6.1	1	10	0.3
4.	**Powerhouse and Bottom outlet**										
	Powerhouse	excavation	BH 1.5m^3	31,000	m^3	980.0	m^3	31.6	1	48	1.6
		backfilling	BH 1.5m^3	3,000	m^3	980.0	m^3	3.1	1	5	0.2
		concrete		7,500	m^3						6.0
	Bottom outlet	concrete		2,100	m^3	150.0	m^3	14.0	1	21	0.7
		gates		5							
5.	**Intake and pecstock**	pipe installation		30	m	2.0	m	15.0	1	23	0.8
		2nd concrete		2,800	m^3	150.0	m^3	18.7	1	29	1.0
6.	**Main dam**										
	Dam	excavation	above EL139.0m	260,000	m^3	980.0	m^3	265.3	2	199	6.6
			below EL139.0m	180,000	m^3	980.0	m^3	183.7	2	138	4.6
								sub-total			11.2
		embankment	BH 3.1m^3	1,380,000	m^3	based on the H-V Curve					17.5
	Foundation grouting	cap concrete		2,000	m^3	150.0	m^3	13.3	1	20	0.7
		curtain		7,720	m	12.0	m	643.3	3	322	10.7
		consolidation		2,000	m	12.0	m	166.7	3	84	2.8
								sub-total			14.2

APPENDIX D

COST ESTIMATE

PREPARATORY SURVEY

ON

MORAGAHAKANDA DEVELOPMENT PROJECT

FINAL REPORT

APPENDIX D COST ESTIMATE

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Appendix D1 Initial Investment Cost for the Project

Unit: Million

Designation	FC (JPY)	LC (LKR)	Total (JPY)	Eligible (JPY)	Non-eligible (JPY)
1. Construction Cost	9,098	3,474	11,842	11,465	377
1.1 Moragahakanda Dam	8,576	3,084	11,012	10,701	311
1.2 Kaudulla Left Bank Extension Area	522	390	830	764	66
2. Procurement Cost	300	0	300	300	0
3. Irrigation and Social Infrastructure for resettlement	1,714	592	2,182	1,951	231
4. Land acquisition and Compensation	0	3,227	2,549	0	2,549
5. Income Restoration Assistance Programmes and others	0	254	201	201	0
6. Environment Management Plan	0	1,000	790	790	0
7. Price Escalation	1,440	3,149	3,927	3,091	836
8. Physical Contingency	1,215	1,151	2,125	1,780	345
Sub-Total (=1 to 8)	13,767	12,847	23,916	19,578	4,338
9. Consulting Services	1,496	1,323	2,541	2,541	0
10. Price Escalation for Consulting Services	189	553	626	626	0
11. Physical Contingency for Consulting Services	168	188	317	317	0
Sub-Total (=9 to 11)	1,853	2,064	3,484	3,484	0
12. Interest During Construction	1,086	0	1,086	1,086	0
12.1 Interest During Construction (Const.)	1,085	0	1,085	1,085	0
12.2 Interest During Construction (Consul.)	1	0	1	1	0
13. Commitment Charge	169	0	169	169	0
Sub-Total (=12 to 13)	1,255	0	1,255	1,255	0
14. Administration Cost	0	1,700	1,343	0	1,343
15. VAT	0	1,767	1,396	0	1,396
Sub-Total (=14 to 15)	0	3,467	2,739	0	2,739
Grand Total	16,875	18,378	31,393	24,317	7,076

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Appendix D2 Construction Cost for Moragahakanda Dam

Unit: Million

No	Designation	FC (JPY)	LC (LKR)	Total (JPY)	Remarks
1	Civil Works				
1.1	Dam	2,885	1,298	3,910	
1.1.1	Diversion works	166	89	236	
1.1.2	Main dam	1,511	560	1,953	
1.1.3	Saddle dam No1	1,208	649	1,721	
1.1.4	Saddle dam No2	266	152	386	non eligible
1.2	Spillway	973	461	1,337	
1.3	Powerhouse & switchyard	240	101	320	
1.4.1	Improvement of existing roads	327	85	394	
1.4.2	Diversion road with bridges & culverts	132	67	185	non eligible
1.5	Preliminary and general works, site installation and administration, etc	1,770	778	2,385	
	Total 1 for civil works	6,195	2,723	8,346	
	Total 2 for civil works	398	219	571	non eligible
2	Hydro-Mechanical Works				
2.1	Spillway	584	82	649	
2.2	Diversion conduit	60	8	66	
2.3	Bottom outlet	227	32	252	
2.4	Power intake	74	10	82	
2.5	Steel penstock	48	7	54	
2.6	Draft tube outlet	22	3	24	
	Total for hydro-mechanical works	1,015	142	1,127	
3	Hydro-Power Equipment				
3.1	Powerhouse	841	0	841	
	Total for hydro-power equipment	841	0	841	
4	Transmission line				
4.1	Transmission line	127	0	127	
	Total for transmission line	127	0	127	
5	Total Construction Cost 1	8,178	2,865	10,441	
	Total Construction Cost 2	398	219	571	non eligible

Prepared by the JICA Survey Team

Appendix D3 Procurement Cost

No		Unit	Quantity	FC(JPY)		LC(LKR)		Total(JPY)
				Unit Rate	Amount	Unit Rate	Amount	
1	Ooeration and Maintenance Equipment							
1.1	Construction equipment							
(1)	Backhoe shovel 0.3m3	Units	2	9,000,000	18,000,000			18,000,000
(2)	Backhoe shovel 1.0m3	Units	2	10,000,000	20,000,000			20,000,000
(3)	Bulldozer 11ton	Units	1	20,000,000	20,000,000			20,000,000
(4)	Weel loader 1.0m3	Units	2	12,000,000	24,000,000			24,000,000
(5)	Motor grader 3.7m	Units	1	22,000,000	22,000,000			22,000,000
(6)	Tire riller 6-8ton	Units	2	8,000,000	16,000,000			16,000,000
(7)	Plate compactor 50-60kg	Units	3	150,000	450,000			450,000
(8)	Concrete breaker 40kg	Units	3	160,000	480,000			480,000
(9)	Concrete mixer 0.1m3	Units	3	1,500,000	4,500,000			4,500,000
(10)	Submersible pump D=75mm	Units	3	20,000	60,000			60,000
(11)	Portable genarator 3kvA	Units	3	500,000	1,500,000			1,500,000
(12)	Air compressor 7.5m3/min	Units	1	2,500,000	2,500,000			2,500,000
(13)	Cargo truck with fuel tank 3000lit	Units	2	3,500,000	7,000,000			7,000,000
(14)	Dump truck 11ton	Units	5	9,500,000	47,500,000			47,500,000
(15)	Dump truck 3ton	Units	3	4,000,000	12,000,000			12,000,000
(16)	Cargo truck 6ton	Units	3	5,000,000	15,000,000			15,000,000
(17)	Cargo truck 6ton with crane 1.5ton	Units	3	8,000,000	24,000,000			24,000,000
(18)	Pick-up truck 1ton	Units	5	2,500,000	12,500,000			12,500,000
(19)	Motor boat	Units	1	7,000,000	7,000,000			7,000,000
(20)	Paitrol boat	Units	1	10,000,000	10,000,000			10,000,000
(21)	Micro bus	Units	2	3,000,000	6,000,000			6,000,000
(22)	Spare parts	L.S.	1	31,010,000	31,010,000			31,010,000
	Sub-total				283,500,000			283,500,000
1.2	Communication equipment	L.S.	1	1,000,000	1,000,000			1,000,000
1.3	Meteorological equipment	L.S.	1	9,000,000	9,000,000			9,000,000
1.4	Survey isstrument	L.S.	1	5,000,000	5,000,000			5,000,000
1.5	Computer	L.S.	1	1,500,000	1,500,000			1,500,000
	Sub-total				16,500,000			16,500,000
	Total				300,000,000			300,000,000

Prepared by the JICA Survey Team

Appendix D4 Consulting Services Cost (Remuneration)

No	Item	Unit	Quantity	FC(JPY)		LC(LKR)		Total(JPY)
				Unit Rate	Amount	Unit Rate	Amount	
(1)	Remuneration and Salary							
(a)	Professional A	MM	422.4	2,700,000	1,140,480,000	0	0	1,140,480,000
(b)	Professional B	MM	1049	0	0	450,000	472,050,000	372,919,500
(c)	Supporting Staffs	MM	1866	0	0	40,000	74,640,000	58,965,600
	Total		0	0	1,140,480,000	0	546,690,000	1,572,365,100

Prepared by the JICA Survey Team

Appendix D5 Direct Cost for Consulting Services Cost

No	Item	Unit	Quantity	FC(JPY)		LC(LKR)		Total(JPY)
				Unit Rate	Amount	Unit Rate	Amount	
(2)	Direct Cost							
(a)	International Airfare	Trips	120	250,000	30,000,000	0	0	30,000,000
(b)	Domestic Airfare	Trips	0	0	0	0	0	0
(c)	Domestic Travel	Trips	0	0	0	0	0	0
(d)	Accommodation Allowance (Professional A)	days	12672	7,000	88,704,000	0	0	88,704,000
(e)	Accommodation Allowance (Professional B)	days	31470	0	0	4,000	125,880,000	99,445,200
(f)	Accommodation Allowance (Supporting Staffs)	days	55980	0	0	2,000	111,960,000	88,448,400
(g)	Per Diem (Professional A)	days	12672	6,000	76,032,000	0	0	76,032,000
(h)	Per Diem (Professional B)	days	31470	0	0	3,000	94,410,000	74,583,900
(i)	Per Diem (Supporting Staffs)	days	55980	0	0	1,000	55,980,000	44,224,200
(j)	Purchase of Car	unit	12	3,500,000	42,000,000	0	0	42,000,000
(k)	Purchase of Motorcycle	unit	25	200,000	5,000,000	0	0	5,000,000
(l)	Fuel for Car	Car・Month	720	0	0	15,000	10,800,000	8,532,000
(m)	Fuel for Motorcycle	Car・Month	2880	0	0	5,000	14,400,000	11,376,000
(n)	Maintenance Cost for Car	Car・Month	720	0	0	60,000	43,200,000	34,128,000
(o)	Maintenance Cost for Mortorcycle	Car・Month	2880	0	0	5,000	14,400,000	11,376,000
(p)	Office Rental	Month	72	0	0	50,000	3,600,000	2,844,000
(q)	Office Supply	Month	2915	0	0	25,000	72,875,000	57,571,250
(r)	Office Equipment	L.S.	1	6,405,000	6,405,000	0	0	6,405,000
(s)	Office Furniture	L.S.	1	0	0	4,410,000	4,410,000	3,483,900
(t)	International Communications	M/M	422.4	5,000	2,112,000	0	0	2,112,000
(u)	Domestic Communications	M/M	2915	0	0	2,000	5,830,000	4,605,700
(v)	Report Preparation	L.S.	1	0	0	1,500,000	1,500,000	1,185,000
(w)	Geological investigation	L.S.	1	15,000,000	15,000,000	0	0	15,000,000
(x)	Hydraulic Model Test	L.S.	1	10,000,000	10,000,000	0	0	10,000,000
(y)	Soft component		0	0	0	0	0	0
	i)Agricultural Extension Services *see Appendix D5-2, D5-3	L.S.	1	0	0	175,596,000	175,596,000	138,720,840
	ii)Establishment and Strengthening of Fos *see Appendix D5-4	L.S.	1	0	0	41,860,000	41,860,000	33,069,400
(z)	Oversease Training	M/M	40	2,000,000	80,000,000	0	0	80,000,000
	Total		0	0	355,253,000	0	776,701,000	968,846,790

Prepared by the JICA Survey Team

Appendix D5-1 Manning Schedule for the Consulting Services

		Position	BillingRate F/C Yen	BillingRate LC/ LKR	2011	2012	2013	2014	2015	2016	2017	Total
A	1	Project Director	2700000	0	0.5	0.3	0.5	0.3	0.3		0.5	2
A	2	Team Leader	2700000	0	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	62
A	3	Dam Engineer (Fill Dam)	2700000	0	1 1	1 1 1		1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1		29
A	4	Dam Engineer (RCC Dam)	2700000	0	1 1	1 1 1	1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1		34
A	5	Civil Design Engineer	2700000	0	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1		54
A	6	Water Resources Planner	2700000	0	1 1 1							4
A	7	Engineering Geologist/Grout Specialist	2700000	0	1 1 1	1 1	1 1 1 1 1 1	1 1 1 1	1 1 1			20
A	8	Soil Mechanical Engineer	2700000	0	1 1 1		1 1 1		1 1 1 1 1 1			12
A	9	Concrete Engineer	2700000	0	1 1 1 1		1 1 1 1 1 1	1 1 1 1 1 1 1	1 1 1			21
A	10	Instrumentation Expert	2700000	0		1 1		1 1 1 1 1 1	1 1 1 1	1 1 1 1	1 1	16
A	11	Hydraulic Model Test Expert	2700000	0	1 1 1 1							4
A	12	Hydro-mechanical Engieer	2700000	0	1 1 1	1 1	1 1 1 1 1 1	1 1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1	1 1	23
A	13	Electrical Engineer	2700000	0	1 1 1	1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1	25
A	14	Transmission line Engineer	2700000	0	1 1 1				1 1 1	1 1 1		11
A	15	Architect/Utility Engineer	2700000	0		1 1		1 1	1 1			6
A	16	Irrigation Engineer	2700000	0	1 1 1	1 1	1 1 1	1 1 1				11
A	17	Agronomist	2700000	0	1 1							2
A	18	Construction Planner/Cost Estimater	2700000	0	1 1	1 1 1						5
A	19	Specification Specialist	2700000	0		1 1 1						3
A	20	Contract Enigneer	2700000	0		1 1 1 1 1 1 1	1 1	1 1 1 1	1 1 1	1 1 1 1 1	1 1 1	25
A	21	O & M/Water Management Expert	2700000	0						1 1 1 1 1 1		6
A	22	Social Specialist (Agriculture & Organizatior	2700000	0	1 1		1	1 1	1	1	1	8
A	23	Social Specialist (Resettlement)	2700000	0	1 1		1	1 1	1	1	1	8
A	24	Environmental Specialist	2700000	0	1 1		1	1 1	1	1	1	8
A	25	Specialist As required	2700000	0				1 1 1 1	1 1	1 1		8
A	26	Home Support Engineer	2700000	0	1 1	1	1 1	1 1 1	1 1 1	1 1 1		15
B	1	Co-Team Leader	0	450000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	68
B	2	Dam Engineer (Fill Dam)	0	450000	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1		49
B	3	Dam Engineer (RCC)	0	450000	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1		50
B	4	Structure Engineer	0	450000	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1					18
B	5	Civil Desgin Engineer	0	450000	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 1 1 1 1	1 1 1 1 1 1 1 1		81
B	6	Water Resources Planner	0	450000	1 1 1 1 1 1							6
B	7	Engineering Geologist	0	450000	1 1 1 1 1 1		2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 1 1 1 1 1	1 1 1 1 1 1			49
B	8	Geodetec Expert	0	450000	1 1 1 1 1 1		1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1		48
B	9	Construction Engineer	0	450000			2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2		84
B	10	Grout Specialist	0	450000		1 1 1 1		1 1 2 2 2 2 2 2	2 2 2 2 2 2 2 2 1 1 1 1	1 1 1 1 1 1		44
B	11	Soil Mechanical Engineer	0	450000	1 1 1 1 1 1	1 1		1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1		41
B	12	Concrete Engineer	0	450000	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1		50
B	13	Instrumentation Expert	0	450000		1 1 1 1		1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	44
B	14	Hydraulic Model Test Expert	0	450000	1 1 1 1	1 1						6
B	15	Hydro-mechanical Engieer	0	450000	1 1	1 1 1 1 1 1	1	1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1	1 1	41
B	16	Electrical Engineer	0	450000	1 1	1 1 1 1 1 1	1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1	1 1	38
B	17	Transmission line Engineer	0	450000	1 1 1	1 1		1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1		27
B	18	Architect/Utility Engineer	0	450000		1 1 1		1 1 1 1 1 1	1 1 1 1 1 1			15
B	19	Irrigation Engineer	0	450000	1 1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1				29
B	20	Agronomist	0	450000	1 1 1							3
B	21	Construction Planner/Cost Estimater	0	450000		1 1 1 1 1 1						6
B	22	Specification Specialist	0	450000		1 1 1 1 1 1						6
B	23	Contract Enigneer	0	450000		1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	60
B	24	O & M/Water Management Expert	0	450000						1 1 1 1 1 1 1 1 1		9
B	25	Social Specialist (Agriculture & Organizatior	0	450000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	67
B	26	Social Specialist (Resettlement)	0	450000	1 1 1 1 1		1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	55
B	27	Environmental Specialist	0	450000	1 1 1 1 1		1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	55
		[Total of Pro-A]			**51**	**62**	**47**	**100**	**87**	**62**	**14**	**422**
		[Total of Pro-B]			**89**	**128**	**154**	**242**	**245**	**175**	**16**	**1,049**
		[Total of Pro-A+Pro-B]			140	190	201	342	332	237	30	1,471
		Total Cost of FC for Each Month(Pro-A)			136,350,000	168,210,000	125,550,000	270,810,000	235,710,000	167,400,000	36,450,000	1,140,480,000
		Total Cost of FC for Each Month(Pro-B)			0	0	0	0	0	0	0	0
		Total Cost of LC for Each Month(Pro-A)			0	0	0	0	0	0	0	0
		Total Cost of LC for Each Month(Pro-B)			40,050,000	57,600,000	69,300,000	108,900,000	110,250,000	78,750,000	7,200,000	472,050,000
C	1	Office Manager	0	40000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	68
C	2	Accountant	0	40000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	68
C	3	Secretary	0	40000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	68
C	4	Computer Operator	0	40000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	68
C	5	Office Boy	0	40000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2	116
C	6	Watchman	0	40000	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	1 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2	116
C	7	Ass. Design Eng. (Dam)	0	40000	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 1 1 1	1 1 1 1 1 1 1 1		108
C	8	Ass. Design Eng. (Irrigation Facilities)	0	40000	2 2	2 2 2 2 2 2 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1				40
C	9	CAD Operator (Dam)	0	40000	2 2 5 5	5 5 5 5 5 5 2 2 2 2 2 2	2 2 2 2 3 3 3 3 5	5 5 5 5 5 5 5 5 5 5 5 5	5 5 5 5 5 5 5 5 5 3 3 3	3 3 2 2 2 2 2 2		215
C	10	CAD Operator (Irrigation Facilities)	0	40000	1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1				32
C	11	Inspector Geology	0	40000			2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 1 1 1	1 1 1 1 1 1 1			46
C	12	Inspector Grouting	0	40000				4 4 4 4 4 4 4 4 4 4 4 4	4 4 4 4 4 4 4 2 2 2 2 2	2 2 2 2 2 2		84
C	13	Inspector Fill Dam	0	40000				4 4 4 4 4 4 4 4 4 4 4 4	4 4 4 4 4 4 4 4 4 4 4 4	4 4 4 4 4 4 4 4		88
C	14	Inspector Soil	0	40000			2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2		68
C	15	Inspector Instrument	0	40000			1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	40
C	16	Inspector RCC dam	0	40000			2 2 2 3 3 3 3 3 3 3 3 3	3 3 3 3 3 3 3 3 3 3 3 3	3 3 2 2			81
C	17	Inspector Concrete	0	40000			2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2		76
C	18	Inspector Archtect/Utility	0	40000				2 2 2 2 2 2 2 2 2 2 2 2	2 2			40
C	19	Inspector Electrical	0	40000				2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2		52
C	20	Inspector Hydro-mech	0	40000				2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2		58
C	21	Inspector Irrigation Facilities	0	40000	4 4 4 4 4 4	6 6 6 6 6 6 8 8 8 8 8 10	10 10 10 10 10 10 10 10 10 10 10 10	10 10 10 10 10 10				290
C	22	Secretary (document control)	0	40000			1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1	44
		[Total of Supporting Staff]			**92**	**250**	**331**	**460**	**449**	**264**	**20**	**1,866**
		Total Cost of LC for Each Month(SS)			3,680,000	10,000,000	13,240,000	18,400,000	17,960,000	10,560,000	800,000	74,640,000
		Grand Total			**232**	**440**	**532**	**802**	**781**	**501**	**50**	**3,337**

Appendix D5-2 Cost Estimate of Agricultural Extension Services under the Project

Item	Unit	Quantity	Unit Cost (LKR)	Amount (LKR)	Remarks
1. Training for extension staff by experts	programs	24	150,000	3,600,000	12 extension staff x 2 programs
2. Equipment and logistics support for extension services					
(1) Establishment and Maintenance of model farms					
i) Model farm at Kaudulla Area (10 ha)	L.S.	1	30,700,000	30,700,000	Refer to cost breakdown (Appendix D5-4)
ii) Model farm at Kalu Ganga Area (25 ha)	L.S.	1	44,175,000	44,175,000	Refer to cost breakdown (Appendix D5-4)
(2) Provision of motor bicycles	Nos.	12	200,000	2,400,000	12 extension staff
(3) Provision of vehicles	Nos.	2	12,000,000	24,000,000	Vehicles for 2 irrigation schemes
(4) Provision of equipment for mobile extension services	L.S.	1	12,921,000	12,921,000	Refer to cost breakdown (Appendix D5-4)
3. Conducting demonstrations in the field	seasons	4	1,700,000	6,800,000	4 seasons
4. Farm training to farmers	programs	120	50,000	6,000,000	50 farmers (about 30 ha) x 120 programs = 6,000 farmers
5. Crop clinics (Giving in-situ solutions to farmers)	programs	72	25,000	1,800,000	18 programs/season x 4 seasons
6. Participation in training programs of technical cooperation projects being implemented in other project areas	programs	4	300,000	1,200,000	3 extension staff x 1 program x 4 times = 12 extension staff
7. Local Experts (Sub-contract)	M/M	210	200,000	42,000,000	5 experts x 3 years x 6 months + 5 experts x 2 years x 12 months
Total				175,596,000	

Prepared by the JICA Survey Team

Appendix D5-3 Cost Estimate of Establishment and Strengthening of FOs under the Project

Item	Unit	Quantity	Unit Cost (LKR)	Amount (LKR)	Remarks
1. Awareness program to farmers	programs	60	50,000	3,000,000	100 farmers x 60 programs = 6,000 farmers
2. Training of trainers	programs	20	100,000	2,000,000	5 trainers x 2 programs x 10 times = 100 trainers
3. Training on organizational management, water management and facilities' O&M to FOs' members	programs	240	50,000	12,000,000	25 members x 2 programs x 120 times = 6,000 members
4. Follow-up workshops on sustainable irrigation system usage	programs	16	50,000	800,000	16 programs
5. Preparation of manuals on water management and O&M activities	sets	6,000	300	1,800,000	6,000 sets for members
6. Preparation of manuals for trainers on training of FOs' members	sets	100	600	60,000	100 sets for trainers
7. Participation in training programs of technical cooperation projects being implemented in other project areas	programs	10	300,000	3,000,000	10 trainees x 1 program x 10 times = 100 trainees
8. Local Experts (Sub-contract)	M/M	96	200,000	19,200,000	4 experts x 2 years x 12 months
Total				41,860,000	

Prepared by the JICA Survey Team

Appendix D5-4 Cost Breakdown of Agricultural Extension Services under the Project

Cost Breakdown of Establishment and Maintenance of model farm at Kaudulla Area (10 ha)

Item	Unit	Quantity	Unit Cost (LKR)	Amount (LKR)
1. Farm Preparation	ha	10	200,000	2,000,000
2. Electric fencing	km	2	625,000	1,250,000
3. Barb-wire fencing	m	2,000	900	1,800,000
4. Construction of buildings				
4.1 Office building	Nos.	1	2,000,000	2,000,000
4.2 Stores	Nos.	1	1,200,000	1,200,000
4.3 Quarters	Nos.	2	2,000,000	4,000,000
4.4 Tool stores, watch huts & Garage	L.S	1	500,000	500,000
4.5 Office furniture	L.S	1	200,000	200,000
5. Infrastructure development				
5.1 Electricity supply facilities	L.S	1	10,000,000	10,000,000
5.2 Roads and irrigation system	L.S	1	1,500,000	1,500,000
6. Machinery and farm tools				
6.1 Four wheel tractors	L.S	1	750,000	750,000
6.2 Two wheel tractors	L.S	1	400,000	400,000
6.3 Processing machines	L.S	1	100,000	100,000
6.4 Tilling implements	L.S	1	400,000	400,000
6.5 Farm tools	L.S	1	100,000	100,000
7. Farm agriculture budget	Seasons	7	500,000	3,500,000
8. Repair and maintenance	L.S	1	1,000,000	1,000,000
Total				30,700,000

Cost Breakdown of Establishment and Maintenance of model farm at Kalu Ganga Area (25 ha)

Item	Unit	Quantity	Unit Cost (LKR)	Amount (LKR)
1. Farm Preparation	ha	25	200,000	5,000,000
2. Electric fencing	km	3	625,000	1,875,000
3. Barb-wire fencing	m	3,000	900	2,700,000
4. Construction of buildings				
4.1 Office building	Nos.	1	2,000,000	2,000,000
4.2 Stores	Nos.	2	1,200,000	2,400,000
4.3 Quarters	Nos.	2	2,000,000	4,000,000
4.4 Tool stores, watch huts & Garage	L.S	1	500,000	500,000
4.5 Office furniture	L.S	1	200,000	200,000
5. Infrastructure development				
5.1 Electricity supply facilities	L.S	1	10,000,000	10,000,000
5.2 Roads and irrigation system	L.S	1	4,000,000	4,000,000
6. Machinery and farm tools				
6.1 Four wheel tractors	L.S	1	750,000	750,000
6.2 Two wheel tractors	L.S	1	400,000	400,000
6.3 Processing machines	L.S	1	100,000	100,000
6.4 Tilling implements	L.S	1	400,000	400,000
6.5 Farm tools	L.S	1	100,000	100,000
7. Farm agriculture budget	Seasons	7	1,250,000	8,750,000
8. Repair and maintenance	L.S	1	1,000,000	1,000,000
Total				44,175,000

Cost Breakdown of equipment for mobile extension services

	Unit	Quantity	Unit Cost (LKR)	Amount (LKR)
1. Multimedia Projector	Nos.	1	150,000	150,000
2. Laptop computer	Nos.	1	150,000	150,000
3. Screen	Nos.	1	20,000	20,000
4. Pen drive (Data storage and transport)	Nos.	2	500	1,000
5. Digital camera and accessories	Nos.	1	100,000	100,000
6. Van	Nos.	1	10,000,000	10,000,000
7. Tool kits for extension workers	Nos.	20	125,000	2,500,000
Total				12,921,000

Prepared by the JICA Survey Team

Appendix D6 Cost of Environment Management Plan

Unit: Million

No	Designation	FC (JPY)	LC (LKR)	Total (JPY)	Remarks
1	Establishment of 100m reservation around the peremeter reservoir	0	96	76	
2	Protection and Conservation of river/streams embankments in the watershed area	0	56	44	
3	Forestry Development in watershed area	0	227	179	
4	Implementation of Soil Conservation Methods for watershed area	0	103	81	
5	Wildlife Conservation in the watershed area	0	147	116	
6	Biodiversity conservation in watershed area	0	26	20	
7	Environment conservation activities in Resettlement area (Kaluganga & Medirigiriya)	0	100	79	
8	Community InfrastructurebDevelopment in watershed ares	0	33	26	
9	Farm production & income generation activities for settlers in watershed area	0	61	48	
10	Training & Capacity Building	0	40	32	
11	Support Facilities	0	51	40	
12	Management cost (Cost for the Management of the total programme & Monitoring cost)	0	61	48	
13	Total Cost	0	1,000	790	

Prepared by the JICA Survey Team

Appendix D7 Cost of Land Acquisition, Compensation and Resettlement

Unit: Million

No	Designation	FC (JPY)	LC (LKR)	Total (JPY)	Remarks
1	Land acquisition and Compensation (non-Eligible)	0	3,227	2,549	
1.1	Moragahakanda	0	3,178	2,511	
1.2	System 'F'- Moragahakanda - Host area	0	49	39	
2	Cost for Income Restoration Assistance Programmes and others (Eligible)	0	254	201	
2.1	Income Restoration Assistance Programmes, Training and Special Grants	0	152	120	
2.2	Monitoring & Evaluation	0	34	27	1% of sum of Items 1 to 3
2.3	Institutional Development	0	68	54	2% of sum of Items 1 to 4
3	Total Cost	0	3,481	2,750	

Prepared by the JICA Survey Team

Appendix D8 Price Indices for Local Currency Portion

i)Price Index for equipment From 2001 to 2010

Item	Base Year Price Index=100	Price indices 2001	Price indices 2010	Escalation from 2001 to
Small equipment	1990(AVG)	125	336.7	2.69
Heavy equipment	1990(AVG)	165.6	313.7	1.89
Fuel	1990(AVG)	340.3	713.4	2.1
			Average	**2.17**

ii)Price Index for materials From 2001 to 2010

Item	Base Year Price Index=100	Price indices 2001	Price indices 2010	Escalation from 2001 to
Cement	1990(AVG)	225	432.2	1.92
Cement blocks	1990(AVG)	214.5	445.4	2.08
Rubble	1990(AVG)	187.4	455.7	2.43
Metal	1990(AVG)	147.3	258.5	1.75
Sand	1990(AVG)	733.7	1717.1	2.34
Bricks (machine cut)	1990(AVG)	163.9	359.9	2.2
Lime	1990(AVG)	224.5	394.5	1.76
Reinforcement steel	1990(AVG)	227.3	460.1	2.02
Structual steel	1990(AVG)	226.4	420.9	1.86
Gl sheets	1990(AVG)	234.7	447.9	1.91
Pvc pipes	1990(AVG)	308.3	632.5	2.05
Formwork timber	1990(AVG)	320.7	702.5	2.19
General timber	1990(AVG)	319.5	755.3	2.36
Bitume 80/100 (using bulk price)	1990(AVG)	115.8	532	4.59
Ready mixed concrete	1993(APR)	165.7	322.9	1.95
High tensile steel wire	1993(APR)	260.6	512.4	1.97
Pre-stressed bridge beams	1993(APR)	244.1	516.3	2.12
Concrete lamp post	1993(APR)	241.4	517.4	2.14
Precast item for bridges,roads etc.	1993(APR)	178.1	362.4	2.03
Hume pipes	1993(APR)	180.7	470	2.6
			Average	**2.21**

iii)Price Index for labour From 2001 to 2010

Item	Base Year Price Index=100	Price indices 2001	Price indices 2010	Escalation from 2001 to
Skilled labour	1990(AVG)	197.2	340.3	1.73
Semiskilled labour	1990(AVG)	192.6	337.9	1.75
Unskilled labour	1990(AVG)	218	375.4	1.72
			Average	**1.73**

iv)Price Index for consumable From 2001 to 2010

Item	Base Year Price Index=100	Price indices 2001	Price indices 2010	Escalation from 2001 to
All construction	1990(AVG)	228.7	459.7	**2.01**
			Average	**2.03**

Price Index for LC portion From 2007 to 2010

Item	Base Year Price Index=100	Price indices 2007	Price indices 2010	Escalation from 2007 to
All construction	1990(AVG)	370.2	459.7	**1.24**

Source of data: ICTAD

Appendix D9 Breakdown of Construction Cost for Moragahakanda Dam

No	Description	Quantity	Unit	FC(J PY)		LC(LKR)		Total Costs	Remarks
				Unit prices	For.(x1000)	Unit prices	Loc.(x1000)	(x1000 JPY)	
1	Civil Works								
1.1	Diversion Works								
1.1.1	Diversion Channel								
	excavation of upstream diversion channel at Saddle NO.1	210,000	m³	413	86,730	258	54,180	129,532	
	Miscellaneous items	10	%	86,730	8,673	54,180	5,418	12,953	
	Subtotal				95,403		59,598	142,485	
1.1.2	Cofferdams								
	foundation excavation common	40,000	m³	413	16,520	258	10,320	24,673	
	primary coffer embankment	15,000	m³	786	11,790	266	3,990	14,942	
	secondary coffer embankment (outside main dam	46,000	m³	786	36,156	266	12,236	45,822	
	Miscellaneous items	10	%	64,466	6,447	26,546	2,655	8,544	
	Subtotal				70,913		29,201	93,981	
	Total of Item 1.1				166,316		88,799	236,466	
1.2	Dams								
1.2.1	Main Dam - Rockfill Dam								
(1)	Dam Construction								
	site clearing light jungle	7	ha	29,548	207	52,923	370	499	
	excavation for dam base	440,000	m³	413	181,720	258	113,520	271,401	
	rockfill with clay core including secondary cofferdam	1,380,000	m³	786	1,084,680	266	367,080	1,374,673	
	Miscellaneous items	10	%	1,266,607	126,661	480,970	48,097	164,658	
	Subtotal				1,393,268		529,067	1,811,231	
(2)	Grouting								
	cap concrete	2,000	m³	8,118	16,236	4,635	9,270	23,559	
	rotary drilling for curtain grout holes	7,720	m	6,299	48,628	1,196	9,233	55,922	
	rotary drilling for consolidation grout holes	2,000	m	6,299	12,598	1,196	2,392	14,488	
	curtain grouting incl. cement	7,720	m	3,005	23,199	782	6,037	27,968	
	consolidation grouting incl. cement	2,000	m	3,005	6,010	782	1,564	7,246	
	Miscellaneous items	10	%	106,671	10,667	28,496	2,850	12,919	
	Subtotal				117,338		31,346	142,102	
	Total of Item 1.2.1				1,510,606		560,413	1,953,333	
1.2.2	Saddle Dam No1 - RCC Dam								
(1)	Dam Construction								
	site clearing light jungle	3	ha	29,548	89	52,923	159	215	
	excavation for dam base	160,000	m³	413	66,080	258	41,280	98,691	
	RCC concrete for dam body	131,000	m³	4,923	644,913	2,944	385,664	949,588	
	conventional concrete for diversion, intake & gallerie	27,000	m³	8,118	219,186	4,635	125,145	318,051	
	reinforcement	500	to	97,650	48,825	25,415	12,708	58,864	
	Miscellaneous items	10	%	979,093	97,909	564,956	56,496	142,541	
	Subtotal				1,077,002		621,452	1,567,950	
(2)	Grouting								
	rotary drilling for curtain grout holes	10,760	m	6,299	67,777	1,196	12,869	77,944	
	rotary drilling for consolidation grout holes	2,000	m	6,299	12,598	1,196	2,392	14,488	
	curtain grouting incl. cement	10,760	m	3,005	32,334	782	8,414	38,981	
	consolidation grouting incl. cement	2,000	m	3,005	6,010	782	1,564	7,246	
	Miscellaneous items	10	%	118,719	11,872	25,239	2,524	13,866	
	Subtotal				130,591		27,763	152,525	
	Total of Item 1.2.2				1,207,593		649,215	1,720,475	

No	Description	Quantity	Unit	FC(J PY)		LC(LKR)		Total Costs	Remarks
				Unit prices	For.(x1000)	Unit prices	Loc.(x1000)	(x1000 JPY)	
1.2.3	Saddle Dam No2 - Earthfill Dam								
(1)	Dam Construction								
	site clearing light jungle	4	ha	29,548	127	52,923	228	307	
	excavation for dam base	194,522	m³	413	80,338	258	50,187	119,986	
	preparation of foundation	32,292	m²	360	11,625	681	21,991	28,998	
	impervious core M	252,857	m³	336	84,960	183	46,273	121,516	
	extra transport core	758,572	m³ km	44	33,377	13	9,861	41,167	
	crushed rockfill S	17,350	m³	1,352	23,457	478	8,293	30,008	
	riprap protection	2,607	m³	529	1,379	179	467	1,748	
	extra for transport rock	59,873	m³ km	44	2,634	1	60	2,681	
	crest road	2,073	m²	1,854	3,843	542	1,124	4,731	
	Miscellaneous items	10	%	241,740	24,174	138,484	13,848	35,114	
	Total of Item 1.2.3				265,914		152,332	386,256	not loan coverd
1.3	Spillway								
1.3.1	Spillway Integrated in Dam								
	structual concrete (including formwork)	13,000	m³	8,869	115,297	4,830	62,790	164,901	
	reinforcement	780	to	97,650	76,167	25,415	19,824	91,828	
	Miscellaneous items	10	%	191,464	19,146	82,614	8,261	25,672	
	Subtotal				210,610		90,875	282,401	
1.3.2	Stilling Basin at Dam Toe								
	excavation overburden and rock	101,000	m³	592	59,792	271	27,371	81,415	
	slope protection, shotcrete	4,500	m^2	1,045	4,703	397	1,787	6,115	
	concrete	29,000	m³	8,869	257,201	4,830	140,070	367,856	
	reinforcement	870	to	97,650	84,956	25,415	22,111	102,424	
	Miscellaneous items	10	%	406,652	40,665	191,339	19,134	55,781	
	Subtotal				447,317		210,473	613,591	
1.3.3	Downstream channel								
	excavation for channel base	240,000	m³	413	99,120	258	61,920	148,037	
	slope protection, concrete	4,200	m³	8,869	37,250	4,830	20,286	53,276	
	slope protection, rock riprap	17,000	m³	529	8,993	179	3,043	11,397	
	reinforcement	200	to	97,650	19,530	25,415	5,083	23,546	
	Miscellaneous items	10	%	164,893	16,489	90,332	9,033	23,625	
	Subtotal				181,382		99,365	259,881	
1.3.4	Downstream road protection								
	excavation including coffering	14,000	m³	413	5,782	258	3,612	8,635	
	concrete(for abutment wall extension)	8,300	m³	8,869	73,613	4,830	40,089	105,283	
	reinforcement	400	to	97,650	39,060	25,415	10,166	47,091	
	slope protection riprap	6,000	m³	529	3,174	179	1,074	4,022	
	Miscellaneous items	10	%	121,629	12,163	54,941	5,494	16,503	
	Subtotal				133,792		60,435	181,534	
	Total of Item 1.3				973,101		461,148	1,337,407	
1.4	Powerhouse & switchyard								
1.4.1	Powerhouse at Dam Toe								
	excavation in rock	31,000	m³	592	18,352	271	8,401	24,989	
	backfilling around powerhouse	3,000	m³	126	378	139	417	707	
	concrete(including formwork)	7,500	m³	8,869	66,518	4,830	36,225	95,136	
	reinforcement	600	to	97,650	58,590	25,415	15,249	70,637	
	Architectual and miscellaneous	45	%	143,838	64,727	60,292	27,131	86,160	
	Subtotal				208,565		87,423	277,629	
1.4.2	Bottom outlet								
	second stage concrete in diversion conduits	2,100	m³	8,869	18,625	4,830	10,143	26,638	
	reinforcement	100	to	97,650	9,765	25,415	2,542	11,773	
	Miscellaneous items	10	%	28,390	2,839	12,685	1,269	3,842	
	Subtotal				31,229		13,954	42,253	
	Total of Item 1.4				239,794		101,377	319,882	

No	Description	Quantity	Unit	FC(J PY)		LC(LKR)		Total Costs	Remarks
				Unit prices	For.(x1000)	Unit prices	Loc.(x1000)	(x1000 JPY)	
1.5	Diversion Road								
1.5.1	New Asphalt Road	13	km						
	site clearing light jungle	13	ha	29,548	381	52,923	683	921	
	excavation common a.form bank	110,719	m3	376	41,630	190	21,037	58,249	
	rock excavation and form bank	5,827	m3	386	2,249	304	1,771	3,648	
	hardcore foundation	19,350	m3	910	17,609	269	5,205	21,721	
	upper layer of ballast	7,740	m3	910	7,043	269	2,082	8,688	
	ashalt base and wearing course	77,400	m2	1,599	123,763	417	32,276	149,261	loan coverd
	extra transport for road metal	433,152	m3km	39	16,893	8	3,465	19,630	
	common excavation f.side drain	9,030	m3	443	4,000	575	5,192	8,102	
	rock excavation f.side drain	645	m3	1,302	840	1,680	1,084	1,696	
	Miscellaneous items	10	%	214,408	21,441	72,795	7,280	27,192	
	Subtotal 1				123,763		32,276	149,261	loan coverd
	Subtotal 2				112,086		47,799	149,847	not loan coverd
1.5.2	Improvement of Existing Roads	12	km						
	hardcore foundation	21,563	m3	910	19,622	269	5,800	24,204	
	upper layer of ballast	8,625	m3	910	7,849	269	2,320	9,682	
	ashalt base and wearing course	86,250	m2	1,599	137,914	417	35,966	166,327	
	extra transport for road metal	502,524	m3km	39	19,598	8	4,020	22,774	
	Miscellaneous items	10	%	184,983	18,498	48,106	4,811	22,299	
	Subtotal				203,481		52,917	245,286	loan coverd
1.5.3	Concrete Bridge at Access Road	1	No						
	excavation common, foundation	450	m3	211	95	54	24	114	
	excavation in sheetpile pits	403	m3	198	80	128	52	121	
	backfill with excavat.material	398	m3	126	50	139	55	93	
	supply and drive sheetpiles	186	to	44,610	8,297	12,244	2,277	10,096	
	precast piles	320	m	4,821	1,543	5,006	1,602	2,809	
	lean concrete	16	m3	2,122	33	4,479	69	88	
	reinforced concrete	719	m3	3,097	2,227	4,770	3,430	4,937	
	reinforcement	75	to	58,426	4,397	14,710	1,107	5,272	
	formwork	445	m2	849	378	2,992	1,331	1,429	
	bridge beam precast	172	m3	5,860	1,008	3,663	630	1,506	
	bridge hand rail	70	m	653	45	183	13	55	
	Miscellaneous items	10	%	18,153	1,815	10,590	1,059	2,652	
	Subtotal				19,968		11,649	29,172	not loan coverd
1.5.4	Culverts in Access Road	36	No						
	culverts in access roads						3,951	3,121	
	culverts in access roads						2,098	1,657	
	culverts in access roads						1,187	938	
	Subtotal						7,236	5,716	not loan coverd
	Total 1 of Item 1.5		US$		327,244		85,193	394,547	loan coverd
	Total 2 of Item 1.5		US$		132,054		66,684	184,735	not loan coverd

Item	Description	Quantity	Unit		FC (x1000 JPY)	LC (x1000 LKR)	Total Costs (x1000 JPY)	Remarks
2	Hydro-Mecanical Works							
2.1	Spillway							
	Radial spillway gates and hoists (W9.7-H12.0m)	5	Sets	Lumpsum Value	459,378	64,860	510,617	
	Stoplog and gantry crane (W9.7-H11.5m)	1	Sets	Lumpsum Value	124,619	17,595	138,519	
	Subtotal				583,997	82,455	649,136	
2.2	Diversion Conduit							
	Closure gates (W5.0-H5.0m)	2	Sets	Lumpsum Value	59,947	8,464	66,634	
	Subtotal				59,947	8,464	66,634	
2.3	Bottom Outlet							
	Bottom outlet gates (Dia.1.6m)	2	Pairs	Lumpsum Value	208,512	29,440	231,770	
	Screen and conduit (Dia.2.0m)	2	Sets	Lumpsum Value	18,571	2,622	20,642	
	Subtotal				227,083	32,062	252,412	
2.4	Power Intake							
	Intake trashrak (W4.5-H4.5mx2)	1	Sets	Lumpsum Value	6,842	966	7,605	
	Intake stoplog (W4.5-H4.5mx1)	1	Sets	Lumpsum Value	34,453	4,865	38,296	
	Intake gate (W2.5-H2.5mx2)	1	Sets	Lumpsum Value	32,254	4,554	35,852	
	Subtotal				73,549	10,385	81,753	
2.5	Steel Penstock							
	Steel penstock (Dia.2.5mx2)	63	m	Lumpsum Value	47,893	6,762	53,235	
	Subtotal				47,893	6,762	53,235	
2.6	Draft Tube Outlet							
	Draft tube outlet gates (W2.75-H2.1m)	2	Sets	Lumpsum Value	21,992	3,105	24,445	
	Subtotal				21,992	3,105	24,445	
	Total of Item 2				1,014,461	143,233	1,127,615	
3	Hydro-Power Euipment							
3.1	Powerhouse							
	Kaplan Turbine (7.5x2MW)	1	Nos.	Lumpsum Value	351,412	0	351,412	
	Synchronous Generator and auxiliary equipment	1	Sets	Lumpsum Value	239,735	0	239,735	
	Step-up transformer	1	Sets	Lumpsum Value	36,200	0	36,200	
	Switchgear	1	Sets	Lumpsum Value	55,477	0	55,477	
	Generator control panel and telemetry	1	Sets	Lumpsum Value	85,975	0	85,975	
	Station auxiliary equipment	1	Sets	Lumpsum Value	72,400	0	72,400	
	Total of Item 3				841,199	0	841,199	
4	Transmission Line							
4.1	Transmission Line							
	Transmission Line (33kV)	15	km	Lumpsum Value	108,600	0	108,600	
	Switchgear (33kV)	1	Sets	Lumpsum Value	18,100	0	18,100	
	Total of Item 4		US$		126,700	0	126,700	

Prepared by the JICA Survey Team

Appendix D10 Unit Prices of Construction Works in 2001

(1 of 2)

Code	Description	Unit	Equipment		Consumable		Materials		Labour cost		Unit Price of 2001			Remarks
			Loc.	For.	Loc.	For.	Loc.	For.	Loc.	For.	Loc.	For.	Total (US$)	
AR 0001	site clearing light jungle	ha	0	243	0	36.06	0	0	266	0	266	279.1	545.06	
0004	excavation common a.form bank	m^3	0	2.91	0	0.64	0	0	0.93	0	0.93	3.55	4.48	
0005	rock excavation and form bank	m^3	0	2.49	0	0.59	0.08	0.56	1.41	0	1.49	3.64	5.13	
0007	hardcore foundation	m^3	0	6.79	0	1.2	0.04	0.61	1.32	0	1.36	8.6	9.96	
0008	upper layer of ballast	m^3	0	6.79	0	1.2	0.04	0.61	1.32	0	1.36	8.6	9.96	
0009	ashalt base and wearing course	m^2	0	6.35	0	1.11	0.53	7.64	1.41	0	1.94	15.1	17.04	
0010	extra transport for road metal	m^3 km	0	0.27	0	0.1	0	0	0.06	0	0.06	0.37	0.43	
0011	common excavation f.side drain	m^3	0	3.34	0	0.85	0	0	2.88	0	2.88	4.19	7.07	
0012	rock excavation f.side drain	m^3	0	8.42	0	2.74	0.09	1.14	8.33	0	8.42	12.3	20.72	
0013	gravel foundation	m^3	0	2.7	0	0.84	0.05	0.67	0.58	0	0.63	4.21	4.84	
BR 0001	excavation common, foundation	m^3	0	1.61	0	0.38	0	0	0.28	0	0.28	1.99	2.27	
0002	excavation in sheetpile pits	m^3	0	1.42	0	0.45	0	0	0.66	0	0.66	1.87	2.53	
0004	backfill with excavat.material	m^3	0	1.01	0	0.18	0	0	0.71	0	0.71	1.19	1.9	
0006	supply and drive sheetpiles	to	0	94.06	0	14.25	3.8	313	56.67	0	60.47	421.3	481.78	
0008	precast piles	m	0	36.72	0	8.81	0	0	25.14	0	25.14	45.53	70.67	
0009	lean concrete	m^3	0	10.81	0	3.09	0.75	6.14	21.54	0	22.29	20.04	42.33	
0010	reinforced concrete	m^3	0	10.81	0	3.09	1.89	15.35	21.54	0	23.43	29.25	52.68	
0011	reinforcement	to	0	14.58	0	3.21	4.56	534	68.1	0	72.66	551.8	624.45	
0012	formwork	m^2	0	3.83	0	0.28	1.15	3.91	13.57	0	14.72	8.02	22.74	
0013	bridge beam precast	m^3	0	14.45	0	3.17	4.12	37.72	13.14	0	17.26	55.34	72.6	
0014	bridge hand rail	m	0	0	0	0	0.31	6.16	0.54	0	0.85	6.16	7.01	
CO 0001	excavation cofferdam base	m^3	0	2.5	0	0.62	0.04	0.78	1.25	0	1.29	3.9	5.19	
0002	preparation rock foundation	m^2	0	2.76	0	0.64	0	0	3.43	0	3.43	3.4	6.83	
0003	impervious layer S quantity	m^3	0	3.23	0	0.85	0	0	1.75	0	1.75	4.08	5.83	
0005	extra for transport	m^3 km	0	0.34	0	0.08	0	0	0.05	0	0.05	0.42	0.47	
0006	crushed rockfill S quantity	m^3	0	3.3	0	0.8	0.04	0.64	1.24	0	1.28	4.74	6.02	
0008	dumped rock slope protection	m^3	0	3.68	0	0.88	0.04	0.64	1.19	0	1.23	5.2	6.43	
0009	extra for transport	m^3 km	0	0.25	0	0.06	0	0	0.04	0	0.04	0.31	0.35	
0010	concrete slab at crest	m^3	0	14.86	0	3.48	1.89	15.35	21.31	0	23.2	33.69	56.89	
0014	supply+install sheetpile circ.	to	0	94.06	0	14.25	3.8	313	56.67	0	60.47	421.3	481.78	
0019	rockfill cellular cofferdam	m^3	0	3.38	0	0.77	0.04	0.64	1.48	0	1.52	4.79	6.31	
0020	extra for transport rock	m^3 km	0	0.25	0	0.06	0	0	0.04	0	0.04	0.31	0.35	
DA 0001	site clearing light jungle	ha	0	243	0	36.06	0	0	266	0	266	279.1	545.06	
0003	excavation for dam base	m^3	0	2.5	0	0.62	0.04	0.78	1.25	0	1.29	3.9	5.19	
0004	preparation of foundation	m^2	0	2.76	0	0.64	0	0	3.43	0	3.43	3.4	6.83	
0010	impervious core M	m^3	0	2.55	0	0.62	0	0	0.92	0	0.92	3.17	4.09	
0012	extra transport core	m^3 km	0	0.34	0	0.08	0	0	0.05	0	0.05	0.42	0.47	
0013	crushed rockfill S	m^3	0	10.51	0	1.62	0.04	0.64	2.37	0	2.41	12.77	15.18	
0017	selected rockfill M	m^3	0	2.7	0	0.64	0.04	0.68	0.58	0	0.62	4.02	4.64	
0019	riprap protection	m^3	0	3.52	0	0.79	0.04	0.68	0.83	0	0.87	4.99	5.86	
0020	extra for transport rock	m^3 km	0	0.33	0	0.09	0	0	0.02	0	0.02	0.42	0.44	
0025	clay backfill to dam base	m^3	0	3.23	0	0.85	0	0	1.75	0	1.75	4.08	5.83	
0034	crushed stone rollcrete M	m^3	0	11.52	0	2.38	0.98	8.29	8.54	0	9.52	22.19	31.71	
0036	crushed stone concrete S	m^3	0	12.92	0	3.42	1.92	15.93	20.93	0	22.85	32.27	55.12	
0037	crushed stone concrete M	m^3	0	10.54	0	3.18	1.92	15.97	12.18	0	14.1	29.69	43.79	
0039	extra transport crushed stone	m^3 km	0	0.27	0	0.1	0	0	0.06	0	0.06	0.37	0.43	
0042	formwork M	m^2	0	2.37	0	0.23	0.61	2.08	11.1	0	11.71	4.68	16.39	
0044	crest road	m^2	0	8.55	0	1.35	0.52	7.61	2.06	0	2.58	17.51	20.09	
0046	percussion drilling open	m	0	4.84	0	1.05	0.08	1.53	2.28	0	2.36	7.42	9.78	
0049	grouting open incl. cement	to	0	61.51	0	8.1	6.92	56.28	98.66	0	105.6	125.9	231.47	
0053	rotary drilling (check hole)	m	0	4.84	0	1.05	0.08	1.53	2.28	0	2.36	7.42	9.78	
0054	rotary drilling (drain hole)	m	0	4.84	0	1.05	0.08	1.65	2.28	0	2.36	7.54	9.9	

Code	Description	Unit	Equipment		Consumable		Materials		Labour cost		Unit price of 2001			Remarks
			Loc.	For.	Loc.	For.	Loc.	For.	Loc.	For.	Loc.	For.	Total (US$)	
SP 0003	concrete to bridges	m^3	0	15.26	0	4.14	1.92	15.93	17.54	0	19.46	35.33	54.79	
0004	concrete to structures	m^3	0	13.19	0	3.89	1.92	15.97	17.18	0	19.1	33.05	52.15	
0005	reinforcement	to	0	14.58	0	3.21	4.56	534	68.1	0	72.66	551.8	624.45	
0006	formwork	m^2	0	1.91	0	0.14	1.41	4.85	13.19	0	14.6	6.9	21.5	
0007	prestressing	to	0	10.65	0	3.39	102	2040	280	0	382	2054	2436.04	
PH 0001	excavation in rock open	m^3	0	3.64	0	0.93	0.05	1.02	1.31	0	1.36	5.59	6.95	
0002	backfilling	m^3	0	1.01	0	0.18	0	0	0.71	0	0.71	1.19	1.9	
0003	concrete	m^3	0	13.19	0	3.89	1.92	15.97	17.18	0	19.1	33.05	52.15	
0004	reinforcement	to	0	14.58	0	3.21	4.56	534	68.1	0	72.66	551.8	624.45	
0005	formwork	m^2	0	1.91	0	0.14	1.41	4.85	13.19	0	14.6	6.9	21.5	
RW 0002	excavation rock	m^3	0	2.37	0	0.57	0.03	0.58	0.98	0	1.01	3.52	4.53	
0003	trimming rock surface	m^2	0	3.02	0	0.98	0.15	2.99	1.59	0	1.74	6.99	8.73	
0007	concrete	m^3	0	13.43	0	3.79	1.89	15.35	20.41	0	22.3	32.57	54.87	
MC 0001	land clearing light jungle	ha	0	243	0	36.06	0	0	266	0	266	279.1	545.06	
0002	land clearing heavy jungle	ha	0	459	0	69.15	0	0	266	0	266	528.2	794.15	
0006	excavation common + formbank	m^3	0	2.49	0	0.59	0.03	0.6	1.41	0	1.44	3.68	5.12	
0007	excav. borrow com + formbank	m^3	0	2.55	0	0.62	0	0	0.92	0	0.92	3.17	4.09	
0009	turfing	m^2	0	0.35	0	0.04	0	0	1.82	0	1.82	0.39	2.21	
0011	concrete lining to canals	m^3	0	8.66	0	2.88	1.89	15.35	20.7	0	22.59	26.89	49.48	
0012	concrete base slab	m^3	0	8.66	0	2.88	1.89	15.35	20.7	0	22.59	26.89	49.48	
0016	excavation on common to structu	m^3	0	1.98	0	0.48	0	0	0.51	0	0.51	2.46	2.97	
0017	excavation on rock	m^3	0	2.08	0	0.52	0.04	0.78	1.18	0	1.22	3.38	4.6	
0018	backfill with excavation	m^3	0	1.01	0	0.18	0	0	0.71	0	0.71	1.19	1.9	
0019	rip rap protection	m^3	0	3.68	0	0.88	0.04	0.64	1.19	0	1.23	5.2	6.43	
0020	91cm dia pipe culvert	m	0	0	0	0	4.25	42.49	8.72	0	12.97	42.49	55.46	
0021	122cm dia pipe culvert	m	0	0	0	0	7.22	72.22	10.7	0	17.92	72.22	90.14	
0022	153cm dia pipe culvert	m	0	0	0	0	10.1	101	11.2	0	21.3	101	122.3	
0023	concrete	m^3	0	11.35	0	3.87	1.89	15.35	27.42	0	29.31	30.57	59.88	
0024	reinforcement	to	0	14.58	0	3.21	4.56	534	68.1	0	72.66	551.8	624.45	
0025	formwork	m^2	0	3.83	0	0.28	1.15	3.91	13.57	0	14.72	8.02	22.74	
0026	gates and steel structures	to	0	3.51	0	1.11	3.8	443	121	0	124.8	447.6	572.42	
0027	extra t rockfor transpor	m^3 km	0	0.25	0	0.06	0	0	0.04	0	0.04	0.31	0.35	

Appendix D11 Unit Prices of Construction Works in 2010

Code	Description	Unit	Price Index					Unit price of 2010			Remarks
			Euip.	Cons.	Matr.	Lab.	For	Loc.	For.	Total(US$)	
AR 0001	site clearing light jungle	ha	2.17	2.01	2.21	1.73	1.17	460.2	326.5	786.7	
0004	excavation common a.form bank	m^3	2.17	2.01	2.21	1.73	1.17	1.61	4.15	5.8	
0005	rock excavation and form bank	m^3	2.17	2.01	2.21	1.73	1.17	2.62	4.26	6.9	
0007	hardcore foundation	m^3	2.17	2.01	2.21	1.73	1.17	2.37	10.06	12.4	
0008	upper layer of ballast	m^3	2.17	2.01	2.21	1.73	1.17	2.37	10.06	12.4	
0009	ashalt base and wearing course	m^2	2.17	2.01	2.21	1.73	1.17	3.61	17.67	21.3	
0010	extra transport for road metal	m^3 km	2.17	2.01	2.21	1.73	1.17	0.1	0.43	0.5	
0011	common excavation f.side drain	m^3	2.17	2.01	2.21	1.73	1.17	4.98	4.9	9.9	
0012	rock excavation f.side drain	m^3	2.17	2.01	2.21	1.73	1.17	14.61	14.39	29.0	
0013	gravel foundation	m^3	2.17	2.01	2.21	1.73	1.17	1.11	4.93	6.0	
BR 0001	excavation common, foundation	m^3	2.17	2.01	2.21	1.73	1.17	0.48	2.33	2.8	
0002	excavation in sheetpile pits	m^3	2.17	2.01	2.21	1.73	1.17	1.14	2.19	3.3	
0004	backfill with excavat.material	m^3	2.17	2.01	2.21	1.73	1.17	1.23	1.39	2.6	
0006	supply and drive sheetpiles	to	2.17	2.01	2.21	1.73	1.17	106.4	492.9	599.4	
0008	precast piles	m	2.17	2.01	2.21	1.73	1.17	43.49	53.27	96.8	
0009	lean concrete	m^3	2.17	2.01	2.21	1.73	1.17	38.92	23.45	62.4	
0010	reinforced concrete	m^3	2.17	2.01	2.21	1.73	1.17	41.44	34.22	75.7	
0011	reinforcement	to	2.17	2.01	2.21	1.73	1.17	127.9	645.6	773.5	
0012	formwork	m^2	2.17	2.01	2.21	1.73	1.17	26.02	9.38	35.4	
0013	bridge beam precast	m^3	2.17	2.01	2.21	1.73	1.17	31.84	64.75	96.6	
0014	bridge hand rail	m	2.17	2.01	2.21	1.73	1.17	1.62	7.21	8.8	
CO 0001	excavation cofferdam base	m^3	2.17	2.01	2.21	1.73	1.17	2.25	4.56	6.8	
0002	preparation rock foundation	m^2	2.17	2.01	2.21	1.73	1.17	5.93	3.98	9.9	
0003	impervious layer S quantity	m^3	2.17	2.01	2.21	1.73	1.17	3.03	4.77	7.8	
0005	extra for transport	m^3 km	2.17	2.01	2.21	1.73	1.17	0.09	0.49	0.6	
0006	crushed rockfill S quantity	m^3	2.17	2.01	2.21	1.73	1.17	2.24	5.55	7.8	
0008	dumped rock slope protection	m^3	2.17	2.01	2.21	1.73	1.17	2.15	6.08	8.2	
0009	extra for transport	m^3 km	2.17	2.01	2.21	1.73	1.17	0.07	0.36	0.4	
0010	concrete slab at crest	m^3	2.17	2.01	2.21	1.73	1.17	41.05	39.42	80.5	
0014	supply+install sheetpile circ.	to	2.17	2.01	2.21	1.73	1.17	106.4	492.9	599.4	
0019	rockfill cellular cofferdam	m^3	2.17	2.01	2.21	1.73	1.17	2.65	5.6	8.3	
0020	extra for transport rock	m^3 km	2.17	2.01	2.21	1.73	1.17	0.07	0.36	0.4	
DA 0001	site clearing light jungle	ha	2.17	2.01	2.21	1.73	1.17	460.2	326.5	786.7	
0003	excavation for dam base	m^3	2.17	2.01	2.21	1.73	1.17	2.25	4.56	6.8	
0004	preparation of foundation	m^2	2.17	2.01	2.21	1.73	1.17	5.93	3.98	9.9	
0010	impervious core M	m^3	2.17	2.01	2.21	1.73	1.17	1.59	3.71	5.3	core=5.3
0012	extra transport core	m^3 km	2.17	2.01	2.21	1.73	1.17	0.09	0.49	0.6	
0013	crushed rockfill S	m^3	2.17	2.01	2.21	1.73	1.17	4.19	14.94	19.1	rockfill average
0017	selected rockfill M	m^3	2.17	2.01	2.21	1.73	1.17	1.09	4.7	5.8	=12.5
0019	riprap protection	m^3	2.17	2.01	2.21	1.73	1.17	1.53	5.84	7.4	compound
0020	extra for transport rock	m^3 km	2.17	2.01	2.21	1.73	1.17	0.03	0.49	0.5	embank. price
0025	clay backfill to dam base	m^3	2.17	2.01	2.21	1.73	1.17	3.03	4.77	7.8	C:R=1:4
0034	crushed stone rollcrete M	m^3	2.17	2.01	2.21	1.73	1.17	16.94	25.96	42.9	=11.0
0036	crushed stone concrete S	m^3	2.17	2.01	2.21	1.73	1.17	40.45	37.76	78.2	
0037	crushed stone concrete M	m^3	2.17	2.01	2.21	1.73	1.17	25.31	34.74	60.1	
0039	extra transport crushed stone	m^3 km	2.17	2.01	2.21	1.73	1.17	0.1	0.43	0.5	
0042	formwork M	m^2	2.17	2.01	2.21	1.73	1.17	20.55	5.48	26.0	
0044	crest road	m^2	2.17	2.01	2.21	1.73	1.17	4.71	20.49	25.2	
0046	percussion drilling open	m	2.17	2.01	2.21	1.73	1.17	4.12	8.68	12.8	
0049	grouting open incl. cement	to	2.17	2.01	2.21	1.73	1.17	186	147.3	333.3	
0053	rotary drilling (check hole)	m	2.17	2.01	2.21	1.73	1.17	4.12	8.68	12.8	
0054	rotary drilling (drain hole)	m	2.17	2.01	2.21	1.73	1.17	4.12	8.82	12.9	

Code	Description	Unit	Price Index					Unit price of 2010			Remarks
			Euip.	Cons.	Matr.	Lab.	For	Loc.	For.	Total(US$)	
SP 0003	concrete to bridges	m^3	2.17	2.01	2.21	1.73	1.17	34.58	41.34	75.9	
0004	concrete to structures	m^3	2.17	2.01	2.21	1.73	1.17	33.96	38.67	72.6	
0005	reinforcement	to	2.17	2.01	2.21	1.73	1.17	127.9	645.6	773.5	
0006	formwork	m^2	2.17	2.01	2.21	1.73	1.17	25.94	8.07	34.0	
0007	prestressing	to	2.17	2.01	2.21	1.73	1.17	709.8	2403	3,113.1	
PH 0001	excavation in rock open	m^3	2.17	2.01	2.21	1.73	1.17	2.38	6.54	8.9	
0002	backfilling	m^3	2.17	2.01	2.21	1.73	1.17	1.23	1.39	2.6	
0003	concrete	m^3	2.17	2.01	2.21	1.73	1.17	33.96	38.67	72.6	
0004	reinforcement	to	2.17	2.01	2.21	1.73	1.17	127.9	645.6	773.5	
0005	formwork	m^2	2.17	2.01	2.21	1.73	1.17	25.94	8.07	34.0	
RW 0002	excavation rock	m^3	2.17	2.01	2.21	1.73	1.17	1.77	4.12	5.9	
0003	trimming rock surface	m^2	2.17	2.01	2.21	1.73	1.17	3.08	8.18	11.3	
0007	concrete	m^3	2.17	2.01	2.21	1.73	1.17	39.49	38.11	77.6	
MC 0001	land clearing light jungle	ha	2.17	2.01	2.21	1.73	1.17	460.2	326.5	786.7	
0002	land clearing heavy jungle	ha	2.17	2.01	2.21	1.73	1.17	460.2	617.9	1,078.1	
0006	excavation common + formbank	m^3	2.17	2.01	2.21	1.73	1.17	2.51	4.31	6.8	
0007	excav. borrow com + formbank	m^3	2.17	2.01	2.21	1.73	1.17	1.59	3.71	5.3	
0009	turfing	m^2	2.17	2.01	2.21	1.73	1.17	3.15	0.46	3.6	
0011	concrete lining to canals	m^3	2.17	2.01	2.21	1.73	1.17	39.99	31.46	71.5	
0012	concrete base slab	m^3	2.17	2.01	2.21	1.73	1.17	39.99	31.46	71.5	
0016	excavation on common to structu	m^3	2.17	2.01	2.21	1.73	1.17	0.88	2.88	3.8	
0017	excavation on rock	m^3	2.17	2.01	2.21	1.73	1.17	2.13	3.95	6.1	
0018	backfill with excavation	m^3	2.17	2.01	2.21	1.73	1.17	1.23	1.39	2.6	
0019	rip rap protection	m^3	2.17	2.01	2.21	1.73	1.17	2.15	6.08	8.2	
0020	91cm dia pipe culvert	m	2.17	2.01	2.21	1.73	1.17	24.48	49.71	74.2	
0021	122cm dia pipe culvert	m	2.17	2.01	2.21	1.73	1.17	34.47	84.5	119.0	
0022	153cm dia pipe culvert	m	2.17	2.01	2.21	1.73	1.17	41.7	118.2	159.9	
0023	concrete	m^3	2.17	2.01	2.21	1.73	1.17	51.62	35.77	87.4	
0024	reinforcement	to	2.17	2.01	2.21	1.73	1.17	127.9	645.6	773.5	
0025	formwork	m^2	2.17	2.01	2.21	1.73	1.17	26.02	9.38	35.4	
0026	gates and steel structures	to	2.17	2.01	2.21	1.73	1.17	217.7	523.7	741.5	
0027	extra t rockfor transpor	m^3 km	2.17	2.01	2.21	1.73	1.17	0.07	0.36	0.4	

Notes:

Unit price of dam embankment P1(calculated to compound cost of core and rockfill)

Unit price of core=5.3, Unit price of rockfill=12.5 (average)

Dam volume ratio core:rockfill=1.4

P1=(5.3x1+12.5x4)/5=11.0 (US$)

Appendix D12 Unit Prices of Engineer's Unit Rates for Construction Works (Ministry of Agriculture Development and Agrarian Services)

Code	Description	Unit	Unit prices (LKR)	Unit prices of 2009 (US$)	Remarks
(1) Clearing and Grubbing					
1.4	clearing and grubbing ligrt jungle by machinery	ha	57,559.00	500.51	
1.5	secondary	ha	28,779.00	250.25	
(2) Ripping, Cross Ripping, Land leveling & Soil Conservation Bunds					
2.1	ripping for leveling of farms	ha	50,609.00	440.08	
2.2	ripping and cross-ripping for leveling of farms	ha	99,019.00	861.03	
2.3	land leveling of farms	ha	15,376.00	133.70	
(3) Earth Excavation					
3.1A	earth excavation or borrow and spoil to waste or fill material, cut 0-3ft lift upto 3ft, spread 100ft	m^3	181.25	1.58	
3.3	earth excavation or borrow and spoil to waste or fill material, cut 10-15ft lift upto 15ft, spread 100ft	m^3	189.25	1.65	
3.6	earth excavation or borrow and spoil to waste or fill material, cut 25-30ft lift upto 30ft, spread 100ft	m^3	278.50	2.42	
3.9	earth excavation or borrow and spoil to waste or fill material, cut 40-45ft lift upto 45ft, spread 100ft	m^3	306.00	2.66	
3.25	haul earth 1/4mile	m^3	81.10	0.71	
3.28	haul earth 1mile	m^3	144.75	1.26	
(4) Common Excavation					
4.1A	common excavation and spoil to waste or fill material, cut 0-3ft lift upto 3ft, spread 100ft	m^3	201.75	1.75	
4.3	common excavation and spoil to waste or fill material, cut 10-15ft lift upto 15ft, spread 100ft	m^3	210.75	1.83	
4.6	common excavation and spoil to waste or fill material, cut 25-30ft lift upto 30ft, spread 100ft	m^3	302.50	2.63	
4.9	common excavation and spoil to waste or fill material, cut 40-45ft lift upto 45ft, spread 100ft	m^3	331.75	2.88	
4.26	common excavation and spoil to waste or fill material, cut 0-5ft lift upto 5ft, haul 1/4 mile	m^3	162.75	1.42	
(5) Gravel Excavation					
5.1A	gravel excavation and spoil to waste or use as constructionb material, cut 0-3ft lift upto 5ft, spread 100ft	m^3	210.00	1.83	
5.3	gravel excavation and spoil to waste or use as constructionb material, cut 10-15ft lift upto 15ft, spread 100ft	m^3	218.50	1.90	
5.6	gravel excavation and spoil to waste or use as constructionb material, cut 25-30ft lift upto 30ft, spread 100ft	m^3	311.50	2.71	
5.9	gravel excavation and spoil to waste or use as constructionb material, cut 40-45ft lift upto 45ft, spread 100ft	m^3	342.00	2.97	
(6) Soft Rock Excavation					
6.1	soft rock excavation and spoil to waste, cut 0-5ft lift upto 5ft, spread 100ft	m^3	308.50	2.68	
6.3	soft rock excavation and spoil to waste, cut 10-15ft lift upto 15ft, spread 100ft	m^3	319.50	2.78	
6.6	soft rock excavation and spoil to waste, cut 25-30ft lift upto 30ft, spread 100ft	m^3	426.00	3.70	
6.9	soft rock excavation and spoil to waste, cut 40-45ft lift upto 45ft, spread 100ft	m^3	465.50	4.05	
(7) Rock Excavation					
7.1	rock excavation and spoil to waste/quarry products ,cut 0-5ft lift upto 5ft	m^3	891.50	7.75	
7.3	additional rate for cut 5-10ft lift upto 10ft	m^3	41.25	0.36	
7.4	additional rate for cut 10-15ft lift upto 15ft	m^3	45.15	0.39	
7.7	additional rate for cut 25-30ft lift upto 30ft	m^3	54.55	0.47	
7.10	additional rate for cut 40-45ft lift upto 45ft	m^3	62.45	0.54	

Code	Description	Unit	Unit prices (LKR)	Unit prices of 2009 (US$)	Remarks
(8) Earthfill in Embankment and around Structure					
8.1	stripping top soil,haul 1/4 mile	m^3	147.75	1.28	
8.6	borrow earth fron borrow areaa, cut 0-10' lift upto 10', haul 1/4 mile	m^3	162.50	1.41	
8.9	borrow earth fron borrow areaa, cut 0-10' lift upto 10', haul 1 mile	m^3	353.00	3.07	
(14) Reinforcement					
14.1	cutting, bending & placing mild steel reinforcement, lift 0-5 ft. haul 150 miles lorry and 8 miles tractor trailer	to	32,750.00	284.78	
14.3	furnishing, cutting, bending & placing mild steel reinforcement, lift 0-5 ft. haul 150 miles lorry and 8 miles tractor trailer	to	152,000.00	1,321.74	Reinforcement =1300
(15) Formwork in Timber and Scaffolding					
15.2	fixing & removing formwork once	m^2	403.00	3.50	
(16) Concrete and Rubber Masonary					
16.1	1:4:8(2")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	10,116.00	87.97	
16.2	1:4:8(1'1/2")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	10,211.00	88.79	
16.3	1:3:6(1'1/2")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	11,194.00	97.34	
16.4	1:3:6(1")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	11,346.00	98.66	
16.5	1:2:4(1'1/2")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	12,590.00	109.48	
16.6	1:2:4(1")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	12,723.00	110.63	
16.7	1:2:4(3/4")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	12,849.00	111.73	
16.8	1:1 1/2:3(3/4")ct. concrete excluding formwork, haul mix. 100', cement 158miles (150 mls lorry & 8 miles T-T), aggregate 5 mls. & water 1.5 mls.	m^3	14,441.00	125.57	
(21) Ligrt duty cast cast iron gates for turnouts					
21.2	Furnishing & install in turnout 12" dia. iron gate & hoist complete with spindle, handle etc as per type plan	Each	35,515.00	308.83	
21.3	As in 21.1 but for 15" dai size	Each	59,202.00	514.80	
21.4	As in 21.1 but for 18" dai size	Each	69,312.00	602.71	
21.5	As in 21.1 but for 24" dai size	Each	95,693.00	832.11	
(23) RCC spun pipes and collars in structures					
23.3	Furnishing, lay & joint 12" dia. Rcc spun pipe including trenching and back fill,	m	4,583.00	39.85	
23.4	As in 21.1 but for 15" dai size	m	5,664.00	49.25	
23.5	As in 21.1 but for 15" dai size	m	7,121.00	61.92	
23.6	As in 21.1 but for 15" dai size	m	8,781.00	76.36	

Appendix D13 Unit Prices of Upper Kotmale Hydropower project Lot-2(Main civil works)

Item		Dedcription	Unit		Unit Price (2007)		Unit Price (2010)			Adopted unit price
					LC (LKR)	FC (JPY)	Price Index (2007-2010)		Total(US$)	
1.2		Intake Dam					LC 1.24	FC 1.05	(Including 20% indirect cost)	
/001	6.3	Clearing and stripping	m^2	25,000	91	93	113	98	2.07	
/002	7.3.1	Excavation, common	m^3	155,000	226	332	280	349	6.29	
/003	7.3.1	Excavation, rock	m^3	64,300	372	812	461	853	13.43	
/004	7.3.2	Trench excavation, common	m^3	500	472	211	585	222	7.54	
/005	7.3.2	Trench excavation, rock	m^3	100	3,946	870	4,893	914	52.65	
/006	9.4	Banking	m^3	610	252	188	312	197	4.89	
/007	17.4.3	Riprap, t=800 mm	m^3	160	2,423	1,610	3,005	1,691	44.82	
/008	17.4.5	Gravel bedding, t=250 mm	m^3	20	1,921	1,708	2,382	1,793	40.53	
/009	17.4.4	Gravel surfacing, t=100 mm	m^3	10	1,291	247	1,601	259	16.78	
/010	17.4.2	Sodding	m^2	2,600	279	96	346	101	4.12	
/011	18.3.2	Drain ditch, type A	m	120	2,022	1,600	2,507	1,680	40.36	
/012	18.3.2	Drain ditch, type B	m	1,210	3,743	2,928	4,641	3,074	74.32	
/013	18.3.2	Drain ditch, type C	m	340	5,368	4,530	6,656	4,757	110.44	
/014	18.3.2	Drain ditch, type F	m	570	1,309	1,061	1,623	1,114	26.42	
/015	18.3.5	P.V.C. drain pipe, 50 mm dia.	m	10	784	4,591	972	4,821	61.72	
/016	18.3.5	P.V.C. drain pipe, 100 mm dia.	m	120	1,593	2,854	1,975	2,997	50.29	
/017	18.3.5	P.V.C. perforated pipe, 150 mm dia. with steel cap	m	170	2,349	2,218	2,913	2,329	51.07	
/018	23.4	Metal work	ton	70	56,802	166,568	70,434	174,896	2545.02	
/019	10.4.2	Drilling consolidation grout hole	m	1,800	1,184	7,038	1,468	7,390	94.42	Drilling average price
/020	10.4.2	Drilling curtain grout hole	m	2,000	1,134	6,833	1,406	7,175	91.51	
/021	10.4.2	Drilling rim grout hole	m	1,100	1,134	6,833	1,406	7,175	91.51	80.0
/022	10.4.2	Drilling check hole with core recovery	m	300	1,517	9,335	1,881	9,802	124.67	
/023	10.4.2	Drilling pressure relief hole, 50 mm dia.	m	200	1,062	5,807	1,317	6,097	78.82	
/024	10.4.4	Consolidation grouting	ton	60	1,734	18,584	2,150	19,513	234.31	Grouting average price
/025	10.4.4	Consolidation grouting	hour	100	11,668	43,029	14,468	45,180	625.04	40.0
/026	10.4.4	Curtain grouting	ton	50	1,734	18,584	2,150	19,513	234.31	
/027	10.4.4	Curtain grouting	hour	85	5,653	37,718	7,010	39,604	498.57	
/028	10.4.4	Rim grouting	ton	25	1,734	18,584	2,150	19,513	234.31	
/029	10.4.4	Rim grouting	hour	40	7,414	38,267	9,193	40,180	523.92	
/030	10.4.3	Permeability Test	nr.	580	1,971	11,712	2,444	12,298	157.14	
/031	11.4.1	Concrete, class A in blockouts, concrete pavement, water	m^3	480	4,900	10,221	6,076	10,732	171.42	
/032	11.4.1	Concrete, class B for open structures	m^3	40,600	4,524	9,241	5,610	9,703	156.00	CVC conrete 130.0
/033	11.4.1	Concrete, class D for main dam body	m^3	13,200	4,421	8,855	5,482	9,298	150.41	RCC conrete is 60% cost of CVC concrete 80.0
/034	11.4.1	Concrete, class E for side walk	m^3	30	4,266	8,761	5,290	9,199	147.65	
/035	21.12.1	Prestressed concrete beam, 11.45m long	nr.	60	71,917	13,766	89,177	14,454	935.16	
/036	21.12.2	Expansion joint	m	30.5	5,114	979	6,341	1,028	66.50	
/037	21.12.3	Bearing pad, 300x500x35 mm	nr.	120	6,964	1,333	8,635	1,400	90.56	
/038	21.12.4	Concrete pad, 200x500x15 mm	m^3	1	19,809	3,791	24,563	3,981	257.58	
/039	21.12.4	Stainless steel dowel at fixed end of bridge beams	nr.	60	1,618	310	2,006	326	21.05	
/040	24.2	Precast concrete kerb, type C	m^3	11	26,357	7,256	32,683	7,619	368.39	
/041	24.2	Precast concrete kerb, type D	m^3	2	29,222	7,804	36,235	8,194	405.63	
/042	24.2	Precast drainage channel	m^3	1	33,171	11,987	41,132	12,586	496.74	
/043	24.2	Precast concrete edging strip	m^3	6	26,357	7,256	32,683	7,619	368.39	
/044	12.4.2	Reinforcing bars	ton	420	83,503	15,984	103,544	16,783	1085.83	
/045	19.5.1	Instrumentation for intake dam	L.S.	1	170,560	1,658,254	211,494	1,741,167	21078.49	

Notes:

Unit price of grouting

i) Unit price of drilling P2 (calculated to average of from item 1.2/019 to 021 and assuming to include 20% indirect cost)

P2= ((94.42+91.51+91.51)/3)/1.2=80(US$)

ii) Unit price of grouting P2 (calculated by total construction cost and grouting length)

Total construction cost of grouting=US$76,563

Grouting length=1800m

P3=(76563/1800)/1.2=40(US$)

Item		Dedcription	Unit		Unit Price (2007)		Unit Price (2010)			Adopted unit price
					Local LKR	Foreign JPY	Price Index (2007-2010)		Total(US$)	
							LC 1.24	FC 1.05	(including 20% indirect cost)	
/046	11.4.2	Waterstop, type A	m	520	607	4,493	753	4,718	58.68	
/047	11.4.2	Waterstop, type B	m	120	434	2,607	538	2,737	34.92	
/048	18.3.5	P.V.C. pipe, 100 mm dia. for cabling	m	120	2,037	390	2,526	410	26.50	
/049	14.4	Shotcrete, t=100 mm with wire mesh	m^2	5,000	333	1,013	413	1,064	15.35	15.0
/050	20.8.2	Base course t= 150 mm	m^3	400	1,549	1,735	1,921	1,822	36.84	
/051	20.8.5	Double bituminous surface treatment	m^2	2,600	252	79	312	83	3.63	
/052	24.5	Water level gauge staff	m	16	5,529	52,862	6,856	55,505	672.93	
/053	22.5.2	Grounding system	ton	1.7	201,913	1,707,689	250,372	1,793,073	21990.11	
/054		Landscaping in Intake Dam Area	P.S	1	2,581,000	2,914,500	3,200,440	3,060,225	61644.55	
1.3		Intake Facilities								
/001	6.3	Clearing and stripping	m^2	10,000	91	93	113	98	2.07	
/002	7.3.2	Trench excavation, common	m^3	120	472	211	585	222	7.54	
/003	7.3.2	Trench excavation, rock	m^3	8,300	358	745	444	782	12.50	
/004	8.4.2	Tunnel excavation	m^3	1,300	1,454	9,583	1,803	10,062	126.86	
/005	14.4	Shotcrete, t=100 mm with wire mesh, open	m^2	1,500	333	1,013	413	1,064	15.35	
/006	14.4	Shotcrete, t=100 mm with wire mesh, tunnel	m^2	500	400	2,888	496	3,032	37.82	
/007	16.4	Steel support	ton	7	17,049	159,690	21,141	167,675	2036.60	
/008	15.4	Rock bolt, L=2m	p.c.	70	629	5,216	780	5,477	67.30	
/009	17.4.2	Sodding	m^2	4,300	224	85	278	89	3.40	
/010	18.3.2	Drain ditch, type C	m	60	5,368	4,530	6,656	4,757	110.44	
/011	18.3.3	Steel drain pipe, 150 mm dia.	m	7	4,701	900	5,829	945	61.13	
/012	18.3.5	P.V.C. drain pipe, 150 mm dia.	m	50	2,283	437	2,831	459	29.69	
/013	11.4.1	Concrete, class A in blockouts	m^3	90	4,922	10,662	6,103	11,195	176.77	
/014	11.4.1	Concrete, class B for open structures	m^3	12,800	4,801	10,288	5,953	10,802	171.12	Structure concrete 140.0
/015	11.4.1	Concrete, class E for levelling	m^3	3	4,336	9,531	5,377	10,008	157.34	
/016	11.4.1	Concrete, class C for tunnel lining	m^3	600	5,005	11,925	6,206	12,521	192.32	
/017	12.4.2	Reinforcing bars	ton	260	83,503	15,984	103,544	16,783	1085.83	
/018	11.4.2	Waterstop, type A	m	160	607	4,493	753	4,718	58.68	
/019	11.4.2	Waterstop, type B	m	50	434	2,606	538	2,736	34.91	
/020	23.4	Metal work	ton	19	56,802	166,568	70,434	174,896	2545.02	
/021	20.8.1	Subbase course, t= 150 mm	m^3	200	1,534	1,733	1,902	1,820	36.65	
/022	20.8.2	Base course, t= 150 mm	m^3	200	1,549	1,735	1,921	1,822	36.84	
/023	20.8.5	Double bituminous surface treatment	m^2	1,200	252	79	312	83	3.63	
/024	40.4	Fence, type B	m	20	25,190	4,990	31,236	5,240	329.52	
/025	40.4	Entrance Gate, type A	nr.	2	168,368	44,434	208,776	46,656	2330.98	
/026	40.4	Entrance Gate, type B	nr.	2	120,166	24,947	149,006	26,194	1585.14	
									0.00	
1.4		Service Road to Dam crest at left bank through A7 Highway							0.00	
/001	6.3	Clearing and stripping	m^2	4,000	91	93	113	98	2.07	
/002	7.3.1	Excavation, common	m^3	10,500	166	207	206	217	4.19	
/003	7.3.1	Excavation, rock	m^3	500	345	739	428	776	12.30	
/004	7.3.2	Trench excavation, common	m^3	100	472	211	585	222	7.54	
/005	7.3.2	Trench excavation, rock	m^3	700	3,946	870	4,893	914	52.65	
/006	9.4	Banking	m^3	1,000	114	22	141	23	1.48	
/007	18.3.2	Drain ditch, type E	m	260	2,169	1,539	2,690	1,616	41.25	

Notes:

Unit price of concrete

i) Unit price of RCC concrete P4 (calculated by item 1.2/033)

Unit price of RCC concrete assumed 60 % of CVC concrete, similarly in fs2001.

Item 1.2/033 is unit price of CVC concrete.

P4=150.41x0.6/1.2=80(US$)

ii)Unit price of CVC concrete P5 (calculated by item 1.2/032)

P5=156.0/1.2=130 (US$)

iii) Unit price of structural concrete P6 (calculated by item 1.3/014)

P5=171.12/1.2=140 (US$)

Item		Dedcription	Unit		Unit Price (2007)		Unit Price (2010)			Adopted unit price
					Local LKR	Foreign JPY	Price Index (2007-2010)		Total(US$)	
							LC 1.24	FC 1.05	(Including 20% indirect cost)	
/008	18.3.4	Concrete drainage pipe, D=900mm	m	10	6,571	4,352	8,148	4,570	121.35	
/009	24.2	Precast drain pit, type B	m^3	1	63,170	16,928	78,331	17,774	877.54	
/010	11.4.1	Concrete, class E for levelling concrete	m^3	20	2,860	4,596	3,546	4,826	84.16	
/011	12.4.2	Reinforcing bars	ton	1	83,841	16,049	103,963	16,851	1090.22	
/012	14.4	Shotcrete, t=100 mm with wire mesh, open	m^2	3,000	329	1,012	408	1,063	15.29	
/013	20.8.1	Subbase course	m^3	200	1,534	1,733	1,902	1,820	36.65	
/014	20.8.2	Base course	m^3	200	1,549	1,735	1,921	1,822	36.84	
/015	20.8.5	Double bituminous surface treatment	m^2	1,300	252	79	312	83	3.63	
/016	23.4	Metal Work	ton	27	64,915	349,226	80,495	366,687	4751.75	
/017	17.4.5	Gravel bedding	m^3	100	1,921	1,708	2,382	1,793	40.53	
1.5		Service Road to Dam crest from right bank through B412 Highway								
/001	6.3	Clearing and stripping	m^2	15,500	91	93	113	98	2.07	
/002	7.3.1	Excavation, common	m^3	16,400	167	134	207	141	3.36	
/003	7.3.1	Excavation, rock	m^3	2,000	325	818	403	859	13.00	
/004	7.3.2	Trench excavation, common	m^3	1,800	472	211	585	222	7.54	
/005	7.3.2	Trench excavation, rock	m^3	400	3,946	870	4,893	914	52.65	
/006	9.4	Banking	m^3	1,650	114	22	141	23	1.48	
/007	18.3.2	Drain ditch, type E	m	900	2,169	1,539	2,690	1,616	41.25	
/008	18.3.4	Concrete drainage pipe, D=900mm	m	20	6,571	4,352	8,148	4,570	121.35	
/009	24.2	Precast drain pit, type B	m^3	2	58,526	16,039	72,572	16,841	817.15	
/010	11.4.1	Concrete, class E for levelling concrete	m^3	90	2,855	4,587	3,540	4,816	84.00	
/011	12.4.2	Reinforcing bars	ton	2	83,841	16,049	103,963	16,851	1090.22	
/012	14.4	Shotcrete, t=100 mm with wire mesh, open	m^2	5,000	329	1,012	408	1,063	15.29	
/013	20.8.1	Subbase course	m^3	430	1,533	1,732	1,901	1,819	36.63	
/014	20.8.2	Base course	m^3	430	1,549	1,735	1,921	1,822	36.84	
/015	20.8.5	Double bituminous surface treatment	m^2	2,900	251	79	311	83	3.62	
/016	23.4	Metal Work	ton	20	64,915	349,226	80,495	366,687	4751.75	
/017	17.4.5	Gravel bedding	m^3	230	1,921	1,708	2,382	1,793	40.53	

Appendix D14 Unit Prices of Pro-Poor Economical Advancement & Community Enhancement Project

Code	Description	Unit	Unit prices (LKR)	Unit prices (US$)	Remarks
1B 1	shrub jungle clearing including secondary growth along the canal & canal reservation including uprooting by machinery & burning outside the reservation	ha	10,000.00	86.96	
2	engaging motor grader to form the road including cambering as directed	m^2	3.00	0.03	
3	scaping top soil in canal bund and spoil to waste as directed	m^2	5.00	0.04	
4	desilting canal and spoil to waste as directed by machinery	m^3	150.00	1.30	
5	earth excavation from borrow and forming canal bund to designed profile including placing, watering and compaction by machinery	m^3	200.00	1.74	
6	earth excavation from borrow and forming road to designed profile with 2Nos turning places including placing, watering and compaction by machinery	m^3	200.00	1.74	
7	strip turfing to newly filled earth in canal bund including watering till turf takes root including transport	m^2	30.00	0.26	
8	for purchasing gravel from appoved quarry with the necessary transport & pilling up carriageway in road platform,spreading gravel for road carriageway with 2nos turning places including watering and compaction to a width of 3.0m and compacted thickness of 100mm from stn.0km to 1.75km & compacted thickness of 150mm from stn.1.75km to 2.45km by machinery	m^3	250.00	2.17	
1D 1.1	allow for unskilled labour	L/d	1,000.00	8.70	
1.2	earth excavation in foundation	m^3	600.00	5.22	
1.3	1:3:6(40mm) cement concrete in foundation without form work	m^3	10,000.00	86.96	
1.4	1:3:6(40mm) cement concrete in foundation with form work	m^3	12,000.00	104.35	
1.5	1:2:4(20mm) cement concrete in foundation without form work	m^3	12,000.00	104.35	
1.6	1:2:4(40mm) cement concrete in foundation with form work	m^3	14,000.00	121.74	
1.7	random rabble pitching in 1:5 mtr.	m^2	15,000.00	130.43	
1.8	16mm thick 1:3 cement sand plastering to rubble pitching	m^2	500.00	4.35	
1E 1.1	earth excavation in foundation and part refill	m^3	600.00	5.22	
1.2	1:3:6(40mm) cement concrete in foundation without form work	m^3	10,000.00	86.96	
1.3	1:3:6(40mm) cement concrete in foundation with form work	m^3	12,000.00	104.35	
1.4	1:2:4(20mm) cement concrete in foundation without form work	m^3	12,000.00	104.35	
1.5	1:2:4(20mm) cement concrete in foundation with form work	m^3	14,000.00	121.74	
1.6	supplying , cutting & bending of tor steel R/fas directed by the engineer	kg	160.00	1.39	
1.7	random rabble masonry work in 1:5 mtr.	m^3	7,300.00	63.48	
1.8	16mm thick 1:3 cement sand plastering to rubble pitching	m^2	500.00	4.35	
1.9	applying of two coats of white washing to the exposed surfaces with the necessary preparation as directed by the engineer	m^2	30.00	0.26	
1.10	supplying, laying and joining 225mm dia. HP with collar	L.m	3,000.00	26.09	

Appendix D15 Unit Prices of Improvements to Left Bank Main Canal of Kaudulla Scheme under Moragahakanda Project

Code	Description	Unit	Unit prices (LKR)	Unit prices (US$)	Remarks
S.L. 1	medium jungle clearing	ha	42,057.00	365.71	
2	earth excavation in canal by machinery & transport 1 Km				
2-1	cut 0 - 1.5m spred 30m	m^3	236.00	2.05	
2-2	cut 1.5m - 3.0m spred 30m	m^3	238.75	2.08	
3	soft rock excavation by machinery & transport 1 Km				
3-1	cut 0 - 1.5m spred 30m	m^3	371.50	3.23	
3-2	cut 1.5m - 3.0m spred 30m	m^3	379.50	3.30	
3-3	cut 3m - 4.5m spred 30m	m^3	379.50	3.30	
4	weathered rock excavation by machinery same as rock excavation blating				
4-1	cut 0 - 1.5m spred 30m	m^3	1,069.00	9.30	
4-2	cut 1.5m - 3.0m spred 30m	m^3	1,128.00	9.81	
4-3	cut 3m - 4.5m spred 30m	m^3	1,132.00	9.84	
4-4	cut 4.5m - 6.0m spred 30m	m^3	1,135.00	9.87	
5	Desilting in canal by machinery				
5-1	cut 0 - 1.5m spred 30m	m^3	214.50	1.87	
5-2	cut 1.5m - 3.0m spred 30m	m^3	226.25	1.97	
6	stripping top cut 0 - 3m lift up to 3m, haul 0.25Km	m^3	114.00	0.99	
7	e/ex.in side drain & spoil to waste by machinery cut 0 - 1.5m, lift 1.5km spread 30m	m^3	138.25	1.20	
8	filling service road(by machinery) & placting & compacting 1.0Km	m^3	243.00	2.11	
9	furnishing, planting & watering turf Haul 4 Km	m^2	120.25	1.05	
10	furnishing, placing & compacting gravel T/P -5Km (by machinery)	m^3	760.00	6.61	
11	levelling & grading service road by machinery	Km	17,640.00	153.39	
12	hourly plant rate (buying committee) of motor grader	hr	3,500.00	30.43	
13	labour charges per month	M	16,000.00	139.13	
	fixing 2"x2" wooden pegs for demarcation of station at 30m	sum	35,000.00	304.35	

APPENDIX E

PROJECT EVALUATION

PREPARATORY SURVEY

ON

MORAGAHAKANDA DEVELOPMENT PROJECT

FINAL REPORT

APPENDIX E PROJECT EVALUATION

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Appendix E-1

Economic Evaluation

Appendix E-1.1 Financial and Economic Project Cost/Annual Disbursement

Financial Project Cost

	Total			2011			2012			2013			2014			2015			2016			2017		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
(Unit: FC million Yen / LC million Rs. / Total million Rs.)																								
A. ELIGIBLE PORTION																								
1) Works / Procurement	13,320	7,921	24,782	571	397	1,120	588	601	1,346	3,006	1,661	5,466	3,594	2,030	6,579	3,060	1,837	5,711	2,500	1,395	4,559	0	0	0
Base Cost	10,672	5,106	18,616	503	331	968	503	460	1,097	2,494	1,166	4,323	2,892	1,307	4,968	2,388	1,085	4,108	1,892	756	3,151	0	0	0
Price Escalation (FC: 3.1%, LC: 9.0%)	1,436	2,095	3,913	16	30	50	32	87	127	239	344	647	376	538	1,013	394	585	1,083	380	512	993	0	0	0
Physical Contingency (10%)	1,211	720	2,253	52	36	102	53	55	122	273	151	497	327	185	598	278	167	519	227	127	414	0	0	0
2) Consulting Services	1,853	2,064	4,410	193	141	385	250	220	537	210	268	534	439	478	1,034	405	514	1,026	297	396	771	59	47	123
Base Cost	1,496	1,323	3,217	170	117	333	214	168	439	174	188	409	353	308	755	316	304	704	225	214	499	44	24	79
Sank Cost	397	182	685	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price Escalation (FC: 3.1%, LC: 9.0%)	189	553	792	5	11	17	13	32	49	17	56	77	46	127	185	52	164	229	45	145	202	10	20	33
Physical Contingency (10%)	168	188	401	18	13	35	23	20	49	19	24	49	40	43	94	37	47	93	27	36	70	5	4	11
Total 1) + 2)	15,173	9,985	29,191	764	538	1,505	839	821	1,883	3,216	1,930	6,000	4,033	2,508	7,614	3,465	2,351	6,737	2,797	1,790	5,330	59	47	123
B. NON-ELIGIBLE PORTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Works / Procurement	447	4,925	5,491	12	502	517	12	930	946	13	1,014	1,030	13	1,105	1,122	0	1,192	1,192	0	0	0	0	0	0
Base Cost	42	3,258	3,311	11	418	432	11	712	725	11	712	725	11	712	725	0	704	704	0	0	0	0	0	0
Price Escalation (FC: 3.1%, LC: 9.0%)	3	1,054	1,058	0	38	38	1	134	135	1	210	211	1	293	295	0	379	379	0	0	0	0	0	0
Physical Contingency (10%)	5	431	437	1	46	47	1	85	86	1	92	94	1	100	102	0	108	108	0	0	0	0	0	0
2) Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3) Administration Cost	0	1,700	1,700	0	101	101	0	141	141	0	352	352	0	437	437	0	396	396	0	267	267	0	6	6
4) VAT	0	1,767	1,767	0	125	125	0	210	210	0	353	353	0	434	434	0	425	425	0	215	215	0	6	6
5) Import Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total 1) ~ 5)	447	8,393	8,958	12	728	743	12	1,282	1,297	13	1,719	1,735	13	1,976	1,992	0	2,013	2,013	0	481	481	0	12	12
TOTAL A + B	15,620	18,378	38,150	776	1,266	2,247	851	2,103	3,180	3,228	3,648	7,735	4,046	4,484	9,606	3,465	4,364	8,750	2,797	2,272	5,812	59	59	134
C. Interest during Construction	1,086	0	1,375	12	0	16	28	0	35	88	0	112	162	0	206	228	0	289	282	0	357	286	0	362
D. Commitment Charge	169	0	214	24	0	31	24	0	31	24	0	31	24	0	31	24	0	31	24	0	31	24	0	31
GRAND TOTAL (A+B+C+D)	16,875	18,378	39,739	812	1,266	2,294	903	2,103	3,246	3,341	3,648	7,877	4,233	4,484	9,842	3,717	4,364	9,069	3,102	2,272	6,199	369	59	526
E. JICA Finance Portion incl. IDC (A+C+D)	16,428	9,985	30,780	800	538	1,551	891	821	1,948	3,328	1,930	6,143	4,220	2,508	7,850	3,717	2,351	7,056	3,102	1,790	5,718	369	47	515

Economic Project Cost

	Total			2011			2012			2013			2014			2015			2016			2017		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
(Unit: FC million Yen / LC million Rs. / Total million Rs.)																								
A. ELIGIBLE PORTION																								
1) Works / Procurement	11,740	4,761	19,621	554	325	1,026	554	402	1,102	2,743	1,094	4,566	3,181	1,233	5,259	2,627	1,015	4,340	2,081	692	3,327	0	0	0
Base Cost	10,672	4,328	17,837	503	296	933	503	365	1,002	2,494	995	4,151	2,892	1,121	4,781	2,388	923	3,946	1,892	629	3,024	0	0	0
Physical Contingency (10%)	1,067	433	1,784	50	30	93	50	37	100	249	99	415	289	112	478	239	92	395	189	63	302	0	0	0
2) Consulting Services	1,645	1,310	3,393	187	116	353	236	166	465	191	186	429	389	305	797	348	301	741	247	212	525	48	23	84
Base Cost	1,496	1,191	3,084	170	106	321	214	151	422	174	170	390	353	277	725	316	273	673	225	193	477	44	21	76
Physical Contingency (10%)	150	119	308	17	11	32	21	15	42	17	17	39	35	28	72	32	27	67	22	19	48	4	2	8
Total 1) + 2)	13,385	6,071	23,014	741	441	1,379	789	568	1,567	2,934	1,281	4,995	3,570	1,538	6,056	2,975	1,315	5,081	2,329	904	3,852	48	23	84
B. NON-ELIGIBLE PORTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Works / Procurement	46	30	89	12	8	22	12	8	22	12	8	22	12	8	22	0	0	0	0	0	0	0	0	0
Base Cost	42	28	81	11	7	20	11	7	20	11	7	20	11	7	20	0	0	0	0	0	0	0	0	0
Sank Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Contingency (10%)	4	3	8	1	1	2	1	1	2	1	1	2	1	1	2	0	0	0	0	0	0	0	0	0
2) Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3) Administration Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4) VAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5) Import Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total 1) ~ 5)	46	30	89	12	8	22	12	8	22	12	8	22	12	8	22	0	0	0	0	0	0	0	0	0
TOTAL A + B	13,431	6,101	23,103	752	449	1,401	801	576	1,589	2,946	1,288	5,017	3,581	1,545	6,078	2,975	1,315	5,081	2,329	904	3,852	48	23	84
C. Interest during Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Commitment Charge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL (A+B+C+D)	13,431	6,101	23,103	752	449	1,401	801	576	1,589	2,946	1,288	5,017	3,581	1,545	6,078	2,975	1,315	5,081	2,329	904	3,852	48	23	84
E. JICA Finance Portion incl. IDC (A+C+D)	13,385	6,071	23,014	741	441	1,379	789	568	1,567	2,934	1,281	4,995	3,570	1,538	6,056	2,975	1,315	5,081	2,329	904	3,852	48	23	84

Appendix E-1.2 Economic Farm Gate Price of Internationally Traded Goods

I. Rice/Paddy		Import parity	
	Operation	Unit	Price
1. Forcasted 2020 world price, f.o.b .Bangkok, 5% broken		USD / ton	354
2. Quality adjustment	x	%	95
3. International shipping and handling	+	USD / ton	17
4. Price at Colombo international port	=	USD / ton	353
5. Customs duty, 5%	+	%	0
6. Port charge, handling and warehousing	+	USD / ton	18
7. Price at Colombo international port	=	USD / ton	371
Equivalent in Rs. / ton 1/	=	Rs. / ton	42,661
8. Transportation cost (Colombo to Kandy)	+	Rs. / ton	600
9. Ex-mill /wholesale price in Kandy	=	Rs. / ton	43,261
10. Milling cost and margin	-	Rs. / ton	1,500
11. Processing ratio	x	%	65
12. By-products through processing	+	Rs. / ton	3,000
13. Millgate paddy price	=	Rs. / ton	30,145
14. Transport/handling from farm gate	-	Rs. / ton	900
15. Farm gate price	=	Rs. / kg	29

II. (1) Urea		Import parity	
	Operation	Unit	Price
1. Forecasted 2020 world price, bulk, f.o.b. Black Sea		USD / ton	180
2. International shipping and handling	+	USD / ton	82
3. Price at Colombo international port	=	USD / ton	262
4. Port charge, handling, warehousing and bagging	+	USD / ton	8
5. Price at Colombo international port	=	USD / ton	270
Equivalent in Rs. / ton 1/	=	Rs. / ton	31,034
6. Transportation cost (Colombo to Kandy)	+	Rs. / ton	600
7. Trade price in kandy	=	Rs. / ton	31,634
8. Transport/handling to farm gate	+	Rs. / ton	900
9. Farm gate price	=	Rs. / kg	31
Price of nutrient (N) 2/		Rs. / kg	67

II. (2) TSP		Import parity	
	Operation	Unit	Price
1. Forecasted 2020 world price, bulk, f.o.b. US Gulf port		USD / ton	249
2. International Shipping and Handling	+	USD / ton	17
3. Price at Colombo international port	=	USD / ton	266
4. Port charge, handling, warehousing and bagging	+	USD / ton	8
5. Price at Colombo international port	=	USD / ton	274
Equivalent in Rs. / ton 1/	=	Rs. / ton	31,508
6. Transportation cost (Colombo to Kandy)	+	Rs. / ton	600
7. Trade price in kandy	=	Rs. / ton	32,108
8. Transport/handling to farm gate	+	Rs. / ton	900
9. Farm gate price	=	Rs. / kg	31
Price of nutrient (N) 2/		Rs. / kg	91

II. (3) Potassium Chloride (KCl)		Import parity	
	Operation	Unit	Price
1. Forecasted 2020 world price, spot, f.o.b. Vancouver		USD / ton	161
2. International shipping and handling	+	USD / ton	111
3. Price at Colombo international port	=	USD / ton	272
4. Port charge, handling, warehousing and bagging	+	USD / ton	8
5. Price at Colombo international port	=	USD / ton	280
Equivalent in Rs. / ton 1/	=	Rs. / ton	32,218
6. Transportation cost (Colombo to Kandy)	+	Rs. / ton	600
7. Trade price in kandy	=	Rs. / ton	32,818
8. Transport/handling to farm gate	+	Rs. / ton	900
9. Farm gate price	=	Rs. / kg	32
Price of nutrient (N) 2/		Rs. / kg	53

Note: 1/ Exchange rate: USD = 115 Rupee (As of February 2010)
2/ Nutrient content: Urea 46%
TSP 34%
KCL 60%

Appendix E-1.3 Other Field Crops Cultivated Area in System H and G

	System H	Area (ha)	Percentage	System G	Area (ha)	Percentage
Chilli	Chilli	148	3%	Chilli	9	2%
Onion	Red onion	12	0%	Red onion	7	2%
	B onion	235	4%	B onion	24	6%
Maize	Maize	832	15%	Maize	117	30%
Vegetables	Kurakkan	8	0%	Kurakkan	4	1%
	Sweet Potato	8	0%	Sweet Potato	0	0%
	Kiriala	8	0%	Kiriala	83	21%
	Manioc	18	0%	Manioc	5	1%
	Gherkin	53	1%	Gherkin	2	1%
	Ash Pumkin	33	1%	Ash Pumkin	0	0%
	Vegetables	1,642	30%	Vegetables	63	16%
Pulses	Green Gram	106	2%	Green Gram	7	2%
	Cowpea	427	8%	Cowpea	9	2%
	Black gram	74	1%	Black gram	0	0%
	Groud nut	25	0%	Groud nut	13	3%
	Soya	732	14%	Soya	0	0%
	Gingerly	29	1%	Gingerly	0	0%
Perennial Crops	Banana	730	14%	Banana	49	12%
	Melon	103	2%	Melon	0	0%
	Papaw	107	2%	Papaw	4	1%
	Pomegranate	1	0%	Pomegranate	0	0%
	Pinapple	3	0%	Pinapple	0	0%
	Guava	2	0%	Guava	0	0%
	Dra fruit	2	0%	Dra fruit	0	0%
	Sweet Melon	0	0%	Sweet Melon	0	0%
	Orange	0	0%	Orange	0	0%
	Lime	0	0%	Lime	0	0%
	Coconut	58	1%	Coconut	0	0%
	Total	5,396		Total	392	

Source: Mahaweli Authority of Sri Lanka

Appendix E-1.4 Financial Crop Budget for Typical Crops in the Project Area

1. Financial Crop Budget without Project Condition

Items	Paddy - Maha			Paddy - Yala			Chilli			Big Onion (Roots and Tuber)			Maize (Creals)			Vegetables			Cowpea (Pulses)			Banana (Perennial Crops)		
	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost
	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha
Seed	55	105	5,775	55	105	5,775	1,750	1	1,750	2,600	8	19,500	85	13	1,105	4,500	1	4,500	140	38	5,250	75	550	41,250
Fertilizer																								
Urea	7	240	1,680	7	240	1,680	52	325	16,900	52	198	10,270	52	218	11,336	52	302	15,704	52	65	3,380	52	200	10,400
Phosphate	7	75	525	7	75	525	54	100	5,400	54	100	5,400	54	100	5,400	54	327	17,658	54	100	5,400	54	138	7,425
Potassium	7	65	455	7	65	455	84	100	8,400	84	75	6,300	84	50	4,200	84	170	14,280	84	75	6,300	84	413	34,650
Manure	-	-	-	-	-	-	-	-	-	30,000	1	30,000	-	-	-	-	-	-	-	-	-	-	-	-
Plant protection																								
Pesticides	6,500	1	6,500	6,500	1	6,500	25,000	1	25,000	10,000	1	10,000	1,200	1	1,200	25,000	1	25,000	2,100	1	2,100	6,000	1	6,000
Herbicides	10,500	1	10,500	10,500	1	10,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1	2,000
Fungicides	2,200	1	2,200	2,200	1	2,200	10,000	1	10,000	9,500	1	9,500	0	0	0	18,000	1	18,000	1,500	1	1,500	1,000	1	1,000
Mechanization																								
Land Preparation	16,000	1	16,000	16,000	1	16,000	12,500	1	12,500	20,000	1	20,000	12,500	1	12,500	12,500	1	12,500	12,500	1	12,500	20,000	1	20,000
Threshing	18,000	1	18,000	18,000	1	18,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	2,000	1	2,000	2,000	1	2,000	2,800	1	2,800	6,000	1	6,000	2,250	1	2,250	6,000	1	6,000	1,500	1	1,500	10,000	1	10,000
Labour																								
Family	0	50	0	0	50	0	0	275	0	0	160	0	0	25	0	0	180	0	0	60	0	0	25	0
Hired	600	18	10,800	600	18	10,800	600	120	72,000	600	190	114,000	600	35	21,000	600	60	36,000	600	50	30,000	600	40	24,000
Miscellaneous items	5,000	1	5,000	5,000	1	5,000	5,000	1	5,000	10,000	1	10,000	5,000	1	5,000	10,000	1	10,000	10,000	1	10,000	2,000	1	2,000
Total cost			79,435			79,435			159,750			240,970			63,991			159,642			77,930			158,725
Value product	33	4,450	146,850	33	4,460	147,180	140	3,600	504,000	40	12,000	480,000	30	2,500	75,000	25	10,000	250,000	80	1,100	88,000	30	11,000	330,000
Gross margin			67,415			67,745			344,250			239,030			11,009			90,358			10,070			171,275

2. Financial Crop Budget with Project Condition

Items	Paddy - Maha			Paddy - Yala			Chilli			Big Onion (Roots and Tuber)			Maize (Creals)			Vegetables			Cowpea (Pulses)			Banana (Perennial Crops)		
	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost
	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha
Seed	55	105	5,775	55	105	5,775	1,750	1	1,750	2,600	8	19,500	85	13	1,105	4,500	1	4,500	140	38	5,250	75	550	41,250
Fertilizer																								
Urea	7	250	1,750	7	250	1,750	52	325	16,900	52	198	10,270	52	218	11,336	52	302	15,704	52	65	3,380	52	200	10,400
Phosphate	7	80	560	7	80	560	54	100	5,400	54	100	5,400	54	100	5,400	54	327	17,658	54	100	5,400	54	138	7,425
Potassium	7	70	490	7	70	490	84	100	8,400	84	75	6,300	84	50	4,200	84	170	14,280	84	75	6,300	84	413	34,650
Manure	-	-	-	-	-	-	-	-	-	30,000	1	30,000	-	-	-	-	-	-	-	-	-	-	-	-
Plant protection																								
Pesticides	7,500	1	7,500	7,500	1	7,500	25,000	1	25,000	10,000	1	10,000	1,200	1	1,200	25,000	1	25,000	2,100	1	2,100	6,000	1	6,000
Herbicides	12,500	1	12,500	12,500	1	12,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1	2,000
Fungicides	2,500	1	2,500	2,500	1	2,500	10,000	1	10,000	9,500	1	9,500	0	0	0	18,000	1	18,000	1,500	1	1,500	1,000	1	1,000
Mechanization																								
Land Preparation	16,000	1	16,000	16,000	1	16,000	12,500	1	12,500	20,000	1	20,000	12,500	1	12,500	12,500	1	12,500	12,500	1	12,500	20,000	1	20,000
Threshing	18,000	1	18,000	18,000	1	18,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	2,000	1	2,000	2,000	1	2,000	2,800	1	2,800	6,000	1	6,000	2,250	1	2,250	6,000	1	6,000	1,500	1	1,500	10,000	1	10,000
Labour																								
Family	0	55	0	0	55	0	0	285	0	0	180	0	0	28	0	0	200	0	0	60	0	0	28	0
Hired	600	23	13,800	600	23	13,800	600	135	81,000	600	207	124,200	600	40	24,000	600	70	42,000	600	50	30,000	600	48	28,800
Miscellaneous items	5,000	1	5,000	5,000	1	5,000	5,000	1	5,000	10,000	1	10,000	5,000	1	5,000	10,000	1	10,000	10,000	1	10,000	2,000	1	2,000
Total cost			85,875			85,875			168,750			251,170			66,991			165,642			77,930			163,525
Value product	33	5,250	173,250	33	5,000	165,000	140	4,000	560,000	40	13,500	540,000	30	3,000	90,000	25	11,000	275,000	80	1,500	120,000	30	12,000	360,000
Gross margin			87,375			79,125			391,250			288,830			23,009			109,358			42,070			196,475

Appendix E-1.5 Economic Crop Budget for Typical Crops in the Project Area

1. Economic Crop Budget without Project Condition

Items	Paddy - Maha			Paddy - Yala			Chilli			Big Onion (Roots and Tuber)			Maize (Creals)			Vegetables			Cowpea (Pulses)			Banana (Perennial Crops)		
	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost
	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha
Seed	50	105	5,198	50	105	5,198	1,575	1	1,575	2,340	8	17,550	77	13	995	4,050	1	4,050	126	38	4,725	68	550	37,125
Fertilizer																								
Urea	31	240	7,440	31	240	7,440	31	325	10,075	31	198	6,123	31	218	6,758	31	302	9,362	31	65	2,015	31	200	6,200
Phosphate	31	75	2,325	31	75	2,325	31	100	3,100	31	100	3,100	31	100	3,100	31	327	10,137	31	100	3,100	31	138	4,263
Potassium	32	65	2,080	32	65	2,080	32	100	3,200	32	75	2,400	32	50	1,600	32	170	5,440	32	75	2,400	32	413	13,200
Manure	-	-	-	-	-	-	-	-	-	27,000	1	27,000	-	-	-	-	-	-	-	-	-	-	-	-
Plant protection																								
Pesticides	5,850	1	5,850	5,850	1	5,850	22,500	1	22,500	9,000	1	9,000	1,080	1	1,080	22,500	1	22,500	1,890	1	1,890	5,400	1	5,400
Herbicides	9,450	1	9,450	9,450	1	9,450	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,800	1	1,800
Fungicides	1,980	1	1,980	1,980	1	1,980	9,000	1	9,000	8,550	1	8,550	0	0	0	16,200	1	16,200	1,350	1	1,350	900	1	900
Mechanization																								
Land Preparation	14,400	1	14,400	14,400	1	14,400	11,250	1	11,250	18,000	1	18,000	11,250	1	11,250	11,250	1	11,250	11,250	1	11,250	18,000	1	18,000
Threshing	16,200	1	16,200	16,200	1	16,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	1,800	1	1,800	1,800	1	1,800	2,520	1	2,520	5,400	1	5,400	2,025	1	2,025	5,400	1	5,400	1,350	1	1,350	9,000	1	9,000
Labour																								
Family	378	50	18,900	378	50	18,900	378	275	103,950	378	160	60,480	378	25	9,450	378	180	68,040	378	60	22,680	378	25	9,450
Hired	378	18	6,804	378	18	6,804	378	120	45,360	378	190	71,820	378	35	13,230	378	60	22,680	378	50	18,900	378	40	15,120
Miscellaneous items	4,500	1	4,500	4,500	1	4,500	4,500	1	4,500	9,000	1	9,000	4,500	1	4,500	9,000	1	9,000	9,000	1	9,000	1,800	1	1,800
Total cost			96,927			96,927			217,030			238,423			53,988			184,059			78,660			122,258
Value product	29	4,450	129,050	29	4,460	129,340	126	3,600	453,600	36	12,000	432,000	27	2,500	67,500	23	10,000	225,000	72	1,100	79,200	27	11,000	297,000
Gross margin			32,124			32,414			236,570			193,578			13,513			40,941			540			174,743

2. Economic Crop Budget with Project Condition

Items	Paddy - Maha			Paddy - Yala			Chilli			Big Onion (Roots and Tuber)			Maize (Creals)			Vegetables			Cowpea (Pulses)			Banana (Perennial Crops)		
	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost	Price	Input	Cost
	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha	Rs. / unit	unit / ha	Rs. / ha
Seed	50	105	5,198	50	105	5,198	1,575	1	1,575	2,340	8	17,550	77	13	995	4,050	1	4,050	126	38	4,725	68	550	37,125
Fertilizer																								
Urea	31	250	7,750	31	250	7,750	31	325	10,075	31	198	6,123	31	218	6,758	31	302	9,362	31	65	2,015	31	200	6,200
Phosphate	31	80	2,480	31	80	2,480	31	100	3,100	31	100	3,100	31	100	3,100	31	327	10,137	31	100	3,100	31	138	4,263
Potassium	32	70	2,240	32	70	2,240	32	100	3,200	32	75	2,400	32	50	1,600	32	170	5,440	32	75	2,400	32	413	13,200
Manure	-	-	-	-	-	-	-	-	-	27,000	1	27,000	-	-	-	-	-	-	-	-	-	-	-	-
Plant protection																								
Pesticides	6,750	1	6,750	6,750	1	6,750	22,500	1	22,500	9,000	1	9,000	1,080	1	1,080	22,500	1	22,500	1,890	1	1,890	5,400	1	5,400
Herbicides	11,250	1	11,250	11,250	1	11,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,800	1	1,800
Fungicides	2,250	1	2,250	2,250	1	2,250	9,000	1	9,000	8,550	1	8,550	0	0	0	16,200	1	16,200	1,350	1	1,350	900	1	900
Mechanization																								
Land Preparation	14,400	1	14,400	14,400	1	14,400	11,250	1	11,250	18,000	1	18,000	11,250	1	11,250	11,250	1	11,250	11,250	1	11,250	18,000	1	18,000
Threshing	16,200	1	16,200	16,200	1	16,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	1,800	1	1,800	1,800	1	1,800	2,520	1	2,520	5,400	1	5,400	2,025	1	2,025	5,400	1	5,400	1,350	1	1,350	9,000	1	9,000
Labour																								
Family	378	55	20,790	378	55	20,790	378	285	107,730	378	180	68,040	378	28	10,584	378	200	75,600	378	60	22,680	378	28	10,584
Hired	378	23	8,694	378	23	8,694	378	135	51,030	378	207	78,246	378	40	15,120	378	70	26,460	378	50	18,900	378	48	18,144
Miscellaneous items	4,500	1	4,500	4,500	1	4,500	4,500	1	4,500	9,000	1	9,000	4,500	1	4,500	9,000	1	9,000	9,000	1	9,000	1,800	1	1,800
Total cost			104,302			104,302			226,480			252,409			57,012			195,399			78,660			126,416
Value product	29	5,250	152,250	29	5,000	145,000	126	4,000	504,000	36	13,500	486,000	27	3,000	81,000	23	11,000	247,500	72	1,500	108,000	27	12,000	324,000
Gross margin			47,949			40,699			277,520			233,592			23,989			52,101			29,340			197,585

Appendix E-1.6 Calculation of Economic Irrigation Benefit

Economic Project Benefit of Irrigation in 2017

Crop	Unit Value (Rs. / kg)	Yield (kg / ha)	Value Product (Rs. / ha)	Production Cost (Rs. / ha)	Gross Margin (Rs. / ha)	Cultivated Area (ha)	Net Benefit (Million Rs.)
Without Project Condition							
Paddy (Maha)	29	4,450	129,050	96,927	32,124	81,373	2,614
Paddy (Yala)	29	4,460	129,340	96,927	32,414	55,356	1,794
Chilli	126	3,600	453,600	217,030	236,570	357	84
Big Onion	36	12,000	432,000	238,423	193,578	630	122
Maize	27	2,500	67,500	53,988	13,513	2,158	29
Vegetable	23	10,000	225,000	184,059	40,941	4,378	179
Cowpea	72	1,100	79,200	78,660	540	3,232	2
Banana	27	11,000	297,000	122,258	174,743	2,405	420
Total						149,889	5,245
With Project Condition							
Paddy (Maha)	29	4,450	129,050	96,927	32,124	84,802	2,724
Paddy (Yala)	29	4,460	129,340	96,927	32,414	66,749	2,164
Chilli	126	3,600	453,600	217,030	236,570	388	92
Big Onion	36	12,000	432,000	238,423	193,578	685	133
Maize	27	2,500	67,500	53,988	13,513	2,347	32
Vegetable	23	10,000	225,000	184,059	40,941	4,762	195
Cowpea	72	1,100	79,200	78,660	540	3,515	2
Banana	27	11,000	297,000	122,258	174,743	2,616	457
Total						165,863	5,798
Production Foregone in Submerged Area							
Paddy (Maha)	29	2,900	84,100	67,849	16,251	739	12
Paddy (Yala)	29	2,700	78,300	67,849	10,451	421	4
Chilli	126	2,400	302,400	195,327	107,073	200	21
Big Onion	36	9,500	342,000	214,580	127,420	42	5
Maize	27	4,000	108,000	48,589	59,411	7	0
Vegetable	23	8,200	184,500	165,653	18,847	106	2
Total						1,515	46
Balance						**15,974**	**507**

Economic Project Benefit of Irrigation in 2022

Crop	Unit Value (Rs. / kg)	Yield (kg / ha)	Value Product (Rs. / ha)	Production Cost (Rs. / ha)	Gross Margin (Rs. / ha)	Cultivated Area (ha)	Net Benefit (Million Rs.)
Without Project Condition							
Paddy (Maha)	29	4,450	129,050	96,927	32,124	81,373	2,614
Paddy (Yala)	29	4,460	129,340	96,927	32,414	55,356	1,794
Chilli	126	3,600	453,600	217,030	236,570	357	84
Big Onion	36	12,000	432,000	238,423	193,578	630	122
Maize	27	2,500	67,500	53,988	13,513	2,158	29
Vegetable	23	10,000	225,000	184,059	40,941	4,378	179
Cowpea	72	1,100	79,200	78,660	540	3,232	2
Banana	27	11,000	297,000	122,258	174,743	2,405	420
Total						149,889	5,245
With Project Condition							
Paddy (Maha)	29	5,250	152,250	104,302	47,949	84,802	4,066
Paddy (Yala)	29	5,000	145,000	104,302	40,699	66,749	2,717
Chilli	126	4,000	504,000	226,480	277,520	388	108
Big Onion	36	13,500	486,000	252,409	233,592	685	160
Maize	27	3,000	81,000	57,012	23,989	2,347	56
Vegetable	23	11,000	247,500	195,399	52,101	4,762	248
Cowpea	72	1,500	108,000	78,660	29,340	3,515	103
Banana	27	12,000	324,000	126,416	197,585	2,616	517
Total						165,863	7,975
Production Foregone in Submerged Area							
Paddy (Maha)	29	2,900	84,100	67,849	16,251	739	12
Paddy (Yala)	29	2,700	78,300	67,849	10,451	421	4
Chilli	126	2,400	302,400	195,327	107,073	200	21
Big Onion	36	9,500	342,000	214,580	127,420	42	5
Maize	27	4,000	108,000	48,589	59,411	7	0
Vegetable	23	8,200	184,500	165,653	18,847	106	2
Total						1,515	46
Balance						**15,974**	**2,684**

Appendix E-1.7 Calculation of Economic Water Supply Benefit

① Total Water Production Amount	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	15.2	15.2	15.2	15.2	15.2	15.2	15.7	15.9	16.2	16.4	16.6	16.9	17.1	17.2	17.4	17.6	17.7	17.9	18.1	18.2	19.9
Trincomalee	14.5	14.5	14.5	14.5	14.5	14.5	19.6	20.8	22.0	23.3	24.5	25.8	26.5	27.3	28.1	28.8	29.6	30.4	31.1	31.9	39.6
Matale	18.2	18.2	18.2	18.2	18.2	18.2	21.4	22.8	24.2	25.6	27.0	28.5	29.2	30.0	30.8	31.6	32.4	33.1	33.9	34.7	42.5
Polonnaruwa	4.5	4.5	4.5	4.5	4.5	4.5	6.2	6.7	7.2	7.8	8.3	8.9	9.2	9.5	9.8	10.1	10.4	10.7	11.0	11.3	14.2
Total	**52.5**	**52.5**	**52.5**	**52.5**	**52.5**	**52.5**	**62.8**	**66.2**	**69.7**	**73.1**	**76.5**	**80.0**	**82.0**	**84.0**	**86.0**	**88.0**	**90.0**	**92.1**	**94.1**	**96.1**	**116.2**
								1	2	3	4	5	1	2	3	4	5	6	7	8	18
② Additional Water Production with Moragahakanda (Unit = ① - Current Water Productic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.9	1.2	1.4	1.6	1.8	2.0	2.1	2.3	2.5	2.6	2.8	3.0	4.6
Trincomalee	0.0	0.0	0.0	0.0	0.0	0.0	5.1	6.3	7.6	8.8	10.0	11.3	12.0	12.8	13.6	14.3	15.1	15.9	16.6	17.4	25.1
Matale	0.0	0.0	0.0	0.0	0.0	0.0	3.1	4.5	6.0	7.4	8.8	10.2	11.0	11.8	12.6	13.3	14.1	14.9	15.7	16.5	24.3
Polonnaruwa	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.2	2.7	3.3	3.8	4.4	4.7	5.0	5.3	5.6	5.9	6.2	6.5	6.8	9.7
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.3**	**13.7**	**17.2**	**20.6**	**24.1**	**27.5**	**29.5**	**31.5**	**33.6**	**35.6**	**37.6**	**39.6**	**41.6**	**43.6**	**63.7**

③ Non-Revenue Water	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Trincomalee	37%	35%	34%	32%	30%	29%	27%	25%	23%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Matale	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
Polonnaruwa	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%

④ NRW Amount = ② x ③	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.9
Trincomalee	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.6	1.8	1.8	2.0	2.3	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	5.0
Matale	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.9	1.1	1.4	1.7	1.9	2.1	2.2	2.4	2.5	2.7	2.8	3.0	3.1	4.6
Polonnaruwa	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.5	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.9
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2.4**	**3.0**	**3.6**	**4.1**	**4.7**	**5.4**	**5.8**	**6.2**	**6.6**	**7.0**	**7.4**	**7.8**	**8.2**	**8.6**	**12.5**

⑤ Additional Water Supply with Moragahakanda (Unit: M = ② - ④	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.7	0.9	1.1	1.3	1.4	1.6	1.7	1.8	2.0	2.1	2.2	2.4	3.7
Trincomalee	0.0	0.0	0.0	0.0	0.0	0.0	3.7	4.7	5.8	7.0	8.0	9.0	9.6	10.3	10.9	11.5	12.1	12.7	13.3	13.9	20.1
Matale	0.0	0.0	0.0	0.0	0.0	0.0	2.5	3.7	4.8	6.0	7.1	8.3	8.9	9.5	10.2	10.8	11.4	12.1	12.7	13.3	19.7
Polonnaruwa	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.8	2.2	2.6	3.1	3.5	3.7	4.0	4.2	4.5	4.7	4.9	5.2	5.4	7.8
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**7.9**	**10.7**	**13.5**	**16.6**	**19.3**	**22.1**	**23.7**	**25.4**	**27.0**	**28.6**	**30.2**	**31.8**	**33.4**	**35.1**	**51.2**

⑥ Population Projection (Unit: '000 persons)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	911	922	933	945	956	968	979	991	1,003	1,015	1,027	1,039	1,052	1,064	1,077	1,090	1,103	1,116	1,130	1,143	1,288
Trincomalee	481	488	495	502	509	516	523	530	538	545	553	561	569	577	585	593	601	609	618	627	720
Matale	496	501	506	511	517	522	527	532	537	543	548	554	559	565	571	576	582	588	594	600	662
Polonnaruwa	421	428	435	442	449	456	463	471	478	486	494	502	510	518	526	534	543	552	560	569	667
Total	**2,310**	**2,340**	**2,369**	**2,399**	**2,430**	**2,461**	**2,492**	**2,524**	**2,556**	**2,589**	**2,622**	**2,655**	**2,689**	**2,724**	**2,758**	**2,794**	**2,829**	**2,865**	**2,902**	**2,939**	**3,338**

⑦ Water Supply Population (Unit: '000 persons)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	219	219	219	219	219	219	225	229	232	236	239	242	245	247	250	252	254	257	259	262	286
Trincomalee	156	160	164	169	173	177	245	266	289	318	335	352	363	373	384	394	405	415	426	436	541
Matale	234	234	234	234	234	234	274	292	311	329	347	365	375	385	395	405	415	425	435	445	545
Polonnaruwa	60	60	60	60	60	60	82	89	97	104	111	118	122	126	130	134	138	142	146	150	190
Total	**669**	**673**	**677**	**682**	**686**	**690**	**826**	**877**	**928**	**987**	**1,033**	**1,078**	**1,105**	**1,132**	**1,159**	**1,186**	**1,213**	**1,240**	**1,266**	**1,293**	**1,562**

⑧ Percentage of Water Supply Population (%) = ⑦ / ⑧ x 100%	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Anuradhapura	24%	24%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	22%
Trincomalee	32%	33%	33%	34%	34%	34%	47%	50%	54%	58%	61%	63%	64%	65%	66%	67%	67%	68%	69%	70%	75%
Matale	47%	47%	46%	46%	45%	45%	52%	55%	58%	61%	63%	66%	67%	68%	69%	70%	71%	72%	73%	74%	82%
Polonnaruwa	14%	14%	14%	14%	13%	13%	18%	19%	20%	21%	23%	24%	24%	24%	25%	25%	25%	26%	26%	26%	28%
Total	**29%**	**29%**	**29%**	**28%**	**28%**	**28%**	**33%**	**35%**	**36%**	**38%**	**39%**	**41%**	**41%**	**42%**	**42%**	**42%**	**43%**	**43%**	**44%**	**44%**	**47%**

⑨ Economic Benefit (Rs. million)	Ratio	Price	O&M	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Existing Water Users	37.5%	41.2	9.1	0	0	0	0	0	0	95	129	163	200	233	266	286	305	325	344	364	383	403	422	617
New Water Users	62.5%	20.6	9.1	0	0	0	0	0	0	57	77	97	119	139	159	170	182	194	205	217	229	240	252	368
Non-Revenue Water			9.1	0	0	0	0	0	0	-22	-28	-33	-37	-43	-49	-53	-56	-60	-64	-67	-71	-74	-78	-114
Total				**0**	**0**	**0**	**0**	**0**	**0**	**131**	**178**	**227**	**282**	**329**	**376**	**403**	**431**	**458**	**486**	**513**	**541**	**568**	**596**	**870**

Appendix E-1.8 Cash Flow and Economic Value Indicators

(Unit: Rs. Million)

Year		Economic Cost		Total Cost	Economic Benefit				Total Benefit	Balance
		Capital Cost	O&M		Irrigation	Hydropower	Water Supply	Fishery		
1	2011	1,401	0	1,401	0	0	0	0	0	**-1,401**
2	2012	1,589	0	1,589	0	0	0	0	0	**-1,589**
3	2013	5,017	0	5,017	0	0	0	0	0	**-5,017**
4	2014	6,078	0	6,078	0	0	0	0	0	**-6,078**
5	2015	5,081	0	5,081	0	0	0	0	0	**-5,081**
6	2016	3,852	0	3,852	0	0	0	0	0	**-3,852**
7	2017	84	74	158	507	289	131	0	927	**768**
8	2018		74	74	871	578	178	0	1,627	**1,553**
9	2019		74	74	1,306	578	227	23	2,134	**2,060**
10	2020		74	74	1,742	578	282	46	2,647	**2,572**
11	2021		74	74	2,177	578	329	46	3,129	**3,055**
12	2022		74	74	2,684	578	376	46	3,684	**3,609**
13	2023		74	74	2,684	578	403	46	3,711	**3,637**
14	2024		74	74	2,684	578	431	46	3,739	**3,664**
15	2025		74	74	2,684	578	458	46	3,766	**3,692**
16	2026		74	74	2,684	578	486	46	3,794	**3,719**
17	2027		74	74	2,684	578	513	46	3,821	**3,747**
18	2028		74	74	2,684	578	541	46	3,849	**3,774**
19	2029		74	74	2,684	578	568	46	3,876	**3,802**
20	2030		74	74	2,684	578	596	46	3,903	**3,829**
21	2031		74	74	2,684	578	623	46	3,931	**3,856**
22	2032		74	74	2,684	578	651	46	3,958	**3,884**
23	2033		74	74	2,684	578	678	46	3,986	**3,911**
24	2034		74	74	2,684	578	706	46	4,013	**3,939**
25	2035		74	74	2,684	578	733	46	4,041	**3,966**
26	2036		74	74	2,684	578	761	46	4,068	**3,994**
27	2037		74	74	2,684	578	788	46	4,096	**4,021**
28	2038		74	74	2,684	578	816	46	4,123	**4,049**
29	2039		74	74	2,684	578	843	46	4,151	**4,076**
30	2040		74	74	2,684	578	870	46	4,178	**4,104**
31	2041		74	74	2,684	578	870	46	4,178	**4,104**
32	2042		74	74	2,684	578	870	46	4,178	**4,104**
33	2043		74	74	2,684	578	870	46	4,178	**4,104**
34	2044		74	74	2,684	578	870	46	4,178	**4,104**
35	2045		74	74	2,684	578	870	46	4,178	**4,104**
36	2046	2,349	74	2,424	2,684	578	870	46	4,178	**1,755**
37	2047		74	74	2,684	578	870	46	4,178	**4,104**
38	2048		74	74	2,684	578	870	46	4,178	**4,104**
39	2049		74	74	2,684	578	870	46	4,178	**4,104**
40	2050		74	74	2,684	578	870	46	4,178	**4,104**
41	2051		74	74	2,684	578	870	46	4,178	**4,104**
42	2052		74	74	2,684	578	870	46	4,178	**4,104**
43	2053		74	74	2,684	578	870	46	4,178	**4,104**
44	2054		74	74	2,684	578	870	46	4,178	**4,104**
45	2055		74	74	2,684	578	870	46	4,178	**4,104**
46	2056		74	74	2,684	578	870	46	4,178	**4,104**
47	2057		74	74	2,684	578	870	46	4,178	**4,104**
48	2058		74	74	2,684	578	870	46	4,178	**4,104**
49	2059		74	74	2,684	578	870	46	4,178	**4,104**
50	2060		74	74	2,684	578	870	46	4,178	**4,104**

Note: Annual Discount Rate: i = 10%

Present Value (Unit: Rs. Million)

Total Cost	Total Benefit	Balance
1,274	0	-1,274
1,313	0	-1,313
3,770	0	-3,770
4,152	0	-4,152
3,155	0	-3,155
2,174	0	-2,174
81	476	394
35	759	724
32	905	874
29	1,021	992
26	1,097	1,071
24	1,174	1,150
22	1,075	1,053
20	984	965
18	902	884
16	826	809
15	756	741
13	692	679
12	634	622
11	580	569
10	531	521
9	486	477
8	445	437
8	407	400
7	373	366
6	341	335
6	312	307
5	286	281
5	262	257
4	239	235
4	218	214
4	198	194
3	180	177
3	164	161
3	149	146
78	135	57
2	123	121
2	112	110
2	102	100
2	92	91
1	84	82
1	76	75
1	69	68
1	63	62
1	57	56
1	52	51
1	47	47
1	43	42
1	39	38
1	36	35
16,370	17,602	1,232

Economic Value Indicator

Net Present Value (NPV)	**1,232**
Benefit / Cost Ratio (B/C)	**1.08**
Economic Internal Rate of Return (EIRR)	**10.6%**

Sensitivity Analysis (EIRR)

Benefit	Cost		
	Base	+10%	+20%
Base	**10.6%**	**8.7%**	**8.0%**
-10%	**8.7%**	**7.8%**	**7.1%**
-20%	**7.6%**	**6.8%**	**6.1%**

Appendix E-1.9 Estimation of Annual Farm Income

1) Annual Farm Income per ha in the Project Area

Crop	Unit Value (Rs. / kg)	Yield (kg / ha)	Value Product (Rs. / ha)	Production Cost (Rs. / ha)	Cultivated Area (ha)	Cultivated Area (ha)	Net Benefit (Rs.)
Without Project Condition							
Paddy (Maha)	33	4,450	146,850	79,435	81,373	0.95	63,893
Paddy (Yala)	33	4,460	147,180	79,435	55,356	0.64	43,678
Chilli	140	3,600	504,000	159,750	357	0.01	4,874
Big Onion	40	12,000	480,000	240,970	630	0.01	1,754
Maize	30	2,500	75,000	63,991	2,158	0.03	277
Vegetable	25	10,000	250,000	159,642	4,378	0.05	4,608
Cowpea	80	1,100	88,000	77,930	3,232	0.04	379
Banana	30	11,000	330,000	158,725	2,405	0.03	4,798
Total per ha					149,889	1.76	124,260
With Project Condition							
Paddy (Maha)	33	5,250	173,250	85,875	84,802	0.97	84,897
Paddy (Yala)	33	5,000	165,000	85,875	66,749	0.76	60,514
Chilli	140	4,000	560,000	168,750	388	0.00	1,740
Big Onion	40	13,500	540,000	251,170	685	0.01	2,267
Maize	30	3,000	90,000	66,991	2,347	0.03	619
Vegetable	25	11,000	275,000	165,642	4,762	0.05	5,966
Cowpea	80	1,500	120,000	77,930	3,515	0.04	1,694
Banana	30	12,000	360,000	163,525	2,616	0.03	5,888
Total per ha					165,863	1.90	163,585
Balance					**15,974**	**0.14**	**39,325**

2) Annual Farm Income per average farm household (0.91 ha) in the Project Area

Crop	Unit Value (Rs. / kg)	Yield (kg / ha)	Value Product (Rs. / ha)	Production Cost (Rs. / ha)	Cultivated Area (ha)	Cultivated Area (ha)	Net Benefit (Rs.)
Without Project Condition							
Paddy (Maha)	33	4,450	146,850	79,435	81,373	0.86	58,143
Paddy (Yala)	33	4,460	147,180	79,435	55,356	0.59	39,747
Chilli	140	3,600	504,000	159,750	357	0.01	4,435
Big Onion	40	12,000	480,000	240,970	630	0.01	1,596
Maize	30	2,500	75,000	63,991	2,158	0.02	252
Vegetable	25	10,000	250,000	159,642	4,378	0.05	4,193
Cowpea	80	1,100	88,000	77,930	3,232	0.03	345
Banana	30	11,000	330,000	158,725	2,405	0.03	4,366
Total per ha					149,889	1.60	113,077
With Project Condition							
Paddy (Maha)	33	5,250	173,250	85,875	84,802	0.88	77,256
Paddy (Yala)	33	5,000	165,000	85,875	66,749	0.70	55,067
Chilli	140	4,000	560,000	168,750	388	0.00	1,584
Big Onion	40	13,500	540,000	251,170	685	0.01	2,063
Maize	30	3,000	90,000	66,991	2,347	0.02	563
Vegetable	25	11,000	275,000	165,642	4,762	0.05	5,429
Cowpea	80	1,500	120,000	77,930	3,515	0.04	1,542
Banana	30	12,000	360,000	163,525	2,616	0.03	5,358
Total per ha					165,863	1.73	148,862
Balance					**15,974**	**0.13**	**35,786**

Appendix E-2

Operation & Effect Indicators

Appendix E-2.1 Operation and Effect Indicators

Operation Indicators

No.	Indicators	Definition of Indicator	Unit	Current (2010)		Target (2018)		Remarks
Irrigation and Agriculture								
1	Area benefited by the Project	Cultivated area in the district benefited by the project	ha		-		87,278	Total cultivated area in System H, I/H, M/H, KHFC, G, D1, D2 including Kaudulla Left Bank extension area (*Refer to Chapter 4.3.3: Proposed cropping pattern based on the result of the water balance simulation)*
2	Cultivated area by crops	Annual total of cultivated area in the district benefited by the project	ha	Paddy (Maha) Paddy (Yala)	81,200 54,400	Paddy (Maha) Paddy (Yala) Increment	84,800 66,700 15,900	Proposed cropping pattern based on the result of the water balance simulation (*Refer to Chapter 4.3.3)*
3	Sufficiency rate of O&M cost	Actual expenditure of O&M cost/requested budget of O&M cost (Total of the charge on the administrative agencies and that on the farmhouses, such as water charge, etc.)	%	Irrigation Dam/Reservoir	78 60	Irrigation Dam/Reservoir	85 (LKR 6.7 mil.) 65 (LKR 44.4 mil.)	Target figures were set based on the current budget allocation and actual expenditure for O&M of System D for irrigation and Victoria, Kotmale and Bowatenna for Dam/Reservoir. *(Refer to Appendix E-2.2)*
4	Annual total volume of inflow to the reservoir	Annual total volume of inflow from rivers to the reservoir	MCM/year		-		560	Target figure was set according to the results of the water balance simulation. (*Refer to Appendix E-2.3)*
5	Annual total volume of water release through intake facilities	Annual total volume of water released from the reservoir for water utilization (volume released through intake facilities)	MCM/year		-		550	Target figure was set according to the results of the water balance simulation. (*Refer to Appendix E-2.4)*
6	Volume of sedimentation in the reservoir	Volume of accumulated sediment in the reservoir	m^3/km^2/year		-		340	*Refer to Chapter Appendix C-2*
Power Generation								
7	Unplanned outage hours	As shown by the name of the indicator	hour/year		-		48	Percentage of power failure accident in Japan (1975-1980) is applied for the target figure.
8	Capacity factor	Capacity Factor = (net electric energy) / (maximum output ×hours per year) × 100 (%)	%		-		50	50% = 66,300 MWh (Refer to Effect Indicator No.4) / (15MW x 24 hrs x 365 days) x 100% *(Refer to Chapter 4.5.1)*
Domestic and Industrial Water Supply								
9	Population served	Population that receives water supply services per year	persons		669,000		877,000	Target figure was set based on the water demand projection. (*Refer to Appendix E-1.6)*
10	Amount of water supply	Average daily water supply = (annual total water supply)/ (number of days in a year)	m^3/day		108,000		143,000	Target figure was set based on the water demand projection. (*Refer to Appendix E-1.6)*

Effect Indicators

No.	Indicators		Unit	Current (2010)		Target (2018)		Remarks
Irrigation and Agriculture								
1	Production volume of major crops	Annual yield of major crops in the district benefited by the project, by crop	ton/year	Paddy (Maha) Paddy (Yala)	361,300 242,600	Paddy (Maha) Paddy (Yala) Increment	407,000 313,500 116,600	Target figure was calculated from the proposed cropping pattern and target yield.
2	Yield of major crops per unit area	Yield of major crops per unit area, by crop adopting values of each season	ton/ha	Paddy (Maha) Paddy (Yala)	4.45 4.46	Paddy (Maha) Paddy (Yala)	4.80 4.70	Current figure is estimated from the paddy yield data of Department of Census & Statistics. Target figure is estimated based on the current status of yield and national target yield.
3	Gross annual average farm income	Annual gross agricultural farm income per household that is worked out after introducing model farming	LKR/year/HH		110,000		130,000	Target figure was set from estimated annual farm income. *Refer to Chapter 7.5*
Power Generation								
4	Net electric energy production	As shown by the name of the indicator	GWh/year		-		66.3	*Refer to Chapter 4.5.1*
5	Maximum output	As shown by the name of the indicator	MW		-	2 x 7.5 MW	15	*Refer to Chapter 4.5.1*
Domestic and Industrial Water Supply								
6	Percentage of Population served	(Population served)/ (population in the project area) × 100	%		29		35	Target figure was set based on the water demand projection. *Refer to Appendix E-1.6* 35% = 877,000 (Refer to Operation Indicator No.10) / 2,524,000 person x 100%

Appendix E-2.2 Sufficiency rate of O&M cost

Budget Allocation for Annual O&M by the MASL (2009)

Irrigation — Unit: LKR Thousand

	Requested Budget *2	Approved Budget	Expenditure	Percentage*1	
System D	42,230	35,700	32,747	78%	← Current Figure of O&M Sufficiency Rate
System G	62,416	53,100	54,373	87%	
System H	229,660	194,775	175,788	77%	
Total	334,306	283,575	262,908	79%	

Source: Recurrent & Capital Expenditure (2009), MASL-Planning & Monitoring Unit (PMU)

Notes: *1: Percentage = Expenditure/Requested Budget

*2: Estimated from Requested Budget/Approved Budget ratio of each system

Unit: LKR Thousand

	Requested Budget	Approved Budget	Ratio
System D	9,700	8,200	1.18
System G	6,700	5,700	1.18
System H	39,500	33,500	1.18

Source: Budget 2009, MASL

Dam/Reservoir — Unit: LKR Thousand

	Requested Budget *3	Approved Budget	Expenditure	Percentage*1	
Kotmale	15,437	13,060	9,209	60%	
Bowatenna	14,302	12,100	7,534	53%	
Victoria	10,709	9,060	7,666	72%	
Total	40,448	34,220	24,409	60%	← Current Figure of O&M Sufficiency Rate

Source: O&M Cost of Head Work Dam Sites (2009), MASL-Headworks Administration, Operation and Maintenance Unit (HAO&MU)

Notes: *1: Percentage = Expenditure/Requested Budget

*3: Estimated from Requested Budget/Approved Budget ratio of HAO&MD

Unit: LKR Thousand

	Requested Budget	Approved Budget	Ratio
HAO&MD	106,900	90,440	1.18

Source: Budget 2009, MASL

Target — Unit: LKR Million

	O&M Sufficiency Rate		Estimated O&M Cost	Target O&M Cost
	Current	Target		
Irrigation	78%	85%	7.9	6.7
Dam/Reservoir	60%	65%	68.3	44.4

Budget - 2009
Mahaweli Authority of Sri Lanka

Rs.'000

Projects	Request Budget	Approved Budget	Release	Expenditure
Administration Capital	**700,000**	**592,500**	**328,600**	**344,640**
Rehabilitation and Improvements of Capital Assets	**362,100**	**306,480**		**213,650**
System B	13,800	11,700		12,740
System C	33,300	28,200		21,360
System D	9,700	8,200		7,180
System G	6,700	5,700		3,020
System H	39,500	33,500		21,990
System L	9,800	8,300		7,480
System UW	32,500	27,470		18,480
System Vic/Kol	7,300	6,200		2,510
System HU	25,400	21,500		6,880
RBMD	500	400		790
HAO & MD	106,900	90,440		79,580
F & E	1,300	1,070		3,940
MSO	7,900	6,700		5,270
MASL/HO	67,500	57,100		22,430
Acquisition of Fixed Assets	**337,900**	**286,020**		**130,990**
System B	31,400	26,540		12,520
System C	25,000	21,200		9,600
System D	14,800	12,550		6,470
System G	11,500	9,730		10,550
System H	28,000	23,530		13,730
System L	33,000	27,950		11,390
System Uw	59,400	50,250		26,590
System Vic/Kol	20,800	17,600		7,050
System HU	24,500	20,750		4,570
RBMD	5,000	4,300		3,150
HAO & MD	15,400	13,070		2,120
F & E	11,600	9,800		8,490
MSO	4,100	3,500		560
MASL/HO	53,400	45,250		14,200

2010/06/11

Recurrent & Capital Expenditure

[Up to end of December - 2009]

Rs.'000

Systems & Projects	Recurrent						Capital						Total						
	Budget	Releases	Expenditure	% from Budg.	% from Rele.	Balance	Budget	Releases	Expenditure	% from Budg.	% from Rele.	Balance	Budget	Releases	Expenditure	% from Budg.	% from Rele.	Total Balance	Commencment
Donor Funded Projects																			
Udawalawa (Left Bank)	8,875	8,875	7,769	88%	88%	**1,106**	24,000	9,500	9,499	40%	40%	**14,501**	32,875	18,375	17,268	53%	100%	15,607	
Dam Safety & Water Resource Planning Pro.(Nawam)							1,675,000	403,147	403,147	24%	24%	**1,271,853**	1,675,000	403,147	403,147	24%	100%	1,271,853	
Moragahakanda & Kaluganga Dev.Project	38,900	38,900	38,900	100%	100%	**0**	2,388,000	1,045,000	1,045,000	44%	44%	**1,343,000**	2,426,900	1,083,900	1,083,900	45%	45%	1,343,000	3,700
Sub Total - 01	**47,775**	**47,775**	**46,669**	**98%**	**98%**	**1,106**	**4,087,000**	**1,457,647**	**1,457,645**	**36%**	**100%**	**2,629,355**	**4,134,775**	**1,505,422**	**1,504,315**	**36%**	**36%**	2,630,460	
Mahaweli Projects																		0	
System B (LB) Consolidation Project	19,325	19,325	24,617	127%	127%	5,292	510,000	360,000	353,678	69%	71%	**156,322**	529,325	379,325	378,295	71%	72%	151,030	
Riverine Bamboo Project							31,875	20,300	20,300	64%	64%	**11,575**	31,875	20,300	20,300	64%	64%	11,575	
SME in Mahaweli Areas							48,750	50,000		0%	103%	**48,750**	48,750	50,000		0%	103%	48,750	
Dairy Development Project in System - C							34,000	15,019	15,019	44%	44%	**18,981**	34,000	15,019	15,019	44%	44%	18,981	
Introduction of New Trade Crops							1,250	2,000	1,727	138%	160%	477	1,250	2,000	1,727	138%	160%	477	
Compensation of Mahaweli Farmers							3,500			0%	0%	**3,500**	3,500			0%	0%	3,500	
Sub Total - 02	**19,325**	**19,325**	**24,617**	**127%**	**127%**	5,292	**629,375**	**447,319**	**390,724**	**62%**		**238,651**	**648,700**	**466,644**	**415,341**	**64%**	**72%**	233,359	
Administration																		0	
System B	211,375	211,375	212,064	100%	100%	689	38,250	22,000	25,252	66%	58%	**12,998**	249,625	233,375	237,316	95%	93%	12,309	3,200
System C	176,950	176,950	173,255	98%	98%	**3,695**	34,000	24,200	24,680	73%	71%	**9,320**	210,950	201,150	197,936	94%	95%	13,014	300
System D	22,950	22,950	21,898	95%	95%	**1,052**	12,750	10,550	10,850	85%	83%	**1,900**	35,700	33,500	32,747	92%	94%	2,953	
System G	42,050	42,050	44,506	106%	106%	2,456	11,050	9,500	9,866	89%	86%	**1,184**	53,100	51,550	54,373	102%	97%	1,273	1,000
System H	152,275	152,275	148,398	97%	97%	**3,877**	42,500	27,000	27,390	64%	64%	**15,110**	194,775	179,275	175,788	90%	92%	18,987	
Madatugama (H 1)																			
System L	36,520	36,520	36,358	100%	100%	**162**	29,750	16,850	15,432	52%	57%	**14,318**	66,270	53,370	51,790	78%	81%	14,480	500
Udawalawa (Right Bank)	178,560	178,560	176,913	99%	99%	**1,647**	42,500	29,000	25,238	59%	68%	**17,262**	221,060	207,560	202,152	91%	94%	18,908	8,800
Victoria & Kotmale	31,190	31,190	27,991	90%	90%	**3,199**	17,000	6,000	7,614	45%	35%	**9,386**	48,190	37,190	35,604	74%	77%	12,586	
Huruluwewa	51,820	51,820	53,330	103%	103%	1,510	29,750	8,700	8,488	29%	29%	**21,262**	81,570	60,520	61,818	76%	74%	19,752	200
Kalaoya River Basin & RBMD	14,100	14,100	13,366	95%	95%	**734**	1,700	1,400	1,439	85%	82%	**261**	15,800	15,500	14,806	94%	98%	994	
HAO&M+Dam safety	181,550	181,550	177,937	98%	98%	**3,613**	102,000	79,000	81,702	80%	77%	**20,298**	283,550	260,550	259,640	92%	92%	23,910	11,472
Forestry and Environment	31,525	31,525	29,829	95%	95%	**1,696**	10,200	10,000	11,733	115%	98%	1,533	41,725	41,525	41,562	100%	100%	163	2,600
Mahaweli Security Organization	298,735	298,735	297,581	100%	100%	**1,154**	10,200	5,400	5,830	57%	53%	**4,370**	308,935	304,135	303,411	98%	98%	5,524	260
MASL (Head Office)	338,800	338,800	338,879	100%	100%	79	100,850	34,350	33,915	34%	34%	**66,935**	439,650	373,150	372,795	85%	85%	66,855	1,100
Agriculture Productivity Enhancement Programme							110,000	44,650	55,210	50%	41%	**54,790**	110,000	44,650	55,210	50%	41%	54,790	
Sub Total - 03	**1,768,400**	**1,768,400**	**1,752,306**	**99%**	**99%**	**16,094**	**592,500**	**328,600**	**344,641**	**58%**	**55%**	**247,859**	**2,360,900**	**2,097,000**	**2,096,947**	**89%**	**89%**	**263,953**	
Grand Total	**1,835,500**	**1,835,500**	**1,823,592**	**99%**	**99%**	**11,908**	**5,308,875**	**2,233,566**	**2,193,010**	**41%**	**42%**	**3,115,865**	**7,144,375**	**4,069,066**	**4,016,603**	**56%**	**57%**	**3,127,772**	

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O&M COST OF HEAD WORK DAMSITES

Dam	2005 (Rupees)			2006 (Rupees)			2007 (Rupees)			2008 (Rupees)			2009 (Rupees)		
	Required	Allocated	Actual	Required	Allocated	Actual	Required	Allocated	Actual	Required	Allocated	Actual	Required	Allocated	Actual
Kot	27,625,000	16,550,000	7,853,340	32,000,000	28,730,000	21,591,000	14,100,000	10,905,000	10,858,000	20,000,000	12,700,000	12,520,000	13,060,000	9,840,000	9,208,970
Pol	23,445,000	7,650,000	6,287,107	23,000,000	20,670,000	10,255,000	19,500,000	11,700,000	8,954,000	20,000,000	8,800,000	9,264,000	10,250,000	8,000,000	6,449,493
Bow	12,730,000	3,900,000	4,474,875	20,000,000	16,900,000	6,007,000	37,900,000	42,595,000	28,190,000	21,000,000	23,280,000	23,123,000	12,100,000	7,750,000	7,534,239
Vic	20,540,000	8,830,000	7,509,134	40,000,000	25,000,000	15,738,000	22,100,000	14,075,000	12,445	28,000,000	13,050,000	12,620,000	9,060,000	7,185,000	7,666,234
Rand & Rant	25,550,000	8,600,000	9,929,000	23,000,000	12,600,000	10,752,000	18,000,000	12,700,000	9,794,000	20,000,000	14,000,000	14,188,888	16,280,000	12,330,000	11,990,709
Map	19,745,000	9,030,000	3,896,437	18,000,000	14,970,000	5,447,000	14,900,000	10,050,000	9,813,000	18,000,000	8,650,000	8,687,000	8,900,000	7,170,000	5,957,746
Mad	17,660,000	8,575,000	4,187,739	16,000,000	15,630,000	5,132,000	18,100,000	8,950,000	4,520,000	35,000,000	7,850,000	5,920,000	9,900,000	7,980,000	6,434,389

Appendix E-2.3 Moragahakanda Reservoir - Annual Total Volume of Inflow to Reservoir

Annual total volume of inflow to the Moragahakanda reservoir consists of the incremental local inflow from the catchment area of the Moragahakanda reservoir, and the outflow (power outlet and bottom outlet) and the spillway release from the Bowatenna reservoir.

The target figure is set applying the results of water balance simulation (with Project: 2017) in 1976/1977 of 1/5-draught year on the annual incremental local inflow to the Moragahakanda reservoir as follows (Ref. Table E-2.3):

Annual Moragahakanda incremental local inflow	271.3 MCM	
Annual Bowatenna power outlet flow & bottom outlet flow	262.8 MCM	
Annual Bowatenna spillway release	22.1 MCM	
Total	556.2 MCM	(560 MCM)

Table E-2.3 (1) Moragahakanda Reservoir - Incremental Local Inflow

	YEAR		Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	Aug	Sep	AVE	
1	1968	1969	16.90	52.10	95.70	70.60	52.80	13.70	23.80	10.80	7.60	5.40	10.70	9.10	369.20	
2	1969	1970	36.30	28.90	94.30	115.10	105.60	27.30	29.00	15.10	6.20	4.80	3.90	5.50	472.00	
3	1970	1971	13.90	24.00	81.70	114.60	27.90	24.30	18.20	20.30	9.90	7.00	18.20	23.40	383.40	
4	1971	1972	22.00	25.40	158.00	47.10	24.60	8.90	9.10	28.00	5.40	7.60	4.20	3.80	344.10	
5	1972	1973	40.60	47.50	121.60	42.30	24.30	9.30	6.90	6.10	3.40	4.20	3.50	4.20	313.90	
6	1973	1974	5.70	17.90	87.70	33.80	7.40	6.90	13.70	7.70	5.20	8.30	13.70	18.80	226.80	
7	1974	1975	10.60	7.80	50.30	43.50	21.70	24.30	8.50	8.90	10.20	6.90	10.20	9.70	212.60	
8	1975	1976	12.80	40.80	66.90	37.80	12.30	23.30	12.00	10.60	5.30	13.10	4.70	8.00	247.60	
9	1976	1977	18.00	45.30	66.00	24.00	44.10	17.00	15.40	7.10	7.60	10.20	10.40	6.20	271.30	← 1/5-Drought Year
10	1977	1978	22.30	60.00	143.70	58.80	61.50	22.10	21.30	3.00	9.50	2.80	10.00	3.40	418.40	
11	1978	1979	31.70	46.30	52.30	67.70	79.00	30.90	20.20	20.70	9.70	10.30	18.10	19.50	406.40	
12	1979	1980	29.20	27.90	30.40	107.20	10.50	17.90	19.50	4.20	6.80	3.10	3.20	3.30	263.20	
13	1980	1981	22.70	44.50	91.30	61.10	46.10	28.40	9.00	6.00	1.50	4.20	5.30	8.80	328.90	
14	1981	1982	18.00	28.40	46.90	31.90	17.00	15.50	9.70	8.40	5.50	11.40	10.90	6.70	210.30	
15	1982	1983	21.00	51.70	155.70	38.90	12.10	15.50	9.30	6.30	6.80	3.30	6.00	4.30	330.90	
16	1983	1984	11.80	27.00	85.40	122.80	77.50	61.00	48.90	22.90	11.00	12.80	11.70	15.10	507.90	
17	1984	1985	28.50	47.00	52.60	66.50	48.70	47.90	17.80	10.70	14.20	15.20	10.80	4.00	363.90	
18	1985	1986	16.80	38.40	85.80	193.10	62.20	31.30	26.40	17.90	13.10	4.80	9.30	5.70	504.80	
19	1986	1987	21.20	13.70	59.30	70.60	19.40	17.80	14.30	9.60	12.70	3.10	6.00	7.30	255.00	
20	1987	1988	25.80	17.60	41.40	34.30	40.20	24.40	49.10	12.60	5.30	9.50	5.20	9.40	274.80	
21	1988	1989	7.90	31.40	53.80	63.00	18.60	17.10	8.40	10.60	4.30	15.30	16.30	12.90	259.60	
22	1989	1990	12.60	64.70	61.20	76.80	27.00	32.20	20.60	20.90	19.90	17.30	21.10	14.60	388.90	
23	1990	1991	24.60	61.10	102.30	68.70	27.80	15.40	7.30	6.60	4.90	7.10	11.80	7.80	345.40	
24	1991	1992	13.40	50.00	80.70	61.50	9.00	8.60	15.10	11.80	10.50	7.50	6.90	10.40	285.40	
25	1992	1993	13.20	76.70	64.40	38.00	25.90	25.80	11.40	9.30	6.80	13.40	4.00	3.70	292.60	
26	1993	1994	28.80	42.50	127.40	74.40	77.30	27.00	12.90	11.70	6.50	3.20	6.30	4.30	422.30	
27	1994	1995	24.80	65.40	108.70	58.20	44.30	29.20	36.90	35.70	13.90	10.40	9.80	6.90	444.20	
28	1995	1996	18.90	45.70	42.60	56.00	32.20	20.30	22.90	11.30	13.50	7.60	9.90	14.70	295.60	
29	1996	1997	17.00	47.00	38.90	34.90	32.30	20.60	27.30	38.90	18.30	17.00	9.80	13.60	315.60	
30	1997	1998	19.00	83.50	111.70	68.90	13.20	17.00	9.30	8.30	9.50	11.70	12.70	20.10	384.90	
31	1998	1999	11.90	25.20	58.10	74.90	36.00	27.70	12.60	8.90	5.20	5.30	1.70	3.90	271.40	
32	1999	2000	16.90	14.80	62.90	80.30	72.50	26.70	23.80	16.90	7.90	11.60	13.20	11.80	359.30	
33	2000	2001	5.80	62.90	73.80	107.80	34.10	22.10	30.10	15.70	12.80	10.00	4.80	10.70	390.60	
34	2001	2002	11.70	39.60	73.20	54.60	23.60	31.30	19.00	10.70	4.30	6.30	4.50	4.40	283.20	
35	2002	2003	20.70	32.60	99.30	116.70	64.30	37.70	43.80	32.60	10.40	17.80	12.40	10.70	499.00	
36	2003	2004	7.40	62.50	42.30	63.00	21.60	25.90	19.50	13.70	9.20	6.30	4.10	12.30	287.80	
37	2004	2005	12.80	71.40	113.20	52.40	17.80	22.30	14.90	9.70	4.00	9.20	4.50	5.30	337.50	
38	2005	2006	20.50	28.20	54.40	313.10	59.10	40.90	32.60	27.50	8.90	11.40	8.60	9.50	614.70	
39	2006	2007	19.10	87.30	80.10	48.60	18.30	14.20	16.00	8.90	8.10	7.50	4.30	11.80	324.20	
40	2007	2008	12.80	45.80	92.90	51.50	18.70	51.40	26.90	12.70	4.00	10.00	5.70	4.50	336.90	
AVERAGE			18.64	43.26	80.22	73.63	36.71	24.53	19.83	13.98	8.49	8.85	8.71	9.25	346.11	

Table E-2.3 (2) Bowatenna Reservoir - Power Outlet Flow and Bottom Outlet Flow

	YEAR		Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	Aug	Sep	AVE	
1	1968	1969	.00	.00	99.77	22.13	.00	.00	57.00	76.64	71.20	.00	.00	14.81	341.54	
2	1969	1970	137.18	118.91	55.95	.00	32.81	.00	18.51	.00	.00	.00	59.40	44.18	466.94	
3	1970	1971	78.00	112.42	98.83	20.19	6.47	21.52	17.23	40.38	73.30	70.22	78.33	87.26	704.16	
4	1971	1972	73.72	14.16	104.78	2.51	.00	.00	.00	108.97	.00	12.91	38.62	31.67	387.33	
5	1972	1973	143.44	150.05	49.14	.00	.00	.00	.00	.00	.00	.00	.00	.00	342.63	
6	1973	1974	.00	.00	130.87	.00	21.33	29.59	76.63	40.18	67.10	72.02	67.33	77.90	582.95	
7	1974	1975	74.84	.00	79.17	35.10	24.16	7.93	52.50	35.14	70.88	.00	66.09	70.65	516.46	
8	1975	1976	78.50	98.10	147.84	45.18	.00	.00	.00	.00	.00	.00	.00	.00	369.63	
9	1976	1977	7.78	29.64	46.15	16.72	.00	.00	83.43	41.02	38.05	.00	.00	.00	262.79	← 1/5-Drought Year
10	1977	1978	131.79	150.10	161.39	.00	.00	.00	2.13	59.43	.00	58.23	71.32	64.45	698.84	
11	1978	1979	98.17	153.99	12.92	20.05	.00	.00	.21	.00	.00	.00	.00	.00	285.35	
12	1979	1980	83.08	139.18	85.81	.00	.00	.00	1.86	.00	.00	.00	.00	.00	309.92	
13	1980	1981	.00	8.02	162.09	37.78	.00	.00	.00	20.39	44.15	.00	.00	63.06	335.49	
14	1981	1982	80.24	88.89	73.30	.00	.00	.00	31.48	18.32	26.69	.00	.00	.00	318.92	
15	1982	1983	19.82	141.48	203.56	32.77	.00	.00	.00	.00	.00	.00	.00	.00	397.62	
16	1983	1984	16.57	66.07	162.43	199.13	56.61	31.50	34.19	.03	67.22	72.45	.00	71.55	777.77	
17	1984	1985	95.30	95.17	42.37	.00	.00	.00	17.25	.00	62.06	79.89	69.33	47.46	508.85	
18	1985	1986	79.43	92.41	9.17	124.60	2.52	6.44	20.07	.00	.00	.00	.00	1.29	335.94	
19	1986	1987	108.37	50.43	13.95	42.69	.00	.00	.00	.00	.00	.00	.00	.00	215.44	
20	1987	1988	48.80	125.98	95.97	.00	.00	.00	153.88	88.13	59.39	.00	63.63	67.11	702.89	
21	1988	1989	.00	89.27	109.08	23.20	.00	.00	.00	71.11	41.35	.00	64.48	72.26	470.75	
22	1989	1990	74.47	155.31	61.59	97.54	36.43	71.67	.00	.00	83.84	75.55	2.03	2.47	660.91	
23	1990	1991	117.98	80.68	.00	.00	.00	.00	.00	.00	.00	14.87	.00	.00	213.52	
24	1991	1992	34.91	134.21	132.63	.00	.00	.00	3.81	.00	8.88	.00	.00	.00	314.43	
25	1992	1993	70.49	161.38	95.60	.00	.00	.00	.00	.00	67.84	9.22	.00	.00	404.52	
26	1993	1994	110.37	144.74	94.06	32.42	52.38	.00	30.37	.00	.00	.00	.00	.00	464.34	
27	1994	1995	130.00	149.93	2.19	.00	17.96	3.03	20.86	98.03	74.30	71.15	12.02	62.41	641.89	
28	1995	1996	83.52	46.26	.00	.00	.00	.00	62.01	.00	.00	.00	.00	.00	191.79	
29	1996	1997	96.73	110.94	36.97	.00	.00	.00	4.59	124.39	.00	6.21	.00	67.65	447.48	
30	1997	1998	126.97	186.29	61.70	.00	.00	.00	.00	.00	.00	.00	.00	69.57	444.53	
31	1998	1999	76.27	82.17	104.90	97.67	.00	.00	22.92	.00	5.78	4.85	.00	.00	394.55	
32	1999	2000	.00	41.46	58.73	60.42	80.55	6.78	23.40	.00	.00	.00	.00	24.86	296.20	
33	2000	2001	70.19	96.66	97.07	.00	14.99	2.98	18.93	.00	.00	.00	.00	.00	300.82	
34	2001	2002	.00	.00	.00	19.45	22.06	.00	72.04	.00	.00	.00	.00	.00	113.56	
35	2002	2003	13.11	38.98	146.73	133.92	1.57	39.77	19.12	41.63	.00	.00	.00	.00	434.83	
36	2003	2004	.00	49.05	.00	.00	.00	.00	.00	12.56	36.45	.00	.00	.00	98.06	
37	2004	2005	18.96	40.21	168.85	51.07	.00	.00	26.65	.00	.00	.00	.00	.00	305.74	
38	2005	2006	.00	129.49	144.15	87.41	2.69	11.35	3.40	58.61	71.51	13.70	.00	.00	522.31	
39	2006	2007	77.47	132.77	.00	.16	.00	.00	22.82	.00	.00	.00	.00	.00	233.21	
40	2007	2008	65.64	136.60	130.40	22.80	41.76	28.04	20.27	.00	.00	.00	.00	.00	445.52	
AVERAGE			63.05	91.04	82.00	30.62	10.36	6.51	22.94	23.37	24.25	14.03	14.81	23.52	406.51	

Table E-2.3 (3) Bowatenna Reservoir - Spillway Release

	YEAR		Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	Aug	Sep	AVE	
1	1968	1969	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
2	1969	1970	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
3	1970	1971	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
4	1971	1972	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
5	1972	1973	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
6	1973	1974	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
7	1974	1975	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
8	1975	1976	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
9	1976	1977	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	← 1/5-Drought Year
10	1977	1978	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
11	1978	1979	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
12	1979	1980	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
13	1980	1981	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
14	1981	1982	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
15	1982	1983	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
16	1983	1984	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
17	1984	1985	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
18	1985	1986	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
19	1986	1987	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
20	1987	1988	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
21	1988	1989	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
22	1989	1990	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
23	1990	1991	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
24	1991	1992	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
25	1992	1993	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
26	1993	1994	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
27	1994	1995	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
28	1995	1996	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
29	1996	1997	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
30	1997	1998	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
31	1998	1999	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
32	1999	2000	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
33	2000	2001	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
34	2001	2002	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
35	2002	2003	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
36	2003	2004	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
37	2004	2005	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
38	2005	2006	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
39	2006	2007	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
40	2007	2008	1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	
AVERAGE			1.87	1.81	1.87	1.87	1.69	1.87	1.81	1.87	1.81	1.87	1.87	1.81	22.08	

Appendix E-2.4 Moragahakanda Reservoir - Annual Total Volume of Water Release through Intake Facilities

Annual total volume of water release through intake facilities of the Moragahakanda reservoir consists of the outflow from power outlet and bottom outlet for water utilization.
The target figure is set applying the results of water balance simulation (with Project: 2017) in 1976/1977 of 1/5-draught year on the annual incremental local inflow to the Moragahakanda reservoir as follows (Ref. Table E-2.4):

Annual Moragahakanda power outlet flow	406.7 MCM	
Annual Moragahakanda bottom outlet flow	146.5 MCM	
Total	553.2 MCM	(550 MCM)

Table E-2.4 (1) Moragahakanda Reservoir - Power Outlet Flow

	YEAR		Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	Aug	Sep	AVE	
1	1968	1969	88.96	71.55	28.51	85.87	72.49	20.95	23.39	85.71	82.94	85.71	69.99	82.64	798.70	
2	1969	1970	20.77	43.53	96.82	96.82	87.45	26.93	48.10	85.03	82.94	85.71	74.61	71.05	819.76	
3	1970	1971	24.52	45.13	79.55	96.82	60.37	19.84	36.02	85.04	82.94	85.71	83.74	84.19	783.88	
4	1971	1972	96.82	55.38	97.38	79.29	93.38	25.47	24.52	84.95	82.94	85.71	76.90	64.28	867.02	
5	1972	1973	17.29	81.70	96.82	94.64	84.03	17.98	40.24	85.71	82.94	74.03	31.73	22.82	729.94	
6	1973	1974	.00	.00	.00	105.40	78.65	37.10	91.45	85.71	82.94	85.71	83.47	84.72	735.15	
7	1974	1975	34.46	91.78	.00	101.78	70.21	33.41	61.51	81.86	82.94	54.38	31.76	68.87	712.96	
8	1975	1976	75.58	54.21	64.24	109.88	99.92	49.79	18.34	85.71	82.94	.00	.00	.00	640.61	
9	1976	1977	.00	.00	61.80	71.85	45.19	17.88	41.28	85.71	82.94	.00	.00	.00	406.66	← 1/5-Drought Year
10	1977	1978	.00	90.62	63.77	97.13	94.04	57.11	36.21	85.71	82.94	85.71	83.36	86.56	863.17	
11	1978	1979	26.85	40.59	67.08	89.09	79.33	30.53	30.56	85.71	82.94	85.71	72.92	82.27	773.58	
12	1979	1980	32.34	27.31	16.12	102.75	92.66	44.97	7.54	85.71	82.94	85.71	63.57	18.35	659.98	
13	1980	1981	22.66	54.13	.00	109.49	97.01	81.57	27.01	80.96	82.94	.00	.00	.00	555.78	
14	1981	1982	59.48	92.11	89.19	97.91	42.08	16.38	42.45	40.29	.00	.00	.00	.00	479.89	
15	1982	1983	.00	.00	69.72	105.88	97.51	108.29	44.75	85.71	49.78	.00	.00	.00	561.64	
16	1983	1984	.00	.00	.00	109.20	87.73	92.13	83.68	85.71	82.94	85.71	83.48	67.23	777.81	
17	1984	1985	41.94	99.67	96.82	67.83	49.03	47.53	35.64	85.71	82.94	85.71	82.80	74.63	850.26	
18	1985	1986	25.67	99.38	96.82	96.82	65.05	37.37	47.06	85.00	82.94	85.71	75.41	54.53	851.76	
19	1986	1987	36.50	65.17	56.28	84.06	98.04	15.12	30.93	85.71	82.94	.00	.00	.00	554.75	
20	1987	1988	.00	.00	98.56	91.74	80.36	26.51	72.93	85.71	82.94	85.04	64.42	71.23	759.44	
21	1988	1989	50.59	91.03	98.09	103.08	80.97	15.30	28.27	85.71	82.94	.00	56.01	64.37	756.37	
22	1989	1990	56.36	95.48	93.61	73.76	82.26	.00	37.53	78.90	82.94	85.71	84.76	50.13	821.45	
23	1990	1991	25.00	99.66	96.82	70.03	82.78	8.03	35.95	85.71	82.94	85.71	76.01	60.18	808.83	
24	1991	1992	26.24	85.12	39.89	108.80	99.53	57.76	14.90	85.71	82.94	.00	.00	.00	600.89	
25	1992	1993	.00	.00	57.03	110.12	97.32	40.06	38.78	76.11	82.94	59.57	.00	.00	561.92	
26	1993	1994	.00	47.39	20.90	96.82	87.45	26.63	43.85	85.04	82.94	85.71	74.97	53.93	705.65	
27	1994	1995	38.51	26.16	66.74	59.53	62.60	31.86	58.35	85.71	82.94	84.30	84.86	44.49	726.06	
28	1995	1996	57.93	93.70	44.45	84.54	63.15	21.69	26.18	85.71	82.94	85.71	77.62	44.13	767.75	
29	1996	1997	55.29	38.48	59.21	109.33	98.10	73.48	21.19	84.93	82.94	85.71	80.24	7.58	796.50	
30	1997	1998	53.62	26.19	97.21	70.23	82.35	21.58	42.21	85.71	82.94	84.76	67.10	60.57	774.48	
31	1998	1999	39.26	82.95	18.99	39.36	36.33	27.33	36.11	85.71	82.94	85.71	63.62	53.86	652.17	
32	1999	2000	41.08	23.85	40.65	46.26	14.87	21.73	47.79	85.04	82.94	85.71	73.50	82.53	645.94	
33	2000	2001	14.43	36.29	33.00	96.82	49.42	24.71	49.62	85.71	82.94	85.00	58.82	55.83	672.59	
34	2001	2002	29.01	94.90	26.13	94.72	46.59	16.29	13.50	85.71	82.94	31.62	.00	.00	521.43	
35	2002	2003	.00	.00	.00	107.65	38.72	27.63	63.51	85.71	82.94	85.71	73.64	72.61	638.12	
36	2003	2004	12.13	41.09	45.47	108.25	94.00	35.53	19.75	85.71	82.94	.00	.00	.00	524.87	
37	2004	2005	.00	.00	51.40	43.66	92.83	17.88	7.93	84.97	82.94	85.71	60.15	.00	527.47	
38	2005	2006	26.51	.00	102.41	108.21	62.13	51.88	36.58	85.71	82.94	85.71	68.22	73.58	783.88	
39	2006	2007	24.97	101.85	81.95	50.09	29.40	14.55	27.96	85.71	82.94	85.71	64.83	52.47	702.44	
40	2007	2008	58.96	59.63	35.45	89.10	66.43	60.03	47.76	85.71	82.94	85.71	73.37	46.63	791.72	
AVERAGE			30.34	51.40	57.22	89.12	73.54	35.02	38.53	83.81	80.04	63.25	52.90	43.91	699.08	

Table E-2.4 (2) Moragahakanda Reservoir - Bottom Outlet Flow

	YEAR		Oct	Nov	Dec	JAN	FEB	MAR	APR	MAY	JUN	JUL	Aug	Sep	AVE	
1	1968	1969	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
2	1969	1970	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
3	1970	1971	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
4	1971	1972	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
5	1972	1973	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
6	1973	1974	20.13	24.78	13.07	.00	.00	.00	.00	.00	.00	.00	.00	.00	57.98	
7	1974	1975	.00	.58	13.07	.00	.00	.00	.00	.00	.00	.00	.00	.00	13.65	
8	1975	1976	.00	.00	.00	.00	.00	.00	.00	.00	.00	33.53	30.22	39.13	102.88	
9	1976	1977	11.01	29.06	.00	.00	.00	.00	.00	.00	.00	33.55	29.00	43.89	146.51	← 1/5-Drought
10	1977	1978	13.47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	13.47	Year
11	1978	1979	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
12	1979	1980	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
13	1980	1981	.00	.00	43.21	.00	.00	.00	.00	.00	.00	28.62	22.84	27.82	122.49	
14	1981	1982	.00	.00	.00	.00	.00	.00	.00	.00	35.20	45.42	26.16	39.19	145.98	
15	1982	1983	10.29	76.19	.00	.00	.00	.00	.00	.00	.00	35.06	21.61	34.06	177.21	
16	1983	1984	10.58	41.67	31.56	.00	.00	.00	.00	.00	.00	.00	.00	.00	83.80	
17	1984	1985	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
18	1985	1986	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
19	1986	1987	.00	.00	.00	.00	.00	.00	.00	.00	.00	35.09	21.61	46.18	102.88	
20	1987	1988	14.73	55.91	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	70.65	
21	1988	1989	.00	.00	.00	.00	.00	.00	.00	.00	.00	21.07	.00	.00	21.07	
22	1989	1990	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
23	1990	1991	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
24	1991	1992	.00	.00	.00	.00	.00	.00	.00	.00	.00	36.43	21.56	43.03	101.02	
25	1992	1993	29.31	28.89	.00	.00	.00	.00	.00	.00	.00	.00	22.09	15.69	95.98	
26	1993	1994	27.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	27.03	
27	1994	1995	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
28	1995	1996	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
29	1996	1997	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
30	1997	1998	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
31	1998	1999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
32	1999	2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
33	2000	2001	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
34	2001	2002	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.73	27.29	44.10	80.13	
35	2002	2003	10.49	25.71	29.54	.00	.00	.00	.00	.00	.00	.00	.00	.00	65.73	
36	2003	2004	.00	.00	.00	.00	.00	.00	.00	.00	.00	36.42	21.55	46.47	104.44	
37	2004	2005	8.44	22.61	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	31.04	
38	2005	2006	.00	26.25	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	26.25	
39	2006	2007	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
40	2007	2008	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
AVERAGE			3.89	8.29	3.26	.00	.00	.00	.00	.00	.88	7.85	6.10	9.49	39.75	