

# Mahaweli System Daily Water Balance Model using RiverWare in Sri Lanka



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# MWSIP Background

UECP

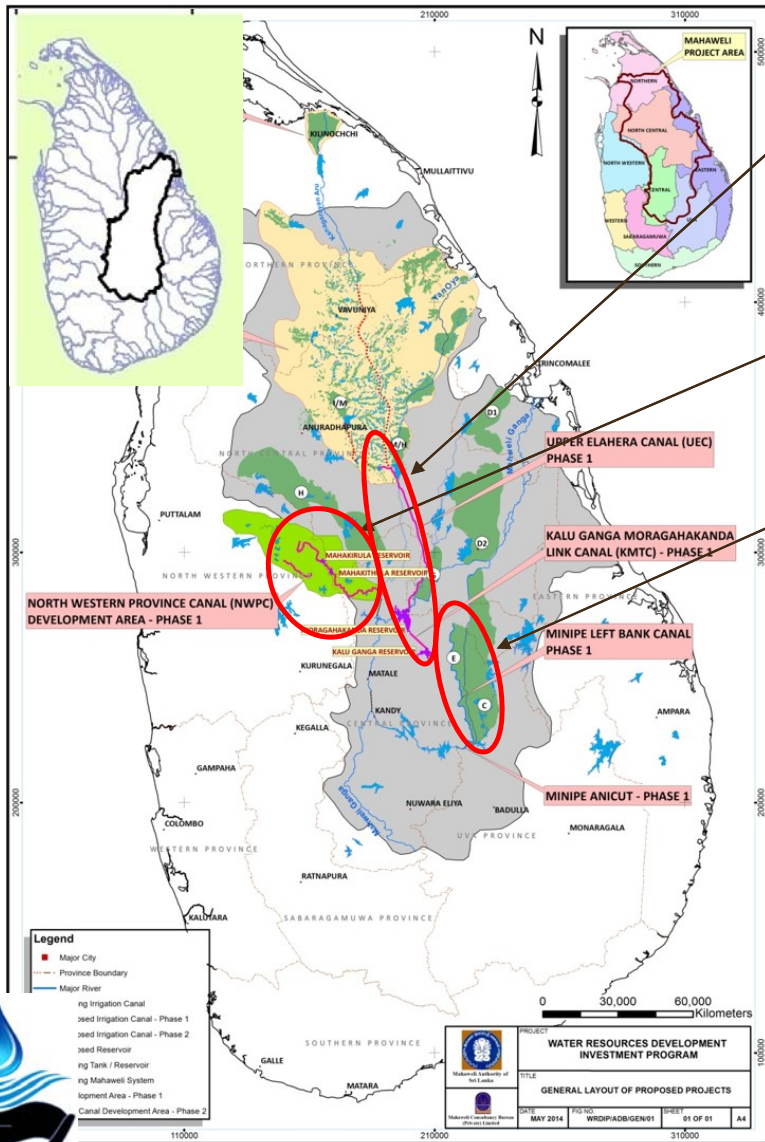
NWPCP

MLBCRP

- Diverting excess Mahaweli water for adjacent basins

During the PPTA study, monthly WB has been carried out, and decided to work with daily water balance study to re-confirm the monthly WB results.

- ADB loan has been obtained after the PPTA study. Project cost is USD 675 Mn.



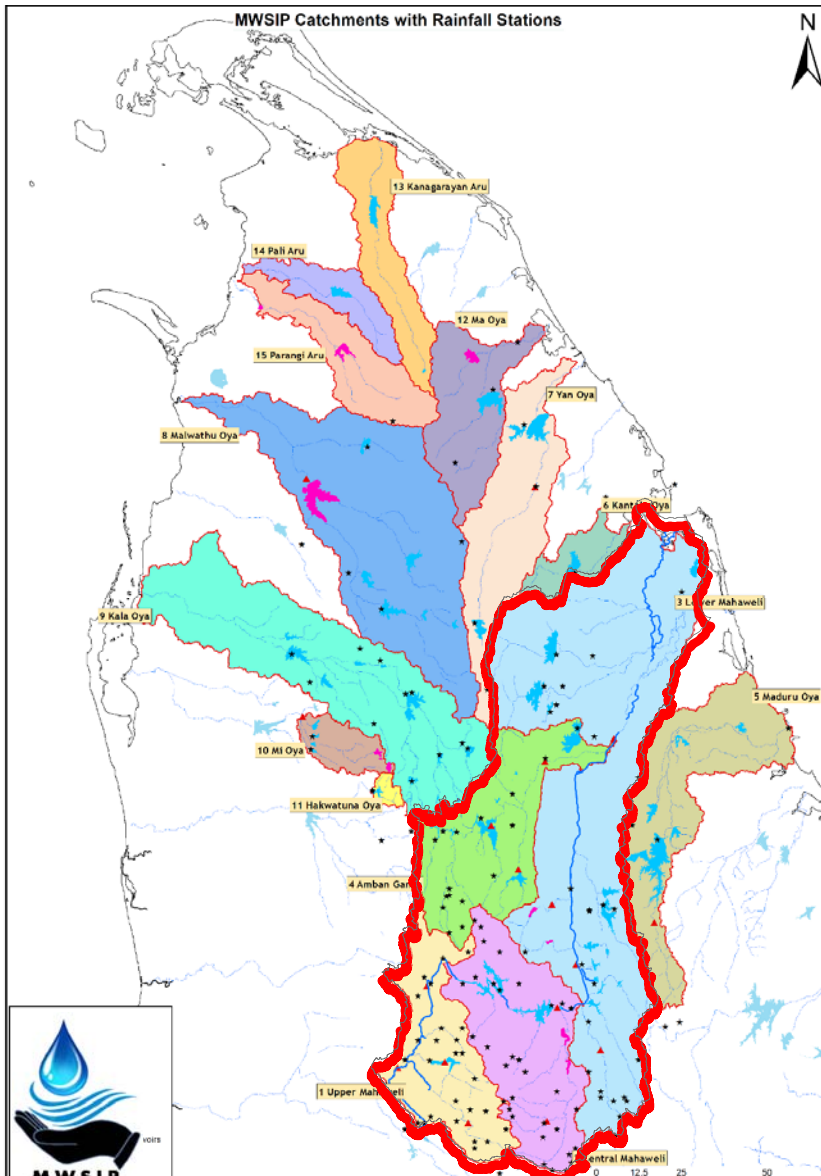
# Water Balance Modelling

- Rainfall Runoff Model - SWAT
  - Irrigation Demand Model - Spread sheet calculation
  - Water Balance Model - RiverWare Software
- } Sys Opr Model

## Purpose:

The Water Balance assessment is to ensure the adequacy of water for planned inter & trans basins transfers without affecting existing water users, predicted on the enhanced water management and more precise control of water flows throughout the system with special reference to the preferred route.





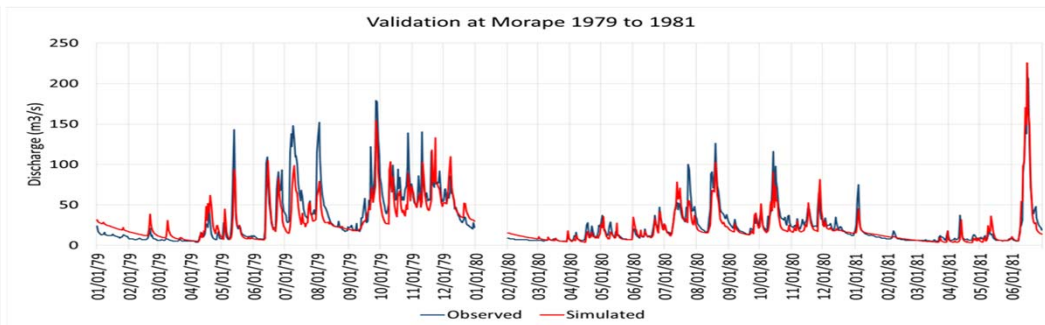
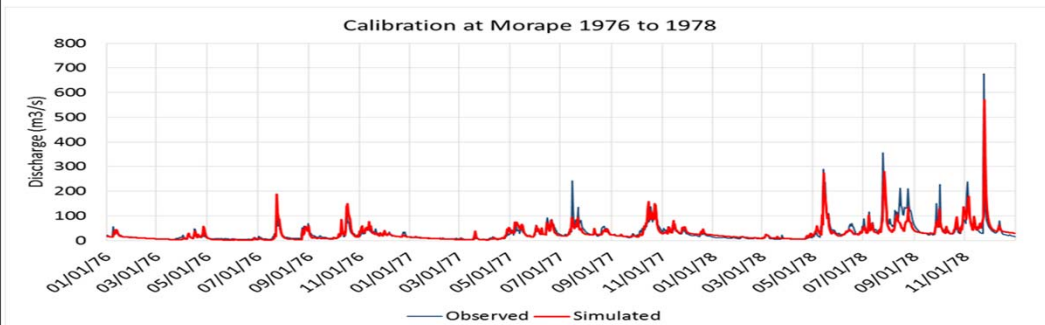
# SWAT – RR Modelling

- Sub Catchments of Mahaweli & Adjoining catchments - 15 Nos.
- Arc Map 10.4
- 30\*30 m DEM of Shuttle Radar Topography Mission (SRTM) & 1:50,000 maps for topographical representation
- Soil maps – Land Use Division of ID
- Temperature – 13 stations
- Rainfall - 164 stations
- Stream flow – 14 Stations



# Calibration of SWAT – RR Model

- Calibration & Validation – For undisturbed basins
- Applied calibrated parameters for hydrologically similar catchments



## Tested Statistical Parameters

1. Correlation
2. Co. eff. of Determination
3. Nash Sutcliffe coefficient



# Water Balance Model – SOP Testing

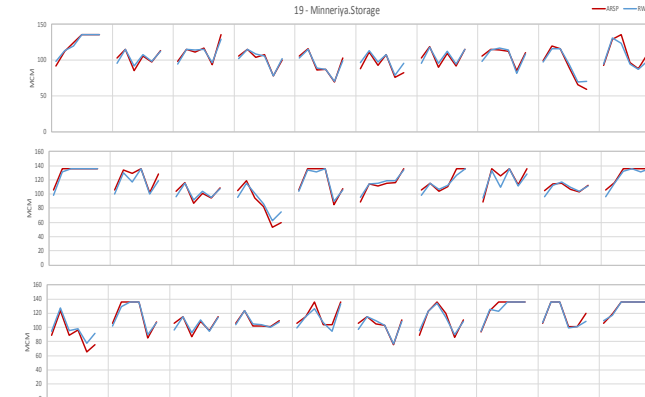
- Developed the existing Mahaweli System by RW model to mimic the ARSP model
- Confirmed the RW model performance by seasonal operational planning simulation runs for

–Maha 2014/15

–Yala 2013

- Comparison of RW model Performance with SOP runs for failure events, Diversions at key Locations & Reservoir levels at the end of season

Scheme	Issue [MCM]	ARSP			RiverWare		
		5%	10%	20%	5%	10%	20%
System A	138	0	0	0	0	0	0
System B	222	1	0	0	1	1	0
System C	267	0	0	0	0	0	0
System E	116	0	0	0	0	0	0
D1 - Minneriya	67	0	0	0	0	0	0
D1 - Giritale	35	0	0	0	0	0	0
D1 - Kaudulla	35	0	0	0	1	0	0
D1 - Kantale	61	2	2	1	2	2	1
D2 - PSS	114	0	0	0	0	0	0
System G	138	0	0	0	0	0	0
KHF	30	0	0	0	0	0	0
MH	29	1	1	1	1	1	1
Dambuluoya	18	0	0	0	0	0	0
Kandalama	37	3	2	2	5	4	1
Kalawewa LB	63	0	0	0	5	4	0
Kalawewa RB	173	0	0	0	1	0	0
Kalawewa TE	38	0	0	0	5	4	1
Nuwarawewa	11	1	0	0	0	0	0
Tissawewa	5	0	0	0	1	1	1
Nachchaduwa	30	0	0	0	1	1	1
Deficits	1628			3.4			6.8
				0.21%			0.42%





# Irrigation Demand model– Spread sheet

- System Irrigation Demand

$$\text{SID} = \frac{((\text{CWR} - \text{Reff}) + (\text{Land Prep} - \text{Reff}) + (\text{Initial Irrgn} - \text{Reff}))}{\text{Efficiency}}$$

SID – System Irrigation Demand

CWR – Crop Water Requirement ( $\text{CWR} = \text{ET0} * \text{Kc}$ )

ET0 – Reference evapotranspiration (mm)

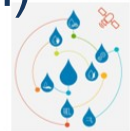
Kc – Crop Coefficient

Reff – Effective rainfall (mm)

Land Prep – Water depth for land preparation for paddy (mm)

Initial Irrgn – Water depth for initial irrigation of field crops (mm)

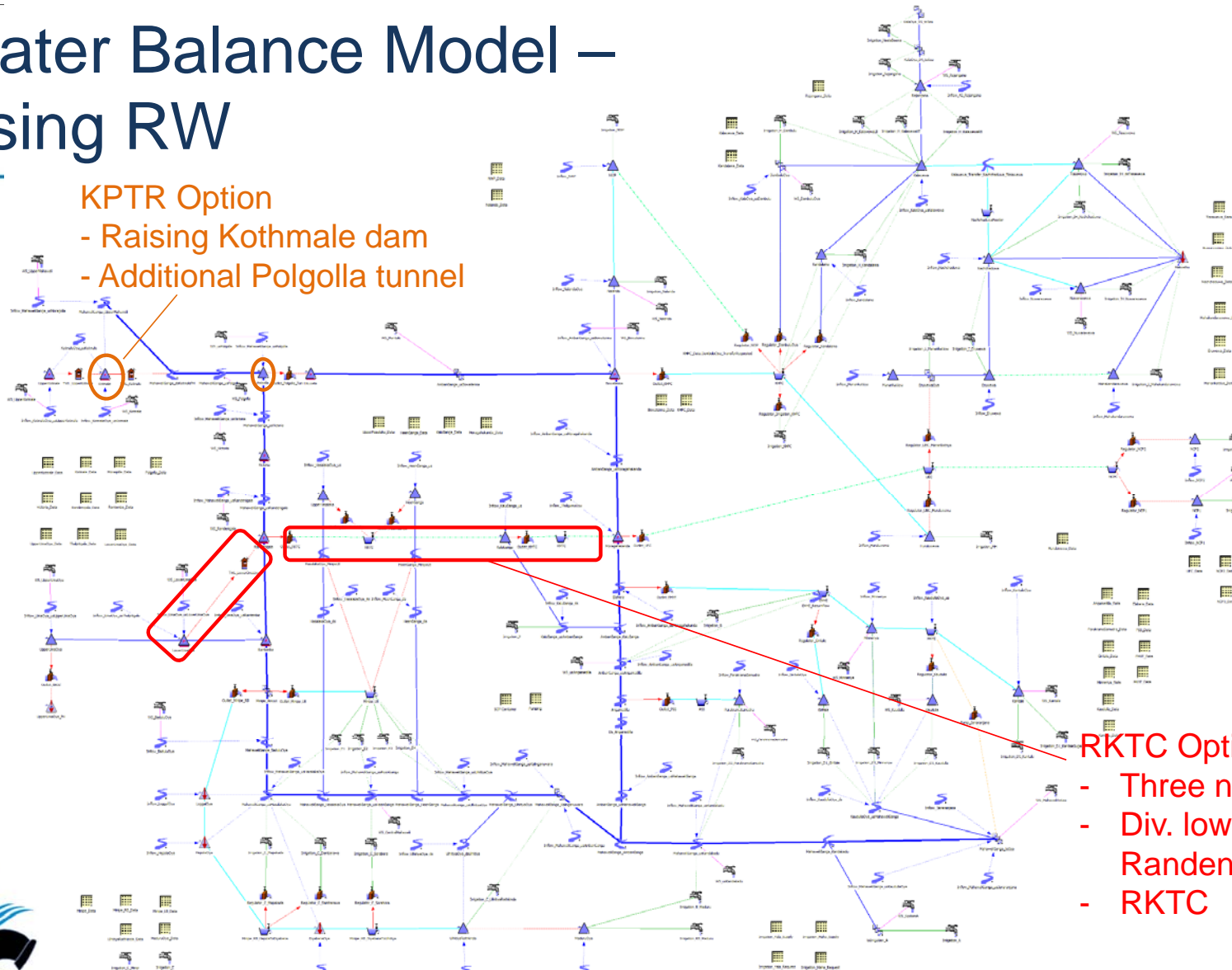
Efficiency – System efficiency (Per season) (%)



# Water Balance Model – Using RW

## KPTR Option

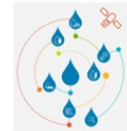
- Raising Kothmale dam
- Additional Polgolla tunnel



43 Reservoirs  
08 HPP  
134 Open Canals  
43 Diversions  
64 WU  
53 Catchment  
inflow nodes  
from SWAT

## RKTC Option

- Three new reservoirs
- Div. lower Umaoya to Randenigala
- RKTC



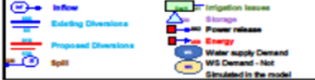


# Approach for final outcome of RW modelling

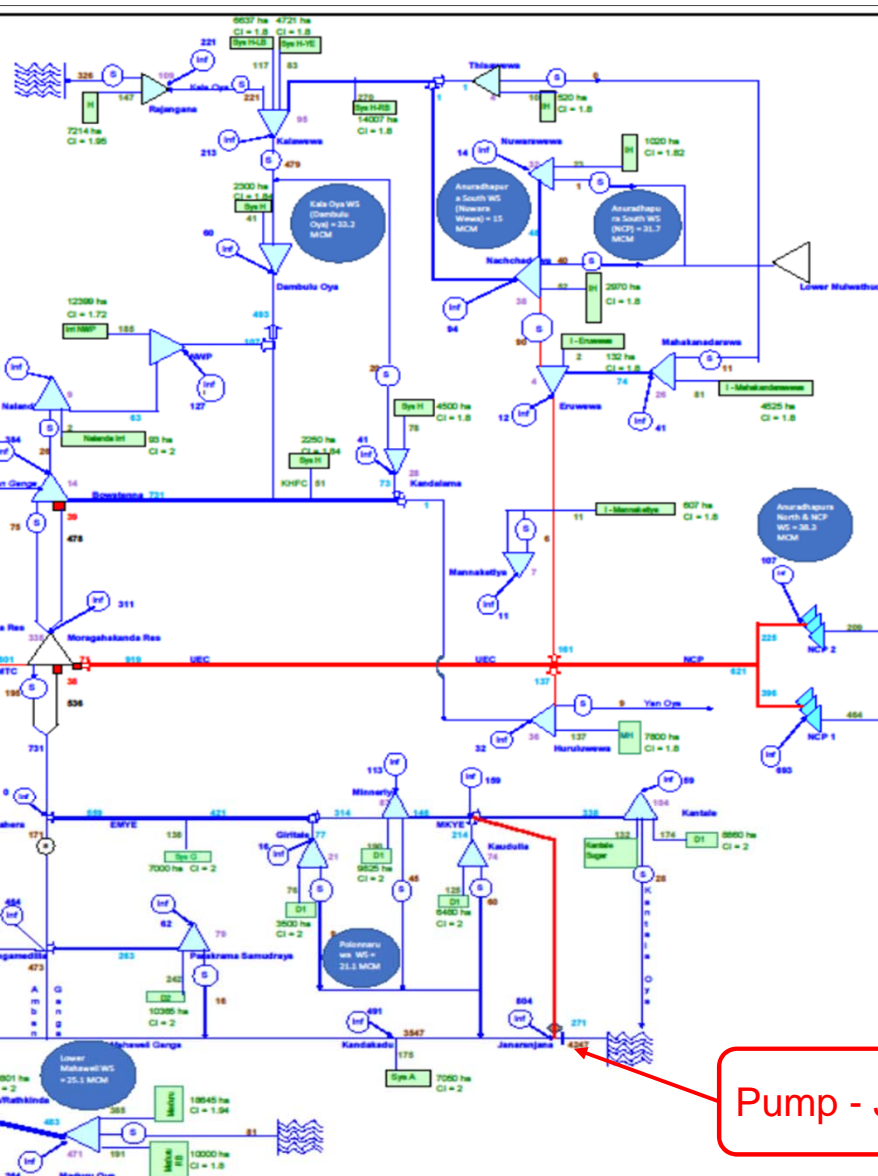
- Comparison of performance of two routes: RKTC & KPTR by MCA
- Number of failure events must not exceed threshold:  
Maximum number of failure events for deficit >5%, 10%, 20% - 8/4/2
- Existing schemes shall have priority over new scheme
- New irrigation Demand, i.e. irrigated area will be increased until one route exceeds number of failure events
- Model run for 40 years (1976 to 2015) in daily time steps

Project	Extent (ha)
MDP	154,088
MWSIP	89,266
<b>Total</b>	<b>243,354</b>





4) Central Mahaweli Water Supply Demand (Victoria & Randeniya/Rantembe/Umsoya) would be considered in Phase II simulation Study



## RKTC Model

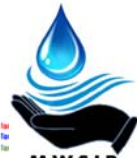
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## Output

CI Mahaweli = 2  
CI Adj basins= 1.8  
CI New areas= 1.7  
(NCP & NWP)

Min Irri. Duty  
Maha = 0.91m  
Yala = 1.06m

## Pump - Janaranjana



# RKTC Summary Output

	Issue	Yala			ΔV	Issue	Maha			ΔV
Scheme	[MCM]	5%	10%	20%	[MCM]	[MCM]	5%	10%	20%	[MCM]
System A	107	0	0	0	0.151	67	0	0	0	0.310
System B	222	6	4	1	7.494	169	0	0	0	0.000
System B-RB	103	7	4	1	3.605	90	0	0	0	0.000
System C	395	2	2	2	5.422	235	0	0	0	0.135
System E	159	0	0	0	0.284	94	0	0	0	0.147
D1 - Minneriya	105	5	4	2	3.967	88	1	0	0	0.251
D1 - Giritale	45	3	3	2	1.054	31	1	0	0	0.110
D1 - Kaudulla	69	3	2	2	2.192	58	1	1	1	0.900
D1 - Kantale	94	1	1	1	1.104	79	0	0	0	0.003
D1 - Kantale Sugar	76	2	1	1	1.516	57	2	2	1	0.744
D2 - PSS	148	4	3	2	3.630	97	0	0	0	0.182
System G	75	2	2	2	1.599	66	1	1	1	0.905
System F	32	0	0	0	0.000	27	0	0	0	0.000
KHF	27	0	0	0	0.016	23	0	0	0	0.000
MH	67	2	2	1	0.707	70	1	0	0	0.181
Dambuluoya	21	2	1	0	0.108	21	1	0	0	0.037
Kandalama	38	4	4	2	1.015	40	1	1	0	0.138
Kalawewa LB	57	0	0	0	0.000	59	0	0	0	0.000
Kalawewa RB	124	4	3	2	2.498	148	1	1	1	1.706
Kalawewa YE	40	0	0	0	0.000	42	0	0	0	0.000
Rajanganaya	73	0	0	0	0.000	73	0	0	0	0.000
NeelaBeema	6	0	0	0	0.003	6	1	0	0	0.079
Nuwarawewa	14	0	0	0	0.000	9	0	0	0	0.000
Tissawewa	5	2	1	0	0.028	5	2	2	0	0.036
Nachchaduwa	25	1	1	0	0.098	27	2	2	0	0.149
Manankattiya	5	1	1	0	0.018	5	2	2	1	0.088
Eruwewa	1	4	3	1	0.018	1	1	1	1	0.016
Mahakandarawewa	40	2	2	1	0.386	41	0	0	0	0.000
NCP1	225	4	4	2	9.781	250	4	3	2	5.580
NCP2	99	3	2	2	4.071	119	5	3	2	6.538
NWP	89	5	4	2	2.627	97	0	0	0	0.083
Deficits	2585				53.2	2195				18.0
					2.1%					0.8%

Energy Generation	[GWh]
Kotmale	456
Victoria	758
Randenigala	302
Rantembe	161
Ukuwela	164
Bowatenna	39
Moragahakanda	38
UEC	71
Lower Uma Oya	41
Heen Ganga	8
Upper Hasalaka	37
System	2076
existing	1918

Diversions	[MCM]
Polgolla	888
Bowatenna	731
EMYE	559
MKYE	146
PSS	263
KMTC	801
UEC	919
NCP	621
NWP	107
Upper Uma Oya	142
Minipe LB	253
Minipe RB	1078
Maduru Oya	483
Lower Uma Oya	287
RKTC	520
Heen Ganga	121
Upper Hasalaka	68

Pumping	[MCM]
Janaranjana	271
System	271

System Spill	[MCM]
Minipe	780
Angamedilla	473
System	1253

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# Thank you very much

