Initial Environmental Examination

October 2014
Project Number: 47381

SRI: Mahaweli Water Security Investment Program

Proposed Raising of the Minipe Anicut and Rehabilitation of the Minipe Left Bank Canal Project in Kandy District

IEE & Public Consultation Report
(compliant with ADB Safeguard Policy Statement 2009)

Prepared by Mahaweli Consultancy Bureau (Pvt) Ltd. for the Asian Development Bank.

PROPOSED RAISING OF THE MINIPE ANICUT AND REHABILITATION OF THE MINIPE LEFT BANK CANAL PROJECT IN KANDY DISTRICT.

Initial Environment Examination (IEE) Report

October 2014

Mahaweli Consultancy Bureau (Pvt) Ltd
No 11, Jawatta Road, Colombo 05.

FINAL REPORT

MINISTRY OF IRRIGATION AND WATER RESOURCES MANAGEMENT

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List of Abbreviations

ADB	Asian Development Bank
AIS	Alien Invasive Species
CC	Construction Contractor
CEA	Central Environmental Authority
DS	Divisional Secretary
DWC	Department of Wildlife Conservation
EIA	Environment Impact Assessment
EMP	Environment Management Plan
EMoP	Enviornemental Monitoring Plan
EMYE	Elahera Minneriya Yoda Ela
EPL	Environmental Protection License
FFPO	Fauna and Flora Protection Ordinance
FSL	Full Supply Level
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GSMB	Geological Survey and Mines Bureau
HFL	High Flood Level
IIE	Initial Environment Evaluation
LB	Left Bank
MASL	Mahaweli Authority of Sri Lanka
MCB	Mahaweli Consultancy Bureau
MCM	Million Cubic Meters
MI&WRM	Ministry of Irrigation and Water Resource Management
MSL	Mean Sea Level
Mt	Metric Tons
NBRO	National Building Research Organization
NCP	North Central Province
NEA	National Environmental Act
NP	Northern Province
NWP	North Western Province
OFC	Other Field Crops
OHS	Occupational Health and Safety
PAA	Project Approving Agency
P-K	Piano-Key
PP	Project Proponent
RB	Right Bank
RKTC	Randenigala Kaluganga Transfer Canal
RP	Resettlement Plan
TOR	Terms of Reference
VRR	Victoria-Randenigala-Rantembe

Executive Summary

1. Mahaweli River, originating in the central hills, is the largest river basin in Sri Lanka with a watershed area of 10,448 km^2 representing ca. 16% of the land area of the Island. The basin has an estimated annual average yield of 11,016 MCM which accounts for 24% of the total water resources of the country. The Mahaweli Ganga Development Programme was drawn up during the period 1964 -1968 in order to utilize a regulated flow of 5200 MCM annually for water resources development of four major sectors, namely irrigation, water supply, industrial and hydroelectric power generation.

2. Mahaweli River is diverted at four locations, first at Polgolla Barrage, where water is diverted to Ukuwela Power House. Thereafter, Mahaweli River passes through three major reservoirs, Victoria, Randenigala and Rantambe generating hydroelectric power at each location. Water released after power generation at the Rantambe Power House and any spillage from the Rantambe head pool flows in to the Minipe Pool bound by the Minipe Anicut situated across the Mahaweli River.

3. Minipe Anicut is the second major diversion point of the Mahaweli River where water is diverted through the LB Canal to a command area with a total extent of 6107 ha and to Mahaweli Systems B & C through the RB transbasin canal. Minipe LB and RB canals have design discharges of 22 m^3/s and 64 m^3/s respectively. The excess water, after the diversion, flows back to the Mahaweli River.

4. Minipe Pool is the only regulatory reservoir for the Minipe LB and RB canals. During peak power demand, two turbines operate in the Rantembe power house for 5 hours with a combined discharge of 180 m^3/s. Since the combined conveyance capacity of LB and RB main canals stands at 86 m^3/s and the Minipe pool has a limited storage capacity of 0.18 MCM, more than 1 MCM of water spills over the Minipe Anicut daily without being utilized.

5. At present the flow of water in Minipe LB canal fluctuates within a range of about 75% of the design discharge in a day as the LB intake is located at a higher elevation (about 0.7 m) than the RB canal intake and therefore, the major portion of water at Minipe Anicut during low flows will flow in to the RB canal. Therefore, farmers at the tail end of the LB canal are facing a water deficit. Further future water resource development in the area such as proposed water resource development in Heen Ganga and Hasalaka Oya will result in a further reduction in inflows to LB canal.

6. The project proponent, Ministry of Mahaweli Development and Environment[1], plans to address the water deficit issue in the command area of the Minipe LB canal through a two pronged approach. First, raising the Minipe Anicut from its current FSL of 114 m MSL to 118 m MSL and thereby increasing the storage capacity of the Minipe pool by an additional 1.1 MCM that would enable better regulation of the water released by the Rantembe reservoir after power generation. Second, the Minipe LB canal will be rehabilitated to improve its water conveyance capacity.

7. The major components of the proposed project includes
   a. Raising the existing Minipe Anicut from its current level of 114 m MSL to 118 m MSL.
   b. Extending the anicut along the axis of the existing retaining wall and thereby joining the left bank end of the anicut to LB silt excluder, embedding the retaining wall. The extended Anicut will have a crest elevation of 118 m MSL

[1] In January 2014 the Ministry of Irrigation and Water Resources Management was renamed as the Ministry of Mahaweli Development and Environment.

c. Make necessary modification to the LB sluice corresponding to the new Anicut level and afflux at design discharge.

d. Modify the LB Silt Excluder to ensure efficient silt exclusion.

e. Construction of an additional silt excluder to improve the silt removal from Minipe pool after raising the Anicut.

f. Introduce necessary protective measures to the RB Sluice after raising the Anicut.

g. Rehabilitation and improvement of the LB main canal to enhance its conveyance capacity

8. This IEE study was carried out with the objective of documenting the baseline environmental conditions of the project affected area and to assess the social and ecological consequences of implementing this project. The study area has been defined as the area that will be inundated due to the raising of the Minipe Anicut, sites where new construction activities will be undertaken, the stretch of the Mahaweli river from the Minipe Anicut up to the confluence of the Badulu Oya that will be subjected to low flows due to the raising of the Minipe Anicut and the command area of the Minipe LB canal that will be affected during the rehabilitation of the Minipe LB canal

9. The proposed project area is located in the Kandy, Nuwara Eliya, Badulla and Polonnaruwa districts. Topographically, the project site is located in the second and third peneplanes of Sri Lanka. The river bed at the proposed dam site is at 108m MSL. The area is dominated by moderately high relief hill, ridges and valley systems.

10. The Minipe Anicut location comprise of high grade metamorphic rocks of granulite facies. The dam axis is underlain by solid bed rock with different mineralogical formation. Geological investigations indicated that fresh solid bed rock is present along almost the entire length of the Anicut axis. Therefore, highly favourable geological conditions prevail in the area for implementation of a project of this nature.

11. Biogeographically, the proposed project area lies within the Intermediate Zone. Floristically it comes under the Eastern Intermediate Lowlands Floristic Zone. Tropical moist semi-evergreen forests and the river (Mahaweli River) associated forest vegetation are the main habitat types observed in the proposed project area. A total of 240 plant species including 17 endemic, 17 nationally threatened and 16 nationally near threatened (NT) plant species and 147 faunal species including 14 endemic, seven Nationally threatened and three Globally threatened species were recorded from the project affected area. Based on the observed species composition the area is rich in Native species including many threatened and endemic species, it can be concluded that the project will be located in an area of high ecological value.

12. The site selected for the proposed project is located within the Victoria-Randenigala-Rantembe Sanctuary declared by the Department of Wildlife Conservation (DWC)[2]. Therefore, no human settlements are found in the area that will be inundated due to the proposed raising of the Minipe anicut. Thus the proposed project will not result in any

[2] Protected areas declared by the DWC under the Fauna and Flora Protection Ordinance include Strict National Reserves, National Parks, Nature Reserves, Jungle Corridors, Refuges, Marine Reserves, Buffer Zones and Sanctuaries. Out of these Sanctuaries have the lowest protection level where traditional uses are allowed. However, hunting; killing; taking of animals; taking or destroying eggs and nests; using guns, explosives, traps and poison; developmental activities and land clearing for cultivation or mining or any other purpose are prohibited. **According to the IUCN system of classifying protected areas (Dudley, 2008), a Sanctuary is a Category VI protected area (a managed resource protected area)**.

negative socio-economic impacts such as loss of livelihoods and resettlement of people. However, the second part of the project, rehabilitation of the Minipe LB canal will have a positive influence on the socio-economic status of the farmers that inhabit the irrigable area of the LB canal as the project will resolve their two major water issues, fluctuation of flow in the canal and deficit of water at the tail end of the canal.

13. An extent of approximately 25 ha of tropical moist evergreen forest on the right and left bank of the existing Minipe Pool will be inundated due to the raising of the Minipe Anicut. This habitat even at present is subjected to a daily inundation regime during the peak energy generation periods of the Rantambe power house. Second, as the proposed project will enhance the storage capacity of the Minipe Pool, the water will recede at a much lower rate compared to the present situation. Therefore, both the extent of the area inundated as well as the time span during which this area remain inundated will increase. However, this change in inundation pattern will not have a significant impact as it will not result in a habitat loss since it is only a transient inundation. However, ground dwelling species inhabiting the newly inundated area will lose their habitat. Species that were observed to occupy the ground layer in the area that will be inundated transiently did not include any endemic, threatened or rare species. As a mitigatory measure it is proposed to reforest the LB canal reservation with indigenous plant species. This will result in the establishment of a riverine vegetation over an extent of 145 ha. This will not only compensate for the loss of habitat (25 ha) that will arise due to the project, but will also function as an ecological corridor between three protected areas (VRR sanctuary, Knuckles Conservation Forest and Wasgomuwa National Park) which would facilitate gene flow between forest restricted species that occupy these three protected areas. Further, it will prevent future encroachment of the canal reservation as well as reduce sediment runoff to the canal during rainy season.

14. After raising the Minipe Anicut, the spillage over the Anicut (1039 mcm) that takes place at present during the two peak power generation periods of the day (3 hours between 1900 – 2200 hrs and 2 hours between 0600 – 0800 hrs) will be reduced by more than 95%. As a consequence there will be little or no flow in the Mahaweli River, in a stretch of about 6.5 km, between the Minipe Anicut and the confluence of Badulu Oya, the first major tributary that joins the Mahaweli River downstream of the Minipe Anicut. Since there are no human settlements within this 6.5 km, the low flows will not have any significant social impacts as there are no downstream water users. However, this will result in a reduction of the carrying capacity of this stretch of the river for aquatic fauna, mainly freshwater fish. Further, the daily wetted perimeter of this stretch of the river will also decrease due to the low flows which will have a negative impact on the aquatic plants. Based on the field investigations, this stretch of the river supports several species of threatened and endemic aquatic fauna and flora that will undergo a population reduction under the new flow regime.

15. Therefore, an environmental flow of 8 m^3/sec and 16 m^3/sec during the cultivation and non cultivation season (mid March to end April and Mid August to end September) respectively, shall be maintained to meet the ecological demands of this section of the river. The e-flow should be released for a period of 5 hours per day in two segments (2 hours from 1900 to 2100 and 3 hours from 0600 to 0900) to simulate the current flow regime of the river. Further, a short (0.5 m) weir will be constructed across the Mahaweli River downstream of the Minipe Anicut (between 15 to 20 m downstream) so that the e-flow released will be dispersed across the river bed to ensure that the wetted perimeter of the river shall not decrease drastically from its present day level.

16. The proposed project involves rehabilitation of existing infrastructure. Further, the construction work will be limited to a short duration and the area impacted is less than 40 ha in extent. Therefore, the impact on the physical environment will be minimal and can be easily mitigated through a well planned and executed environmental management plan.

17. Therefore, the proposed project will not have any significant impacts on the environment other than the reduction of flow in the Mahaweli River that shall be addressed by releasing an adequate enviornemental flow. The project proponent shall also take steps to execute the environmental management plan that has been developed with appropriate funds to implements it during construction and operation of the project.

18. Since part of the project activities will take place in a protected area an appropriate monitoring mechanism with relevant funds shall be established for this project as indicated in the environment monitoring plan to ensure that the proposed project activities will not have any significant negative impacts on the protected area. A member of the Department of Wildlife Conservation will be asked to be present at the construction site during the entire construction period to safeguard the interests of the wildlife and to ensure that the project activities complies with the provisions of the Fauna and Flora Protection Ordinance.

19. **Technical Features**

Parameter	Existing	Proposed
Anicut Weir		
Type	Ogee section and Retaining wall section	Piano-Key type weir
Length	Main Ogee: 225.0 m Side retaining wall: 115.0 m Total length: 340.0 m	Total P-K weir length:325m
Crest Level	Ogee: 114.0 m MSL Retaining wall: 115.0 m MSL	118.0 m MSL
Maximum Height	4.0 m	9.0 m
Left Bank Sluice		
Gate Type	Manually operated steel sliding gates	Electrically operated steel sliding gates
Number of gates	3	3
Size of gates	2 / 3.50m x 1.52m 1 / 3.50m x 0.92m	2 / 3.00m x 1.52m 1 / 3.00m x 0.92m
Sill Level	111.88 m MSL	111.88 m MSL
Pier Top Level	118.3 m MSL	121.5 m MSL
Pier width	1.52m	2.02m
Trash Rack	No trash rack at present	A trash rack will be installed
Left Bank Silt Excluder		
Gate Type	Manually operated wooden sliding gates	Electrically operated steel sliding gates
Number of gates	4	2
Size of gates	1.50m x 0.91m	3.0m x 3.0m
Sill Level	3 bays at 111.25 m MSL 1 bay at 110.99 m MSL	109.5 m MSL
Right Bank Head Sluice		
Gate Type	Electrically operated steel sliding gates	No change to the existing structure
Number of gates	6	
Size of gates	2.75m x 3.0m	
Sill Level	111.10 m MSL	
Pier top level	121.0 m MSL	Protection wall with top level of 121.5m MSL

Trash Rack		
Right Bank Silt Excluder		
Type	Manually operated radial gates	No change to the existing structure
Number of gates	2	
Size of gate	1.50m x 3.0m	
Sill Level	109.5 m MSL	
Central Silt Ejector – NEW		
Location		
Type of gate		Electrically operated steel sliding gate
Number of gates		01
Gate size		3.0m x 3.0 m
Sill level		109.5 m MSL
Flank Bund – NEW		
Type		Earthen bund
Length		102.5 m
Top width		2 m
Top level		121.5 m MSL

PART A GENERAL INFORMATION

A.1 Name of the Project: Proposed Raising of the Minipe Anicut and Rehabilitation of the Minipe Left Bank Canal Project in Kandy District.

A.2 Developer **:** The Ministry of Irrigation and Water Resources Management
Postal Address **:** 500 T B Jaya Mawatha, Colombo 10
Phone **:** +94112684710
Fax No **:** +94112689548

Contact person
Name **:** Eng. K. W. Ivan De Silva
Designation **:** Secretary, Ministry of Irrigation & Water Resources Management
Phone **:** +94112676844
Fax **:** +94112676846

A.3 Nature of the project

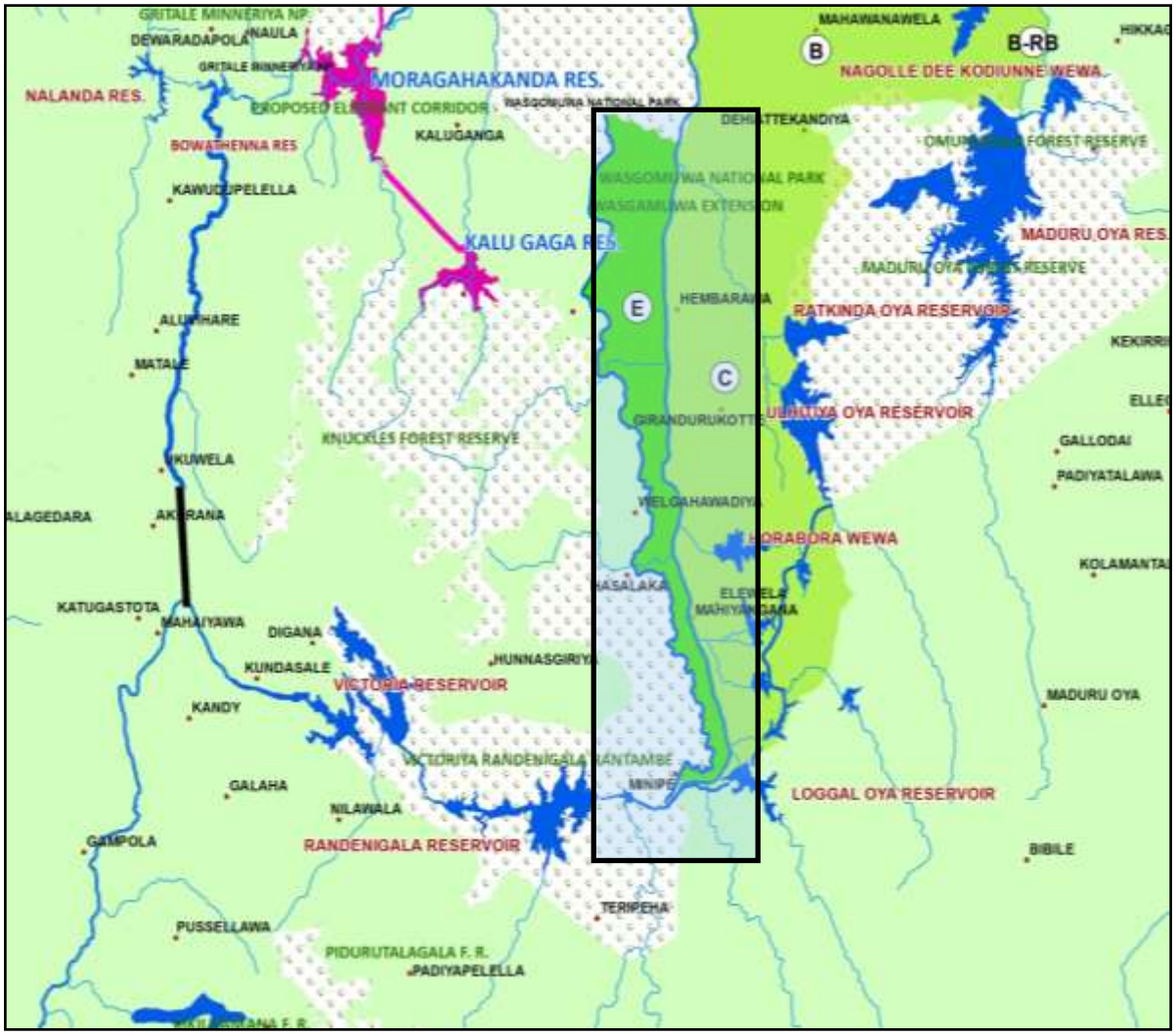
20. Mahaweli River originates from the western and northern slopes of the central hills and flows in a North Eastern direction and release into the sea at Trincomalee. The river has a watershed area of 10,448 km2 that represents approximately 16% of the land area of Sri Lanka. Upper reaches of this river receive substantial amount of rainfall during “North-East” and “South-West” monsoons and the annual average yield of the basin has been estimated to be around 11,016 MCM which accounts for 24% of the total water resources of the country. A significant amount of this water flows to the sea unused annually. Therefore, the Mahaweli Ganga Development Programme was drawn up during the period 1964 -1968 in order to utilize a regulated flow of 5200 MCM annually for water resources development in four major sectors, namely irrigation, water supply, industrial and hydroelectric power generation.

21. Under this programme Mahaweli water is diverted at four main locations namely:

- **Polgolla Barrage** - Divert water to Ukuwela Hydro Power station. The Tail water in turn comes back to Sudu Ganga, a tributary of Amban Ganga
- **Minipe Anicut** - Divert water to the Minipe Yoda Ela in the Left Bank and to Ulhitiya and Maduru Oya *etc*. in systems B & C through Right Bank transbasin canal
- **Elahera Anicut** - Divert water to Giritale/ Minneriya/ Kaudulla and Kantale tanks through Elahera Minneriya Yoda Ela (EMYE)
- **Angamedilla Anicut** - Divert water to Parakrama Samudraya

22. After diverting a regulated quantity of water to Ukuwela Power House at Polgolla Barrage, the Mahaweli River flows to the Victoria Reservoir. After generating Hydro Power at Victoria Power House, water flows in to the Mahaweli River and in turn to the Randenigala reservoir. Any spillage of Victoria reservoir is also directed to the Randenigala reservoir via Mahaweli River. At Randenigala too Hydro Power is generated at the Randenigala Power House and the water after power generation flows into the Rantambe head pool via the Mahaweli River. Any spillage from Randenigala reservoir also flows in to the head pool of Rantambe. Water released after power generation at the Rantambe Power House and any spillage from the Rantambe head pool flows in to the Minipe Pool bound by the Minipe anicut situated across the Mahaweli River. Excess water in the Minipe pool flows in to the Mahaweli River, after diverting water through Left and Right bank canals (Figure 1).

Figure 1. Layout of the Polgolla diversion, Victoria, Randenigala and Rantembe reservoirs, Minipe anicut and the command areas of the Minipe LB and RB canals. The project activities will take place in the boxed area.



23. Minipe Anicut is an Ogee type concrete gravity structure having a length of 225 m and a maximum height of 13 m at the crest elevation of 114.00 m MSL. This was built by ancient kings and subsequently developed at different times during the period spanning from 1939 to 1968. Minipe Anicut is the second major diversion point of the Mahaweli Ganga Development Programme. The irrigable area of the Minipe anicut lies along the left bank of the Mahaweli River starting from the Minipe anicut which is the head work for the system and extends up to Wasgamuwa National Park with a total extent of 6107 ha. The transbasin canal starting at the right bank end of the Minipe anicut provides water to System B & C of the Mahaweli development area.

24. Minipe Pool, having a storage capacity of 0.18 MCM, is the only regulatory reservoir for the Minipe LB and RB canals that have design discharges of 22 m3/s and 64 m3/s respectively. Minipe LB canal intake is located at a higher elevation (about 0.7 m) than the RB canal intake. As such, the major portion of water at Minipe pool will flow in to the RB canal. This has resulted in an irregular flow in the LB canal that fluctuates within a range of about 75% of its design discharge resulting in water deficits in its command area, especially at the tail end of the canal.

25. The Minipe LB canal is an unlined contour canal that is 74 km in length. Its conveyance capacity has been substantially reduced due to silting of the canal bed and growth of water weeds especially at the downstream reach of the canal, resulting in very low flow velocities. Further, along the canal there are several locations where the water spreads over large areas, making ponds, which has resulted in excessive lag time for water to reach downstream. Further, the water regulation capacity of the Minipe LB canal is substantially reduced due to deteriorated canal structures and inadequate regulation structures, The net result of all these factors have contributed to an overall reduction in efficiency of the irrigation operation leading to water deficits at the tail end of the Minipe LB canal. This situation is expected to get worse in the future as the proposed water resources development of Hasalaka Oya and Heen Ganga, which at present augments the LB canal, will result in a further reduction of the availability of water to the LB canal (see figure 2).

26. Therefore, the Ministry of Mahaweli Development and Environment (MMDE) proposes to under take this project with the aim of addressing this pressing problem by introducing number of improvements to the Minipe Anicut and Minipe LB canal that will increase the water retention ability of Minipe pool as well as enhance the water conveyance capacity of the Minipe LB canal.

27. **Main objectives of the project**: The main objective of the proposed project is to address the current water shortage experienced by the farmers cultivating within the command area of the Minipe LB Canal that comprise of 6107 ha. This water deficit is expected to further aggravate in the future due to proposed diversion of Hasalaka Oya and Heen Ganga in order to augment the water supply to NCP canal via Randenigala-Kaluganga transfer canal (Figure 2). The objective of addressing the water deficit in the LB command area will be achieved through two activities. First, the storage capacity of the Minipe pool will be increased by a further 1.1 MCM, through raising the Minipe Anicut from its current FSL of 114 m MSL to 118 m MSL. This would effectively reduce the flow fluctuations in the Minipe LB canal by diverting a higher volume of the water released from Rantambe reservoir after power generation. Second, LB canal will be rehabilitated to improve its conveyance capacity, which includes desilting of the canal, removing the water weeds, lining selected sections of the canal, providing cross regulators, adding water measurement devices to distribution and field canals and reinstating the canal to its original condition.

28. Thus, the proposed project can be described as an improvement of an already existing irrigation system, i.e. Minipe diversion through

1. Raising the existing Minipe anicut and thereby enhancing the carrying capacity of Minipe Pool.
2. Rehabilitation and improvement of the structures associated with the Minipe anicut for water diversion and silt release to ensure efficient functioning of the system.
3. Rehabilitation of the Minipe LB canal to improve its conveyance capacity

29. **Justification**: The farmers who are cultivating within the command area of the Minipe LB canal, fed by the Minipe pool, is facing severe water shortages, while approximately 1 MCM of water released after power generation from the Rantambe power house flows over the Minipe anicut every day without being utilized due to inadequate storage capacity of the Minipe Pool. The proposed project titled "Raising of Minipe Anicut and Rehabilitation of the Minipe Left Bank Canal" aims to address this issue using a two step process. First, enhancing the regulatory capacity of the Minipe Pool by increasing the storage capacity of the Minipe pool by 1.1 million m^3 and second, improving the conveyance capacity of Minipe LB canal. Therefore, the proposed project can be considered as an improvement of an already existing irrigation system.

30. The water quality analysis of the Minipe LB canal presented in section C1ii indicates that there is heavy erosion as well as excessive use of agrochemicals in the command area of the Minipe LB canal which in turn will result in sedimentation of the LB canal as well as reduce the quality of the water in the LB canal below the accepted safety standards for drinking and bathing during certain times of the year. Therefore, along with the proposed rehabilitation work, the project will also implement a programme within the Minipe LB canal command area to promote sustainable farming practices with respect to land preparation (without compromising the integrity of the soil structure and soil biodiversity), water usage (efficient water management), weed/ pest management and reducing post harvest loses. Through such a programme it will be possible to reduce sedimentation, pollution and duty on farming within the project area.

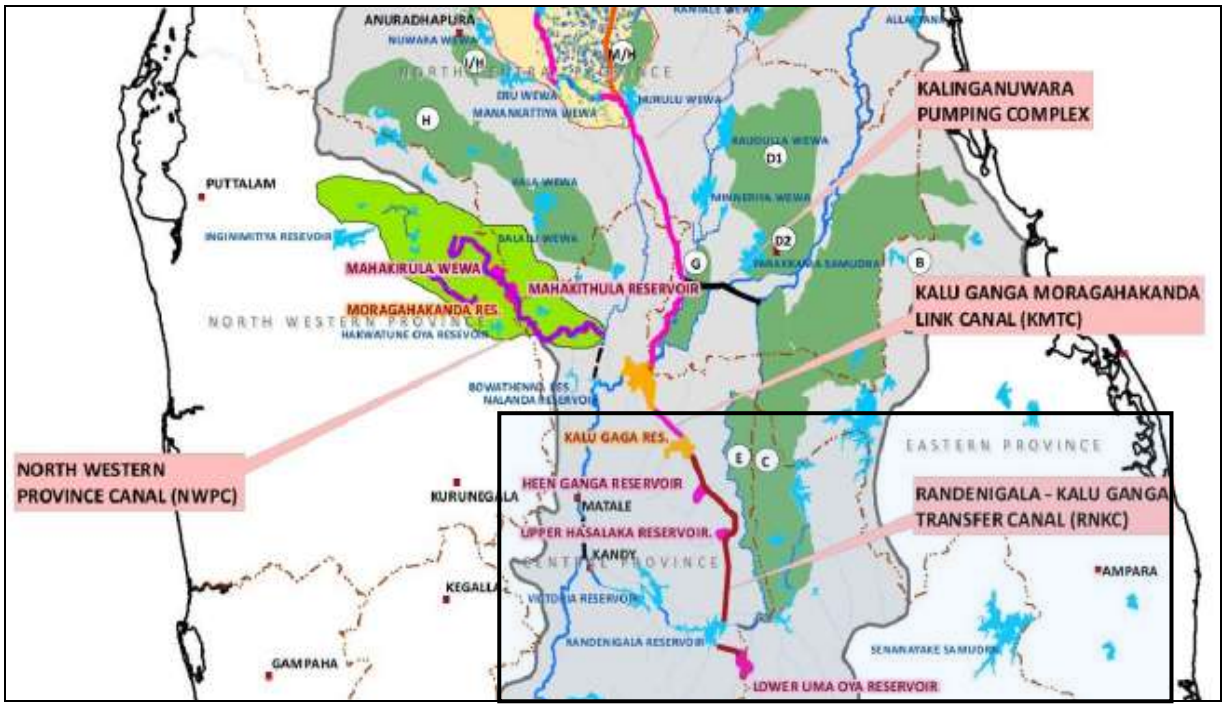


Figure 2. The proposed water resource development to augment water supply to the NCP canal through diversion of water from Heen Ganga, Hasalaka Oya and Lower Uma Oya via the Randenigala-Kalu Ganga Transfer Canal (RKTC) as indicated in the boxed area.

A.4 Location of the project:

i. **Pradeshiya Sabha**: Hasalaka

ii. **Divisional Secretariat**: Minipe

iii. **Provincial Council**: Central Province

iv. **Location map indicating the project site, access to the site, surrounding development and infrastructure within 500 m of the site -** shown in figure 3

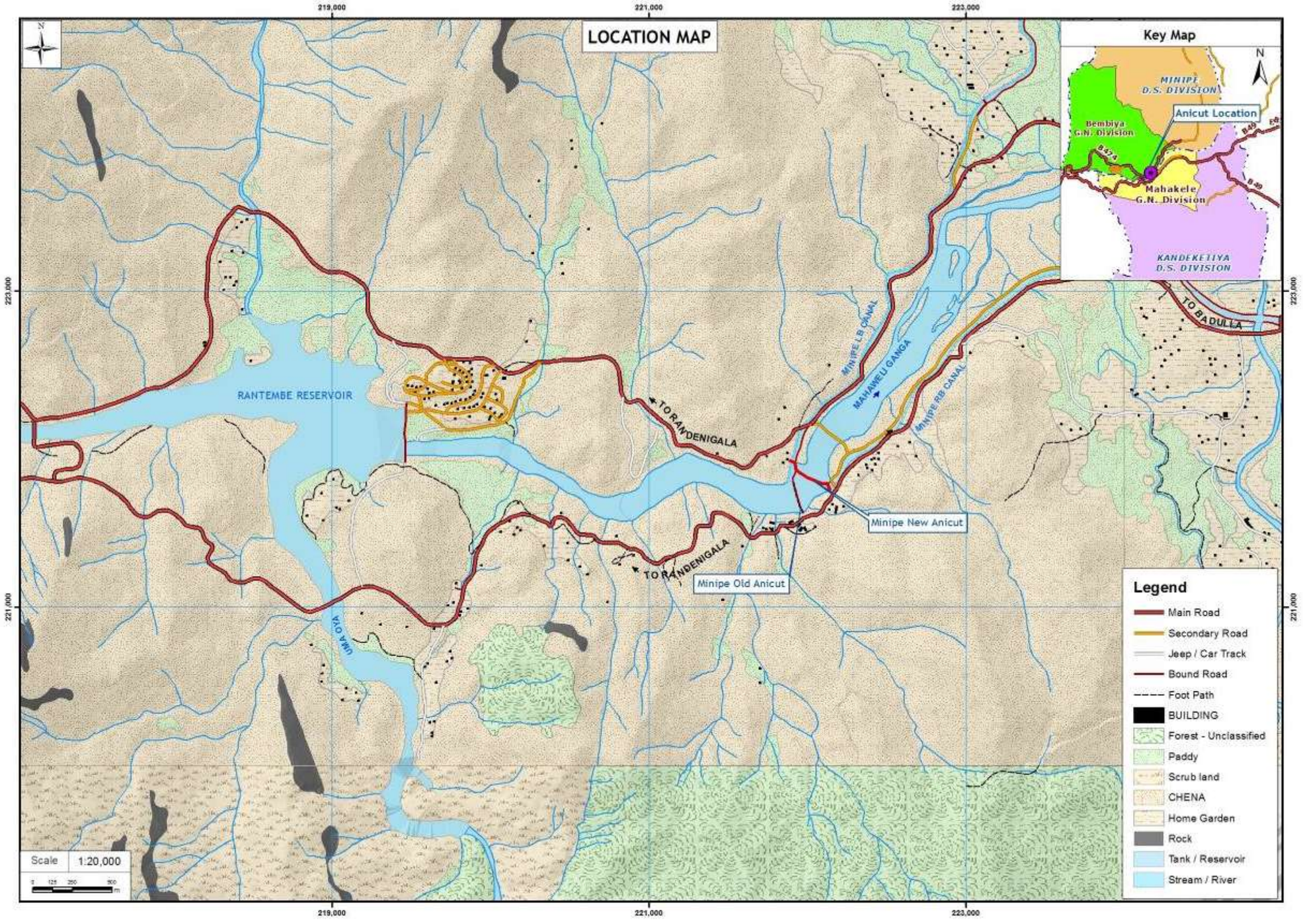


Figure 3. Location Map Indicating the project Site and access roads

A.5 Applicable laws, regulations, standards and requirements covering the proposed project:

31. In Sri Lanka, there are over 70 laws that directly or indirectly relates to protecting and conserving the natural environment and human health. While most of these laws address specific issues pertaining to environment in the respective sector, it was the introduction and enactment of the National Environmental Act (NEA) that provided the overarching legal basis for regulation of pollution and protection of the environment from all sources in a comprehensive manner. The following section outlines the broad legal and institutional framework in Sri Lanka for environmental management, which will be relevant to the proposed project.

32. **National Environmental Act No 47 of 1980 and its subsequent amendments**
The National Environmental Act (NEA) is the legislation with powers to control any activity with impacts or potential impacts on the environment and natural resources of the entire country. The Central Environmental Authority (CEA), which presently functions under the Ministry of Environment and Renewable Energy is the regulatory body empowered to implement provisions under NEA. There are two main regulatory provisions in the NEA through which impacts on the environment from the process of development are assessed, mitigated and managed. These are:

1. **Environmental Impact Assessment (EIA) procedure for major development projects:** Regulations pertaining to this process are published in Government Gazette Extraordinary No.772/72 dated 24 June 1993 and in several subsequent amendments.
2. **Environmental Protection License (EPL) procedure for the control of pollution:** Regulations pertaining to this process are published in Government Gazette Extraordinary No. 1533/16 dated 25 January 2008.

33. **Environmental Impact Assessment:** The provision relating to EIA is contained in Part IV C of the National Environmental Act. The procedure stipulated in the Act for the approval of projects provides for the submission of two types of reports; Initial Environmental Examination (IEE) report and Environmental Impact Assessment (EIA) report. Such reports are required in respect of “prescribed projects” included in a Schedule in an Order published by the Minister of Environment in terms of section 23 Z of the act in the Gazette Extra Ordinary No. 772/22 dated 24th June 1993.

34. Any project or undertaking irrespective of its magnitude, if located partly or wholly within an Environmental Sensitive Area, will become a prescribed project requiring approval under the regulations. The approval will have to be obtained from the appropriate project approving agencies (PAAs) who are concerned or connected with such prescribed projects. This IEE was carried out in accordance with the NEA under the TOR issued by the CEA.

35. **Environmental Protection License (EPL):** The Environmental Protection License (EPL) is a regulatory/legal tool under the provisions of the National Environmental Act No: 47 of 1980 amended by Acts No 56 of 1988 and No 53 of 2000. Industries and activities which required an EPL are listed in Gazette Notification No 1533/16 dated 25.01.2008. Industries are classified under 3 lists i.e., List "A","B" and "C" depending on their pollution potential.

36. Part "A" comprises of 80 significantly high polluting industrial activities and Part "B" comprises of 33 numbers of medium level polluting activities. EPL for industries in lists "A" and “B” have to be obtained from the relevant Provincial Offices or District Offices of the CEA.

37. Part "C" comprises of 25 low polluting industrial activities which have been delegated to Local Government Authorities, namely Municipal Councils, Urban Councils and Pradeshiya Sabhas. EPL for the industries in List "C" has to be obtained from the respective Local Authorities. The Local Authorities carry out issuing of EPLs and related functions such as follow up, monitoring and law enforcement. Several activities associated with construction activities, such as establishment of asphalt plants, concrete batching plants, require an EPL.

38. **Fauna and Flora Protection Ordinance:** EIA provisions are also included in the Fauna and Flora Protection Ordinance (FFPO) Amended Act No. 49 of 1993. According to this Act, any development activity of any description what so ever proposed to be established within one mile from the boundary of any National Reserve, is required to be subjected to EIA/IEE, and written approval should be obtained from the Director General, Department of Wildlife Conservation prior to implementation of such projects. Since the project will result in the inundation of ca. 25 ha of a sanctuary (Victoria-Randenigala-Rantambe Sanctuary) declared under the FFPO, the views and concerns of the DWC will be given due consideration.

39. **Pradeshiya Sabha Act No 15 of 1987:** Pradeshiya Sabhas are empowered to formulate by-laws for governance of the areas under their jurisdiction on the subjects devolved to them under the Pradeshiya Sabhas Act No. 15 of 1987. Some activities falling under this Project such as building activities, waste disposal etc. fall under the purview of the local Pradeshiya Sabha and as such need its approval. The approvals required from the Pradeshiya Sabha may be one time as in the case of building permits or in the form of annual renewals for carrying out day to day activities such as waste disposal. Permit issuing authority for the Project under the Pradeshiya Sabhas Act is the Hasalaka Pradeshiya Sabha as the Project Area falls within its jurisdiction.

40. **Mines and Minerals Act No. 33 of 1992:** Under this Act, mining falls within the purview of the Geological Survey and Mines Bureau (GSMB). Mining of minerals including sand must be done with a license issued by GSMB. Mining is not permitted within archaeological reserves or within specified distances from such monuments. New mining licenses are subject to the EIA process, if the type and extent of mining is listed under the EIA regulations. Additionally, GSMB has the power to stipulate conditions including cash deposits and insurance policy for the protection of environment. Regulations made by GSMB under the Act cover a variety of environmental stipulations, criteria and conditions for licensing and operating mines. This also covers the disposal of mine wastes. The Act also deals with the health, safety and welfare of miners. Mining rights on public and private land are subject to licensing by GSMB, and all minerals wherever situated belonging to the State. The right to mine public land parcels are subjected to EA procedures.

41. Since the project will not set up its own quarries or borrow sites, all resource requirements for construction will be procured from quarries or burrow sites having a valid mining license obtained from the Geological Survey and Mines Bureau (GSMB) or Environmental Protection License (EPL) from Central Environmental Authority (CEA).

42. **ADB’s Safeguard Policy Statement (2009)**: ADB uses a classification system to reflect the significance of potential environmental impacts that may arise due to a project. A project’s category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project’s area of

influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories based on ADB's Safeguard Policy Statement (2009):

43. **Category A:** Projects with potential for significant adverse environmental impacts which are irreversible, diverse, or unprecedented. An environmental impact assessment (EIA) is required to address significant impacts.

44. **Category B:** Projects judged to have some adverse environmental impacts, but of a lesser degree and or significance than those of category A projects. An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

45. **Category C:** Projects unlikely to have adverse environmental impacts. No EIA or "IEE is required, although environmental implications are still reviewed.

46. **Category F1:** Projects are classified as category F1, if they involve a credit line though a financial intermediary. The financial intermediary must apply on environmental management system; otherwise all subprojects will result in insignificant impacts

A.6 Clearances/ permits obtained or should be obtained from relevant state agencies and /or local authority:

47. In terms of the prevailing laws and regulations governing the development activities in the country, the project proponent must obtain several approvals/certificates from relevant line agencies and the associated stakeholders prior to the initiation of the development activity. The number of approvals that needs to be obtained varies according to the number of stakeholders involved. Therefore, the number of approvals/permits that the development activity will have to obtain depends on its size and its complexity. Some of the approvals will be applicable during the planning and construction phases of the project while others are applicable during the operational phase of the project. Following table provides a list of the approvals needed for the project and the current status with regard to obtaining the said approval/permits by the project proponent.

No.	Name of Permit/ Approval required	Relevant Line Agency/ Authority	Present status of the approval
1	Approval under National Environment Act No. 47 of 1980 and Subsequent Amendments (1988, 1995, 1999 & 2000)	CEA	To be obtained
2	Approval under the Pradeshiya Sabhas Act No.15 1987 for the construction of the buildings, access roads, waste disposal *etc*.,	Hasalaka Pradeshiya Sabha	To be obtained during the construction stage
3.	No objection letter from the Department of	DWC	To be obtained[3]

[3] Already the project has been discussed with the Department of Wildlife Conservation who has agreed on principal to allow the proposed project activities within the Sanctuary. However, formal approval from the Department of Wildlife Conservation will be provided only after the CEA has approved the project. The technical evaluation committee that will be appointed by the CEA to review the IEE report prior to giving approval will also be represented by a senior officer of the Department of Wildlife Conservation and therefore,

No.	Name of Permit/ Approval required	Relevant Line Agency/ Authority	Present status of the approval
	Wild Life Conservation		
4	Approval from National Building Research Organization (Since the project area is located within a landslide prone area)	NBRO	Obtained[4]
5.	Removal of trees during land preparation	Minipe DS Division and DWC	To be obtained during the construction stage[5]

Department of Wildlife Conservation that is entrusted with the management of the VRR Sanctuary will be fully appraised of the project and will play an active role in the project appraisal and approval process.

[4] The NBRO report has been annexed and their recommendations are incorporated to the section E (Mitigation measures) of the IEE report.

[5] Removal of trees is not envisaged according to the project design. However if the need arise during the construction stage approvals should be obtained from Pradeshiya Sabha for trees that are outside the VRR sanctuary and Department of Wildlife Conservation for trees that are within the VRR sanctuary

PART B PROJECT DETAILS

B.1 Project layout:

48. There are two main project components, *viz* raising the Minipe anicut by 4m in order to increase its capacity to retain the water released by Rantambe power plant after power generation and rehabilitation of the associated structures and the rehabilitation of the Minipe LB canal. The first part of the proect will be carried out at the existing anicut while the rehabilitation activities of the Minipe LB canal will spread across its legth (74km). General layout of the proposed project activities are shown in figure 4.

B.2 Project components including its principal features

49. The major components of the proposed project includes

1. Raising the existing Minipe Anicut.
2. Modification of the LB sluice.
4. Modification of the LB Silt Excluder.
5. Construction of an additional silt excluder.
6. Introduction of necessary protective measures to the RB Sluice.
7. Rehabilitation and improvement of the LB main canal.

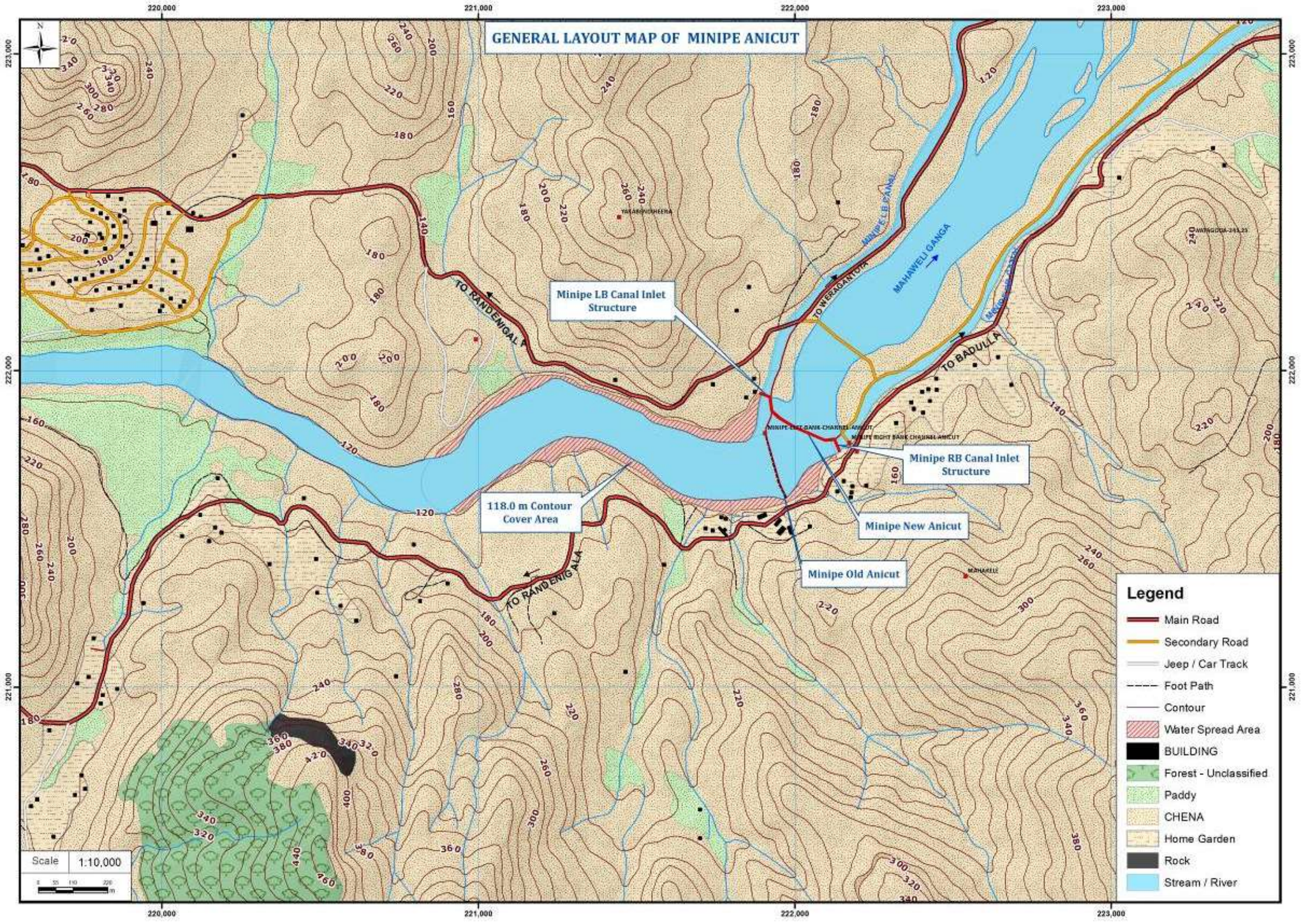


Figure 4. Map showing the general layout of the proposed project activities

A. **Irrigation infrastructure**

50. **Dam and structures to be formed in the dam and their functions:** Under the proposed project one of the main items is raising of the existing Minipe Anicut and its associated structures. However a new silt ejector is proposed under the project to prevent silt accumulation in the middle section of the anicut. The sill level of the structure is kept at 109.5 m MSL similar to the sill level of other two silt excluders. It consists of one opening with vertical lifting gates of 3.0m x 3.0m.

51. **Reservoir details:** At present the Minipe pool has a limited capacity of 0.18 MCM. The proposed raising of the Minipe Anicut will increase the storage capacity of the Minipe pool by 1.25 MCM that will be sufficient to accommodate the water released by the Rantambe power house during peak power generation periods of the day (06:00 to 08:00 and 17:00 to 20:00) as illustrated below.

During peak power demand, two turbines at Rantambe Power house will be operating for 3 hours in the evening and 2 hours in the morning with a combined discharge of	180 m^3/s
Combined conveyance capacities of LB and RB main canals	22 + 64 = 86 m^3/s
Discharge in excess of canal conveyance capacities	180 - 86 = 94 m^3/s
Approximate additional storage needed to accommodate the excess discharge[6]	94x3x3600/10^6 or 1.015 million m^3
The present capacity of the Minipe Pool	0.018 million m^3
Capapcity of the Minipe Pool after raising of the anicut by 4m	1.25 million m^3

52. As can be seen from the graph below (Figure 5), after raising the Minipe Anicut, the storage capacity will be increased to 125 MCM; thereby spillage over the Anicut during the peak power generation hours will no longer take place. As a result there will be significant reduction in the flow of water in the Mahaweli River (approximately 1 MCM per day) in a stretch of about 6.5 km between the Minipe Anicut and the confluence of Badulu Oya as there are no major inflows to this stretch of the river other than small streams and return flows from upstream irrigation systems. Therefore, a river maintenance flow (e-flow) will be released through the proposed new silt excluder and through the modified silt ejector at the extreme LB end in the raised Anicut structure (please refer section B.6 below for further description of the proposed Environmental flow release from the Minipe Anicut).

[6] The calculation was done for only three hours because out of the two power generation periods (1900-2200 and 0600-0800) this is the longest period and therefore will result in release of a higher volume of water.

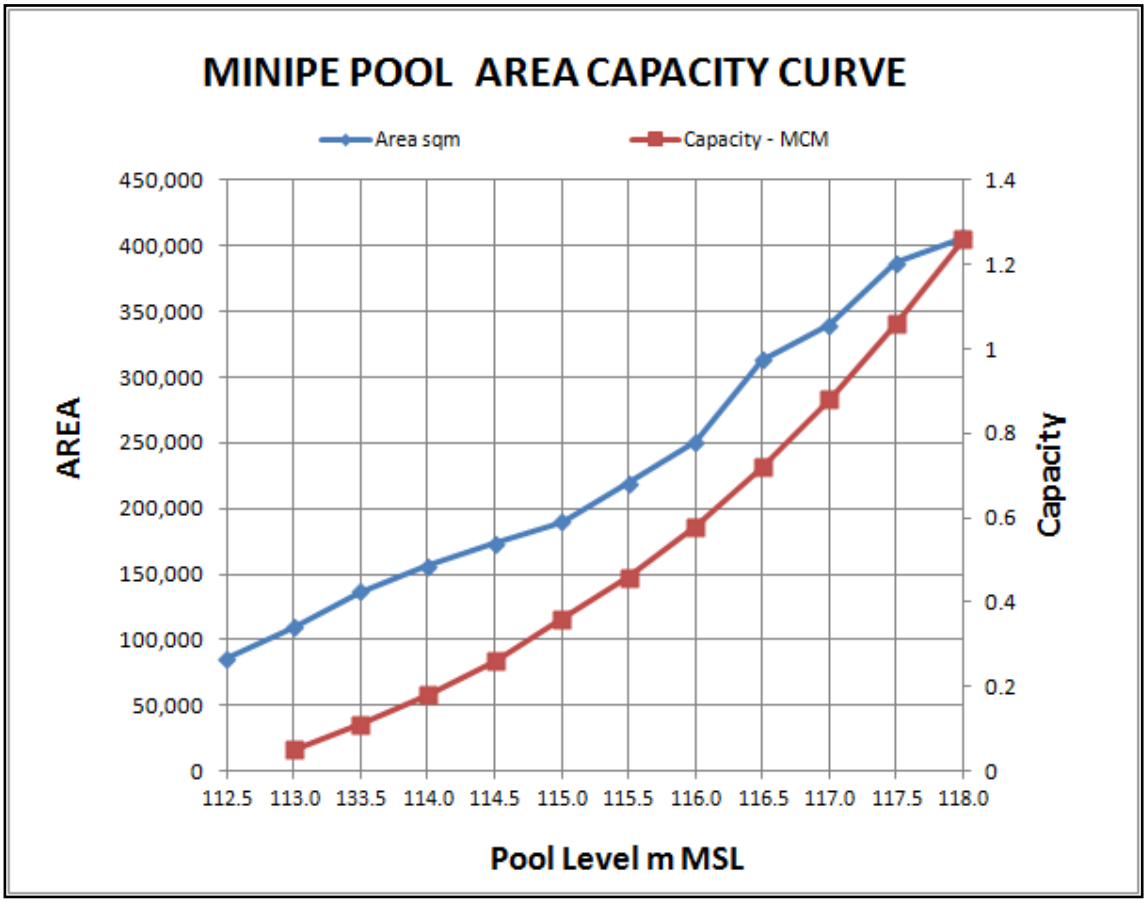


Figure 5. The capacity and the area curve of the Minipe Pool with changes in the anicut height. The proposed anicut height is 118 m MSL

53. The natural drainage pattern along the Minipe LB canal will not be affected due to the proposed rehabilitation or structural modifications of the canal. But the proposed diversion of Hasalaka Oya and Heen Ganga through the Randenigala – Kaluganga Transfer Canal (RKTC) will result in a reduction of inflows to the LB canal. However, it should be noted that the proposed Uper Hasalaka reservoir and Heen Ganga reservoir will enhance the ability to regulate inflows to the Minipe LB canal as required, while diverting water to Kalu Ganga reservoir through the RKTC. Further, during heavy rains, the spillages from Hasalaka and Heen Ganga reservoirs will flow in to the LB canal via Hasalaka Oya and Heen Ganga.

54. **Design Flood Discharge:** The flood discharge at Minipe has been taken as the spill discharge at Rantambe Reservoir as the catchment of the Minipe Pool between Rantambe dam and Minipe Anicut is only 2.1 km^2 in extent and therefore inflows from the catchment are insignificant.

55. The Rantambe flood discharges have been obtained from the "Detailed Design Report - Rantambe Dam - April 2010" prepared under the Dam Safety and Water Resources Planning Project. According to the summary of flood analysis, the outflow flood peak for 1000 year and PMF are 5,551.5 m^3 /s and 8,500.1 m^3/s, respectively. Therefore, for the design of the Anicut, the design discharge has been considered as 5,551.5 m^3/s in considering the historical flows at the Minipe Anicut. The flow records at Minipe Anicut from 1991 to 2010 show that the maximum daily average spill flow at Minipe was 1,046 m3/s. It was also considered that the inflow to the Anicut is controlled by Randenigala and Rantambe

reservoirs at present, and in addition by the proposed Uma Oya reservoir in the future. The design afflux is 4.0 m and the High Flood Level at the anicut is 122.0 m MSL.

56. **Irrigation and drainage works:** The irrigable area of Minipe anicut lies along the left bank of the Mahaweli River, starting from the Minipe anicut which is the head work for the system and extending up to Wasgamuwa National Park. The scheme has a total command area of 6107 ha. The transbasin canal starting from right bank end of the Minipe anicut provides water to System B & C of the Mahaweli development area.

57. **Proposed improvements to the existing structures**:

1. Raising Minipe Anicut from its current level of 114 m MSL to 118 m MSL.
2. Extending the anicut along the axis of the existing retaining wall and thereby joining the left bank end of the anicut to LB silt excluder, embedding the retaining wall. The extended Anicut will have the Piano-Key type weir and the crest elevation of 118 m MSL.
3. Construction of a 100 m long Gabion structure on the right bank to protect the toe of the slope from erosion and instabilities due to the fluctuation of the water level as recommended by the National Building Research organization.
4. Make necessary modification to the LB sluice corresponding to the new Anicut level and afflux at design discharge.
5. Modify the LB Silt Excluder to ensure efficient silt exclusion.
6. Construct an additional silt excluder to improve the silt removal after the raising of the Anicut.
7. Introduce necessary protective measures to the RB Sluice after raising the Anicut.
8. Rehabilitation and Improvements to the LB main canal include the following activities
9. Construction of a short weir (0.5m) across the Mahaweli River, 15 to 20 m downstream of the minipe Anicut

58. Proposed changes to the existing Minipe anicut are shown in figure 6 and figure 7.

Figure 6 Existing Anicut Indicating the proposed Changes

Figure 7 Proposed changes to the LB Sluice and Silt Excluder

59. **Rehabilitation of existing structures of the Minipe LB Canal**[7]

- Weed removal from the canal bund and turfing the bund to prevent erosion
- De-silting the canal components including its principal features of the bund
- Demarcating the canal reservation and planting suitable tree species in the canal reservation to prevent encroachment of the reservation (refer Annex V table 4 for the recommended list of plant species for replantation in the Canal reserve.
- Removing the water weeds
- Lining the canal at selected locations
- Removal of the obstructions to flow including roots of trees, collapsed and unused structures *etc*.,
- Improving the approach to deep sections for better maintenance including excavating berms and approaches in to the canal at appropriate locations where the bank height is greater than 3 m
- Introduce clay cutoff walls at locations identified as having excessive seepage from the canal bund
- Improving the Operational & Maintenance Road on the bund including repairs to causeways
- Repairing existing measuring gauges and introducing new ones at the beginning and identified canal reaches
- Introducing automatic water level recorders at identified locations
- Establishing Kilometer Posts, marking the location at key structures and setting up information boards for distributary canals
- Improvements/ Modifications to canal spills cum silt ejectors: Repairs to damaged sections, raising to the design level, and making the silt ejectors operational by opening the vents and providing gates with locking arrangements
- Repairs to siphons: The repairs and modifications include providing trash-racks, repairing the wing walls and de-silting at the entrance and exit where necessary
- Repairs to cross regulators: There are 12 regulators along the main canal of which 7 will be repaired and 2 will be reconstructed. These rehabilitation works include replacement of gates and repairs to the concrete structures. The 3 balance regulators will be removed and based on the canal operation needs 5 new regulators will be introduced
- Turnout Structures: Identified improvements include constructing wing walls with back filling to provide access to head wall for operations and constructing steps from bund tops or the wing walls to the head wall for operating the gate. A standard type headwall with lifting arrangements will be introduced for all turnout structures to facilitate operation and maintenance. The downstream of most of the turnout structures will be reconstructed due to their poor condition

[7] The Contract will be packaged into 6 packages in order to complete the construction work in the shortest possible time, considering the constraints imposed by irrigation requirements and the hydrology. These 6 packages include Minipe Anicut, Minipe LB Stage I, Minipe LB Stage II, Minipe LB Stage III & IV, Gates and electro-mechanical components and O&M Equipment respectively.

- Radial-gated spill structures: There are seven radial gated spill structures along the main canal located at intermediate reservoirs. Rehabilitation activities include repair/ replacement of mechanical parts, electrification, modifications to the gate leaf, and the concrete structure where necessary
- Bridges: The rehabilitation works include repairs to the masonry walls in abutments, piers and wing walls, especially the portion under water. It is proposed to strengthen these weak sections with concrete jacket walls with suitable mix of concrete. In addition, wing walls of bridges will be keyed to the ground with stepped wall and backfilling up to the ground
- Feeder Canals: Repairs to the canal bund/ O&M road of Bogahawewa to Maraha Wewa and to Maraka Wewa to Radunna Wewa, and De-silting/ dredging the water-pooling sections of the Heen ganga feeder canal

60. **New Structures introduced to the Minipe LB Canal**

- Drainage Inlets cum Silt Traps**:** It is proposed to build drainage inlet cum silt traps at locations where small streams are flowing in to the main LB canal that brings considerable amounts of silt to the canal
- Spill for Berabun Oya Intermediate Reservoir: It is proposed to provide a semicircular overflow canal spill for the intermediate storage reservoir at the confluence with Berabun Oya
- Small Pooling Sections: It was originally envisaged to bring the canal to a uniform section, as much as possible. However, this was found to be a very expensive work, and therefore, canal lining will be provided for a stretch of 9.2 km in stage IV only
- Canal Lining/ Bank Protection: Canal lining will be provided to 9.2 KM in stage IV. The purpose is to reduce pollutants flowing from the left bank, reducing sediment inflow to the canal and control weed growth. The left bank will be protected with a vertical gabion wall and the right bank will be protected with a sloping gabion wall at 1:2 (V:H)
- Duckbill Weir: A duckbill weir will be built at 63.650 km to regulate the canal flow
- Introduce by pass structures to prevent inflow of waste water into the LB canal especially near the Hasalaka Town

61. **Improvements to Electro Mechanical Components:** The rehabilitation criterion for electro-mechanical parts are under three categories

1. Re-designs and Improvements
2. Necessary modifications
3. Replacements/ New Structures

62. **Command area new:** No new lands will be developed under the proposed project.

63. **Command area existing:** The existing irrigable area of the Minipe anicut lies along the left bank of the Mahaweli River starting from the Minipe anicut and extends up to the Wasgamuwa National Park. The scheme has a total command area of 6107 ha. The proposed project aims to regularize water supply to the LB canal as well as enhance the efficiency of water conveyance to the command area of the LB canal, especially to the tail end of the canal, in order to address the water deficit issues in the existing command area of the LB canal. No new additions will be made to the existing command area.

B. **Proposed rehabilitation works of the anicut, canals and the reservoir:**

64. **Anicut:** Minipe Anicut is an Ogee type concrete gravity structure having a length of 225 m and a maximum height of 13 m at the crest elevation of 114.00 m MSL. The Anicut will be raised by 4 m up to 118m MSL changing the existing ogee weir to a Piano-Key type weir. Also the anicut will be extended along the axis of existing retaining wall joining the left bank end of the anicut to LB silt excluder, embedding the retaining wall. The construction cost of anicut raising is approximately Rupees. 1.2 Billion and cost of rehabilitation work of LB canal is approximately Rupees. 1.6 Billion.

65. **LB Sluice:** The proposed modifications to the existing structure are as follows:

- Raising the existing pier top level from its present 118.3 m MSL to 121.5 m MSL
- Widening the existing piers by 0.25m on both sides of the centerline.
- Extending the existing 8.2 m long pier by 6.28 m at upstream and 6.33 m at downstream end to accommodate stop logs, trash rack and stilling basin.
- Raising LB abutment from 118.3 m MSL to 121.5 m MSL and extending upstream length by 6.28 m to accommodate spacing for stop logs and trash racks and again extending by 6.33 m in downstream.

66. **Construction techniques:** The construction techniques are formulated with the objective of assuring an undisturbed irrigation releases during the cultivation season, and releases for the domestic needs during the two closed seasons (30th January to 15th April and 25th August to 15th November). Accordingly, the improvements to the LB Sluice will be carried out during the closed seasons. Two out of the three gates will be isolated and taken up for modification first. A bypass canal with a capacity of 8 m^3/s will be constructed on the Left Bank of the LB Sluice. A culvert with 4 rows of 4 ft (1.22 m) diameter RCC pipes will be constructed through the high-elevation section of the ground near the Sluice. A headwall with CI gates for each barrel will be provided to control the flow.

67. **Timing of construction**: The construction activities of LB Sluice will start in the closed season between the end of Yala 2015 and beginning of Maha 2015-16. It is expected that Yala water issues will terminate around 25th August and Maha water issues will commence on November 15 giving a minimum of 2 ½ months for construction. The bypass construction, except the linking with LB canal approach and downstream of the sluice, will be completed by this time.

68. **Dealing with water at the LB sluice**: The canal will be coffer-dammed with sand bags and will be raised to a level of 115.0 m MSL. Two heavy duty pumps will be used to keep the dry conditions necessary for construction. The remaining bay would be taken up for construction with due consideration to the progress of the first two bays. Together with the third bay, the LB Silt Excluder will also be constructed.

69. **Dealing with water at the Weir**: The Anicut is to be modified in six sections, each having a length of 60 m, and each section will be raised separately. Each section will be coffer-dammed with sand bags and heavy duty pumps will be used to maintain dry conditions necessary for construction. The new silt excluder in the central part of the Anicut will be built in parallel. By the time the whole anicut is raised, the silt excluders will also be used to release the environmental flow. To the extent possible, construction joints of the new weir will be located at the construction joints of the existing weir.

70. **Irrigation requirements of the Minipe LB Scheme during construction**: The modifications and repairs to the LB Sluice and LB canal are planned to start in the end of June 2015, with the repairs to the smaller gate on the Sluice structure. The larger gates and the structure will be modified during the closed season (30th January to 15th April and 25th August to 15th November) and would end in mid-October. Further, construction work will be carried out in six separate packages (as described in review note 5 in page 18) to increase the efficency of the rehabilitation work. In addition, the construction schedule and potential problems that may arise with regard to supply of water will be discussed at length with the farmers during the Kanna meeting[8] where the co-operation of the Farmer Organizations during the construction period (such as ways to increase the length of the closed season by cultivating short term varieties, switching to crops that require less water, and ways by which water shortages can be dealt with) will be discussed and a common agreement will be reached.

71. Table 1 describes the tentative construction schedule for the Anicut. The LB Main Canal rehabilitation is recommended to be carried out during the closed season.

Table 1. The Construction Schedule

Task	Start	Finish
Protection wall for RB Sluice and RB Silt Excluder	Jul-15	Aug-15
By pass to issue water to Minipe LB scheme	Jun-15	Jul-15
Modifications to LB Sluice	Aug-15	Oct-17
Modifications to LB Silt Excluder	Jul-15	Oct-17
Flank bund on LB	Jul-15	Sep -15
Grouting for Anicut Foundation	Jun-15	Sep-15
Anicut Raising	Jul-15	Oct-17
Central Silt Excluder	Jul-17	Oct-17

[8] A meeting held between farmers and the irrigation officials before the onset of each croppin season to discuss water distribution issues.

72. **Equipments to be used:** The list of equipment that will be used during the construction of Raising Minipe Anicut is given in table 2 below.

Table 2. The equipment to be used in construction work

Machine	Number
Compressor machines with accessories	5 Nos
Grouting machines with accessories	2 sets
Backhoe machine with chipping hammer	3 Nos
Long arm excavators	2 Nos
Dumpers	5 Nos
4 WD Tractors with trailers	5 Nos
Boom trucks	2 Nos
Concrete batching plants	2 Nos
Generators – 50 kv	2 Nos
Tamping rollers	2 Nos
Concrete pump cars	2 Nos
Vibrators	5 Nos
Concrete truck mixers	2 Nos
Front end loaders	2 Nos
Crawler tractors	2 Nos
Water Bowsers	2 Nos
4” diameter water pumps – for dewatering	2 Nos
2” diameter Water pumps (electrical)	2 Nos
1” diameter water pumps	2 Nos
Electric welding plants	2 Nos
Gas cutters	2 Nos
Heavy duty hand drills	2 Nos
Grinders	4 Nos

C. **Improvements of the command area.**

73. This project will not involve any improvements of the command area of either RB or LB canals.

B.3 Raw materials to be used for constructional purposes

74. The principal materials required for the project includes earth, gravel, sand, rock and metals *etc*., A detailed list of the major construction material required for the construction activities, their sourcing and the locations of borrow areas is shown in Table 3 below.

Table 3. Detailed list of construction materials that will be used for the project

Type	Quantity (m^3)	Source	Location of quarry/ borrow
Metals (40 mm)	10280	From existing licensed metal quarries	Within 20 km radius
Metals (37.5mm)	15790	From existing licensed metal quarries	Within 20 km radius
Metals (20 mm)	3850	From existing licensed metal quarries	Within 20 km radius
Metals (18mm)	175	From existing licensed metal quarries	Within 20 km radius
Earth	57675	From Upstream of Minipe Anicut	
Sand	18800	From existing licensed sand extraction sites in the Mahaweli river	Within 20 km radius
Rubble	43600	From existing licensed sand extraction sites in the Mahaweli river	Within 20 km radius

75. **Sources of Construction material:** The project will not set up any quarry sites or borrow sites of its own. All the necessary raw material will be procured from licensed quarry or borrow sites in the area.

B.4 Disposal of dredged materials

76. As the project involves only short term rehabilitation work, a significant quantity of construction waste or solid waste is not expected. The waste generated will be disposed at sites agreed upon with the local government agencies. Desilting of the LB main canal is expected to generate 74270 m^3 (1003.6 m^3/km) of sediment. All suitable material arising from de-silting will be used to form a bund in the LB side of the canal (to be used as an operation and maintenance road in the future) keeping drainage paths as existing at present. The newly formed bund will be turfed to protect it from erosion. Based on the past experience in undertaking such activities by the client it is expected that all dredged material can be utilized for the bund construction. However, in the event that some of the dredged material will not meet the required standard for the construction of the bund, such material will be disposed at a safe site agreed upon with local authorities.

77. The protocol that will be followed in selecting and disposing such unsuitable material is outlined below.

- The dredged material will be tested at an accredited lab to determine the nature of the material
- Based on the analytical report a site will be selected that will allow containing the dredged material safely
- A drainage management plan will be developed for the dredged material disposal site

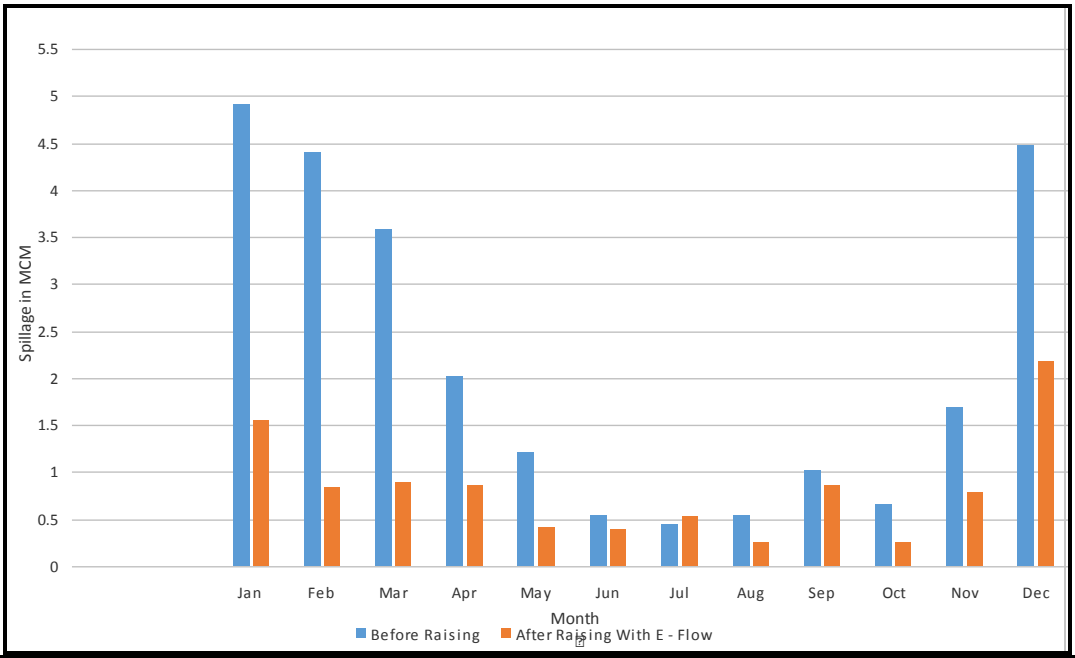
- A traffic management plan will be developed for the transport of dredged material to the selected site
- Unsuitable dredged material will be disposed at a safe location
- The site will be rehabilitated once all the material are disposed safely

B.5 Infrastructure facilities

78. There are two main access roads to the Minipe anicut site, namely Badulla-Kandy road and Randenigala-Mahiyangana road. Both roads are in good condition and do not require any improvements. After the project completion any damages caused to the above two roads directly as a result of project based activities will be repaired by the project proponent.

B.6 Operational procedure including environmental flow to be maintained and justification of the down stream flow release below the dam

79. Any diversion or extraction of water away from the river should guarantee that the requirements (both social and ecological) of the downstream water users are not affected. The ancient irrigation diversion schemes like Minipe LB canal can now be considered as part of the natural drainage system due to its prolonged existence. The raisning of the anicut will reduce the spill over. However, it will not totally eleiminate spilling over the anicut as during the three hour power generation period there will be spilling for about 30 min. This will be in addition to the release of e-flow. Therefore, even though the river flow has been diverted there will be considerable flow in the river downstream of the diversion point due to other side streams joining the river after the diversion point and return flows from upstream irrigation systems and some spillage over the anicut and release of environmental flow (Figure 8).



Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Before Raising	4.92	4.41	3.59	2.01	1.21	0.55	0.44	0.54	1.02	0.65	1.69	4.48
After Raising With e-Flow	1.55	0.83	0.89	0.86	0.41	0.40	0.52	0.25	0.86	0.25	0.78	2.17

Figure 8. The annual flow pattern of water in the Mahaweli River downstream of the Minipe anicut, with and without the proposed raising of the Minipe Anicut. The with project scenario includes the release of environmental flow.

80. The environmental flow that will be released from the Minipe Anicut will be 8 m^3/sec and 16 m^3/sec during the cultivation and non cultivation season (30th January to 15th April and 25th August to 15th November) respectively. Further, the e-flow will be released for a period of 5 hours per day in two segments (2 hours from 1900 to 2100 and 3 hours from 0600 to 0900) to simulate the current flow regime of the river. The flow downstream of the Minipe Anicut s a regulated flow resulting mainly due to release of water after power generation from the Rantambe Power house.

81. In calculating the e-flow, flow duration curve based methods such as percentage probability flow methods cannot be used. Therefore, in determining the e-flow for the Minipe project the Tennant method[9] has been used where a flow of 20 to 40% of the Mean annual flow of the river has been recommended. As can be seen from figure 8 the e-flow along with spillages from Minipe anicut will ensure that at least 28% of the Mean Annual Flow of the river will be released into the river to meet the ecological demands of the river downstream of the Minipe Anicut. Further, a major tributary, (Badulu Oya) releases into Mahaweli River approximately 6.5 km downstream of the Minipe Anicut. However, stretch of the Mahaweli River downstream of the Minipe Anicut that will be subjected to low flows after completion of this project water quality parameters such pH, DO, turbidity and TSS should be monitored quarterly during the operational phase of the project and necessary changes to e-flow (by simulating a short period of spillage over the anicut to flush the area downstream) should be done if the said parametersdecrase below the levels that are necessary to support the ecological demands of the river.

82. Further, a short (0.5 m) weir will be constructed across the Mahaweli River downstream of the Minipe Anicut so that the e-flow released will be dispersed across the river bed to ensure that the wetted perimeter of the river shall not decrease drastically from its present day level. This will ensure that the aquatic vegetation present in the river will not decline in their distribution and deep pooles within the river that can support large fish species such as the Marsheer, are continuously refreshed and therefore the quantity and quality of water in such pools will not decline even with the increase in the divertion of water from the main river after completion of the Minipe raising.

B.7 Future additions, expansions envisaged

83. No future additions or expansions are planned for this project.

B.8 Proposed time schedule for construction

84. The project will require approximately three years to complete the construction activities. The construction schedule is given in Annex V.

[9] Tennant, D.L. (1976). "Instream flow regimens for fish, wildlife, recreation and related environmental resources." Fisheries 1(4): 6-10.

PART C. INFORMATION ON ENVIRONMENTAL ELEMENTS

85. **STUDY AREA:** The proposed project area is located in the Kandy, Nuwara Eliya, Pollonnaruwa and Badulla districts. For the purpose of this IEE report the study area has bee defined as the

- Area that will be inundated due to the raising of the sites where new construction activities will be undertaken
- The stretch of the Mahaweli river between the Minipe Anicut up to the confluence of the Badulu Oya that will be subjected low flows due to the raising of the Minipe Anicut
- The LB canal and its command area

C.1 Hydrology

i. Natural drainage system in the scheme, its functions and the associated flooding pattern

86. The Minipe Anicut is located in the intermediate zone of Sri Lanka. The average temperature is around 23.5^{0}C and average relative humidity is between 69% and 88% during day and night respectively. The predominant rain season in the project area occurs during the North East Monsoon. The upper catchment of the project area at Randenigala receives an average rainfall of 2300 mm. Randenigala reservoir receives inflows from its net catchment, power flow releases from Victoria and Uma Oya. The monthly inflow pattern of the Randenigala reservoir (Figure 9) assumes a bimodal distribution with peak inflows during July and December, which coincides with the South West and North East Monsoon respectively.

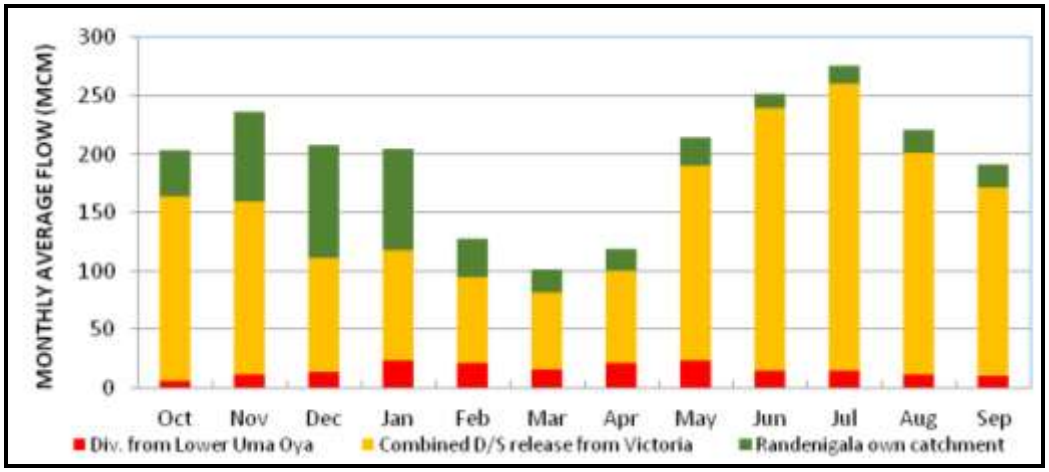


Figure 9. Monthly inflows at Randenigla Reservoir

87. Randenigala reservoir releases water mainly for power generation and in future for augmenting Kalu Ganga Reservoir via RKTC. The monthly outflow from the Randenigala reservoir is shown in Figure 10. Out of these the power release functions as the inflow to the Rantember reservoir located immediately upstream of the Minipe anicut

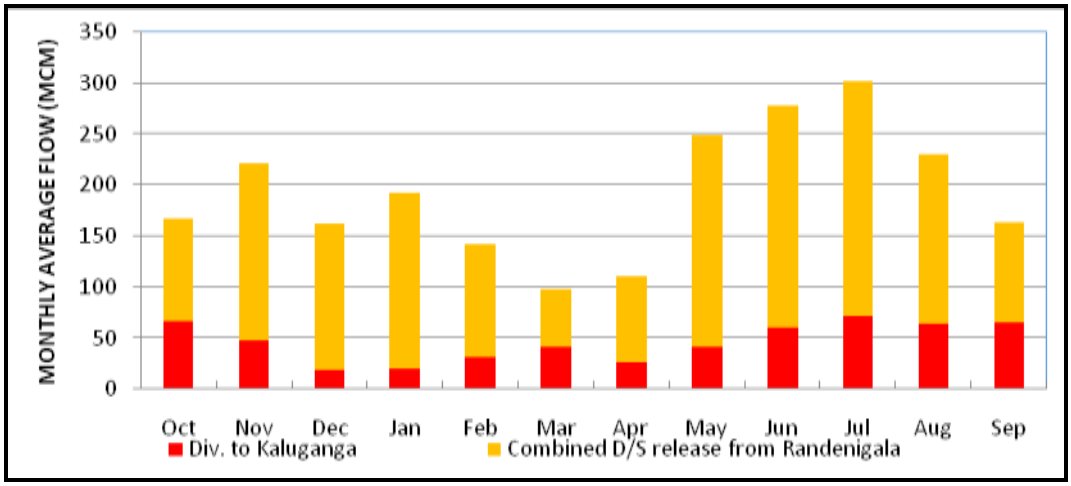


Figure 10. Monthly out flows from Randenigala reservoir

88. The catchment of the Minipe Pool between Rantambe dam and the Minipe Anicut is only 2.1 km^2 (210 ha.) and therefore inflows from the catchment to the Minipe Pool are insignificant. Therefore, the water released after power generation from the Rantambe Power House functions as the major inflow to the Minipe Pool. Further, any spillage from the Rantambe head pool also flows in to the Minipe Pool. The Rantambe power plant generates electricity to cater for the peak power demands, 3 hours between 1900 – 2200 hrs and 2 hours between 0600 – 0800 hrs. The Water level in the Minipe pool reaches the maximum level around 2200 hrs of the day, the time of the shutting down of the Rantambe power plant after supplying the 3 hour peak power demand in the evening. The pool will start lowering after 2200 hrs due to divertion of water to the LB and RB canals and overflow of the excess water over the Minipe Anicut. The pool will start rising again at 0600 hrs of the day with the start of the power generation for supplying the 2 hour peak demand in the morning. The pool level will come to a minimum level around 1800 hrs of the day.

89. Minipe Anicut is the second major diversion point of the Mahaweli Ganga Development Programme where water is diverted through the LB Canal to a command area with a total extent of 6107 ha and to Mahaweli Systems B & C through the RB transbasin canal. Minipe LB and RB canals have a design discharge of 22 m^3/s and 64 m^3/s respectively. The excess water, after diverting water to the Left and Right bank canals, overflow in to the Mahaweli River over the Minipe Anicut. Simulation results show that total spillage at Minipe Anicut is approximately 1,039 MCM (Figure 11).

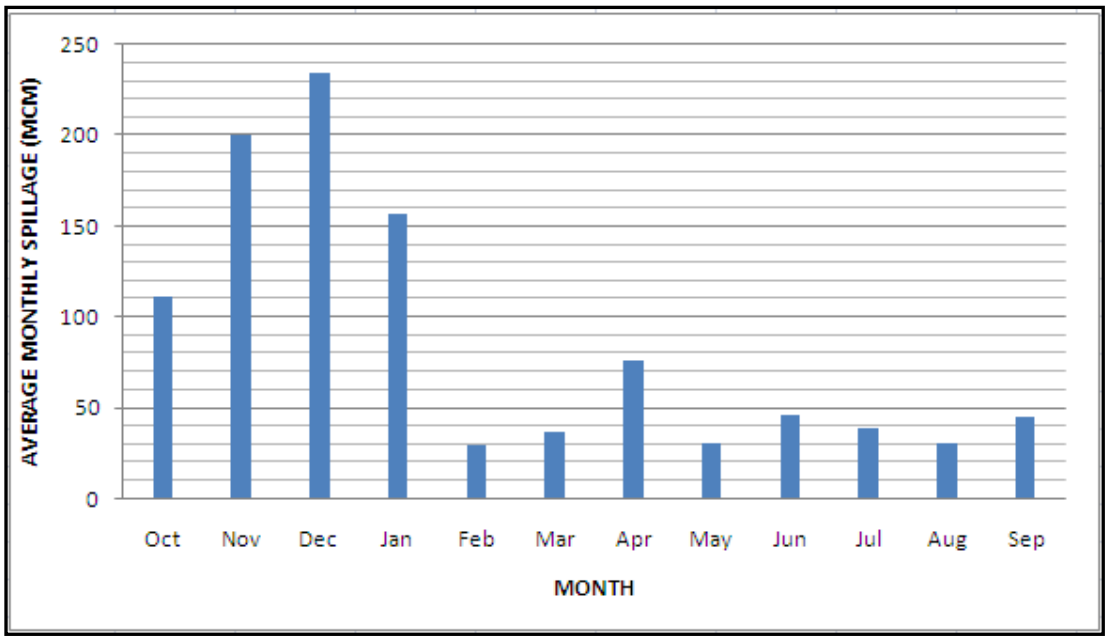
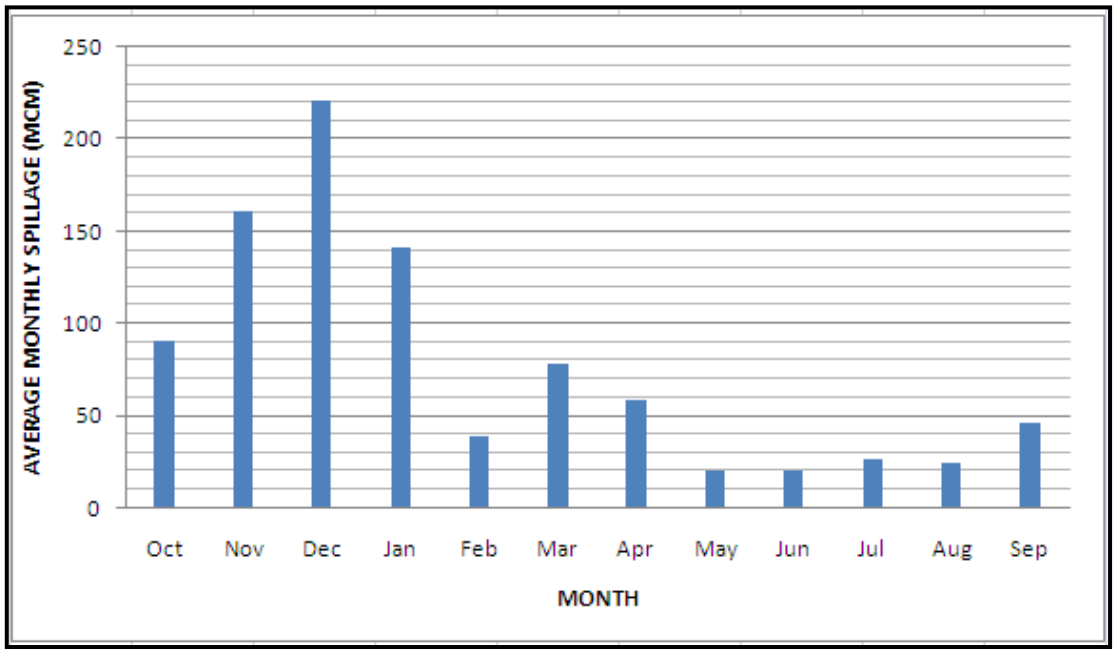


Figure 11. Monthly spillage at the Minipe Anicut at present

90. After implementation of the proposed Kaluganga / Moragahakanda diversion through the Randenigala-Kaluganga Transfer canal, the total spillage at the Minipe Anicut is expected to be reduced to 932 MCM (Figure 12).

Figure 12. Monthly spillage expected at the Minipe Anicut after the Kaluganga / Moragahakanda diversion.



91. Water spilling over Minipe anicut during peak power generation at Rantambe power house is shown in figure 13.

Figure 13. Spillage of water over the Minipe Anicut during the peak power generation period of the day at Rantambe power house.

ii. Water quality of the Minipe Pool and Minipe LB Canal

92. Previous observations have shown that a heavy sediment load comprising both coarse grained and fine grained material is deposited in the Minipe Pool. In addition, a large amount of sediment and pollutants flow into the LB canal from the immediate catchment, which results in heavy siltation of the main canal and growth of water weeds in the canal. This may also contribute to health problems as the water in the LB canal is used for both irrigation and domestic use. In this section results of a water quality study conducted by the Engineering Design Centre of the University of Peradeniya from May to December 2012 covering an entire irrigation cycle is presented. The water quality parameters are evaluated in reference to Sri Lanka Standards (SLS) as well as regional standards defined for Inland Water Quality for bathing, drinking and irrigation of agriculture.

93. In the Minipe LB canal, except at Hasalaka, color values are within the acceptable 100 PtCo units limit. Also the pH, EC, Fluoride, Hardness and Manganese contents are well within the required guideline standards. pH 7.14 to 8.54 is within the favorable margin for surface waters.

94. Except for a single EC reading 568µS/cm (at Hettipola), all other readings are well below 400µS/cm signifying low dissolved solids content in the canal. The high EC value at Hettipola may have resulted due to influx of domestic wastewater into the LB Canal. The Highest recorded values for Fluoride content 0.74 mg/l, Hardness 228 mg/l and Manganese 0.36 mg/l are well within the normal values specified for surface waters.

95. Suspended solids and turbidity show a high variation along the canal. Both of these parameters are strongly correlated with the soil erosion. High turbidity (116 NTU) and suspended solids (162 mg/l) values were observed during the rainy season spanning from

October to December indicating significant soil erosion in the area. Furthermore, high turbidity values were observed in the upstream section of the LB canal that indicates sediment loading to the canal via Mahaweli Waters. Except for environmental and esthetic concerns, no major health or agriculture impact is anticipated from high turbidity or suspended solids values.

96. High values were obtained for Aluminum concentrations at all the sampling points during the land preparation months of May to October. Use of rodenticide, insecticide and weedicide during land preparation is believed to be the main source for this high Aluminum levels observed. Highest Aluminum levels recorded at Hasalaka (0.74 mg/l) and Hettipola (0.62 mg/l), during May and October respectively, are good examples for this phenomenon. Even though these levels are very much below the permissible maximum 5.0 mg/l for irrigation purposes, it is higher than the permissible maximum for drinking water (0.2 mg/l). Though no proven human health impacts from consuming Aluminum rich waters are reported, it is always safe not to use this water for direct consumption as it is well above the ambient water quality guideline standards for human consumption.

97. Nitrate-Nitrogen (NO3--N) content of the LB canal (maximum 2.48 mg/l) is well within the maximum allowable level (5.0 mg/l). However, the Phosphates (as PO4--P) show significantly high peaks during the months of June and July in the upstream section of the canal. Phosphate levels of 6.8 mg/l at the Minipe Anicut and 5.3 mg/l at Mananna Oya confluence are much higher than the level recommended (0.7mg/l) for irrigation purposes. Therefore, water in the LB canal during the phosphate peak periods is not suitable for human use. The regional standards (in other South Asian ountries) however, do not consider phosphate as a deciding factor in determining the quality of irrigation waters. However, it should be noted that these nutrient concentrations are more than sufficient to promote weed growth and unless these incoming nutrient loads are reduced, controlling weed invasion downstream can be difficult. The observed high Phosphate peak may have resulted due to animal husbandry.

98. The BOD5 observed throughout the LB canal are below the recommended value of 5 mg/l. However, the coliform levels were much higher than the recommended SLS levels, indicating contamination with human waste. Therefore, the water in the LB canal is not suitable for recreational use or direct human use.

99. Therefore, in conclusion the Color, Phosphate, Aluminum and Coliform counts contributed by non-point soil erosion and surface runoff exceed the safety levels for bathing and drinking water during certain times of the year. However, in comparison to SLS standards and regional ambient water guidelines, the water in the LB canal is suitable for irrigation use.

100. Previous studies have shown that Rantambe reservoir has a high sediment trap efficiency and most of the sediment deposited in the Rantambe originates from Uma Oya catchment. Flushing of this sediment from Rantambe reservoir results in high sedimentation of the Minipe Pool. Raising of the Minipe anicut will further increase the sediment trap efficiency at the Minipe Anicut. At present the suspended sediment load entering the approach channel of LB Canal at Minipe appears to be relatively high due to high sediment inflow to Minipe pool discharging from Rantembe reservoir. Therefore, raising the Minipe anicut would contribute to a further increase in the sediment load of the Minipe LB canal. In addition to inflow of sediment from Minipe pool the LB canal also receive a high sediment load originating due to human activities taking place in the upper watershed of the canal. The study results show that the suspended sediment load gradually increases along the canal up to Heenganga and decreases thereafter, which confirms influx of sediment from the upper watershed.

iii. Existing Irrigation structures and their operation: The following major modifications have been proposed

101. **Main Anicut / Weir**

- The main anicut structure will be raised by 4 meters with an Ogee crest similar to earlier for better discharge. The length of the Ogee spilling section will be increased from 225 m to 373m converting the side retaining wall section of length 148 m to Ogee crested section.
- The manually operated LB sliding gated sluice structure will be converted to an electrically operated sliding gated sluice of different size. The operation of the proposed structure will be easy.
- The manually operated LB sliding gated (4 gates) silt excluder will be converted to an electrically operated sliding gated (2 gates) silt excluder. The sizes of the gates have been enlarged.
- No changes are proposed for the RB sluice other than raising of the protection walls above the high flood level
- No changes are proposed for the RB silt ejector.
- An electrically and remotely operated silt excluder has been introduced at the centre of the anicut. The location has been decided according to the results of the model study.

C.2 Geology and Soil types in the area

102. **Geomorphology of the Study Area:** The geomorphology of Sri Lanka is characterized by the presence of 3 distinct topographic levels (peneplains), namely Lowest, Middle and Highest Peneplains (Figure 14). The lowest peneplain surrounds the central Hill Country on all sides and it's almost flat, sometimes gently undulating, plain stretching down to the coast and elevation rises up to 30 m with isolated erosional remnants having elevations that rise up to 150 m above sea level. Rising from this inner edge in a steep step of about 270 m is the middle peneplain with a maximum elevation 910 m consisting of ridge and valley topography and highly dissected plateaus. Another steep step of 910 to 1200 m is the highest peneplain at the general level of 1500 m to 1900 m.

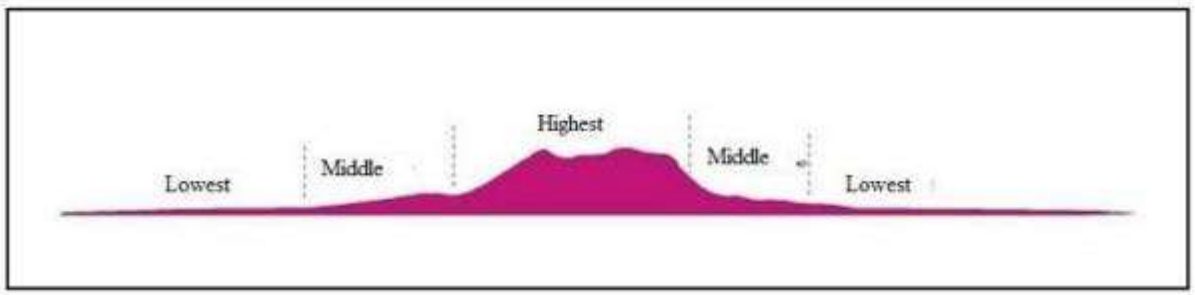


Figure 14. Cross section map showing the three main topographic levels of Sri Lanka**.**

103. The proposed project area is located in Kandy, Nuwara Eliya, Pollonaruwa and Badulla district in central hills coming down to low lying areas of the country. Topographically, the project site is located in the highest and middle peneplanes. Further, the mountainous area can be classified into hill area and around up to 1400 m in elevation and comprise of characteristically small rounded mountains that are dissected by shallow valleys. The river bed at the proposed dam site is at 108m MSL. The area is dominated by moderately high relief hill, ridges and valley systems.

104. Geotechnical investigations of the proposed project were carried out by the Geological Survey and Mines Bureau (GSMB). The investigations were mainly based on Core Drilling with water pressure test and engineering geological mapping. Following core drilling works were carried out with eight (08) holes including three (03) holes in the water pool one (01) hole in the downstream of the Mahaweli river and four (4) holes along the diversion canal (Minipe Left bank).

105. **Underling Geology and Setting**: Geologically Sri Lanka is an extension of the Indian Peninsula and forms part of the Indian shield, one of the oldest and most stable parts of the earth's crust. Ninety percent of the island is covered by high-grade metamorphic rocks in a Precambrian terrain. These rocks form three major litho tectonic units (Figure 15), namely, the Highland Complex (HC), the Vijayan Complex (VC), and the Wanni Complex (WC). Among these, the Highland Complex is the largest unit and forms the backbone of the Precambrian rocks of Sri Lanka. The balance comprises of Jurassic and Miocene sedimentary rocks (LC) in the coastal regions of northwestern to northern parts of the country and Quaternary sediments covering entire costal region of the country as a narrow strip.

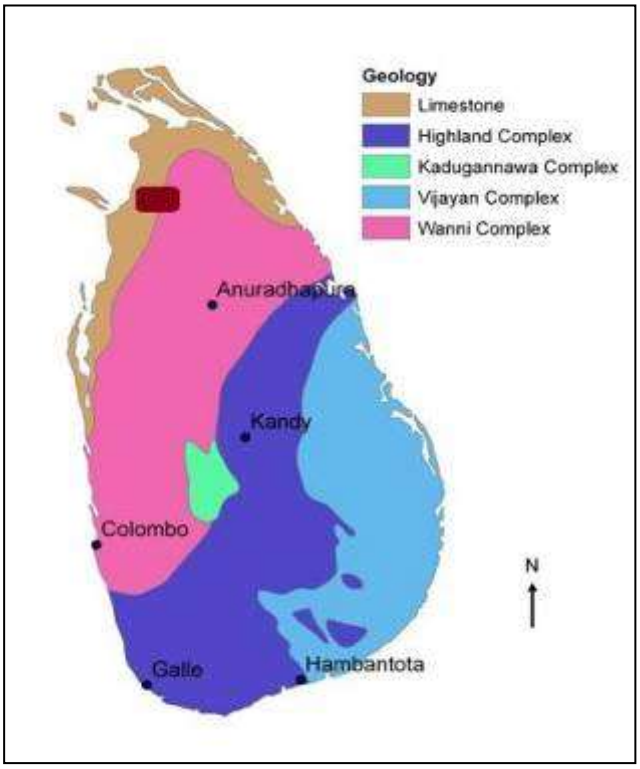


Figure 15. The geological map of Sri Lanka showing the major litho tectonic units

106. The rocks comprising the Highland Complex are mainly of granulites facies metamorphites, predominantly varieties of granulites including charnockites, quartz-feldspar garnet-sillimanite-graphite schist, quartzite, marbles, and calc-gneisses. The Vijayan Complex, lying to the east of the central Highland Complex consists of biotite-hornblende

gneisses and scattered bands of metasediments and charnockitic gneisses. Among the other prominent geological features of the Vijayan Complex are the small plutons of granites and acid charnockites near the east coast and the north-west-trending suite of dolerite dikes.

107. The Wanni Complex consists of a suite of granitoid gneisses, charnockitic gneisses, and granites, along with a variety of amphibolite- to granulite facies rocks such as metasediments of predominantly pelitic (sedimentary rock) to semipelitic composition.

108. The project area comes within the highland complex and the main irrigation channel passes through the same geological formation.

109. **Detailed Geology of the Dam Site and Foundation Conditions:** The Minipe Anicut lies within the eastern arm of large Rantambe syncline. The project site lies within the Highland Complex and consists of granulite facies metasediments, Quartz- Feldspathic and charnockitic gneisses. The distribution of the rock types is shown in the geological map (Figure 16). The dominant rock types within the Anicut location is Garnet biotite gneiss and quartz feldsphathic gneiss. Quartz, feldspar and biotite are the main mineral constituents while pyroxene and garnet are present in accessory amounts. Mostly fresh exposures can be found on the river bed.

110. The rocks strike in North West direction with dip angle varying from 25^0 to 40^0. Prominent joints found along the East – West direction are vertical. Majority of the joints are vertical and no significant weathering or infillings along joint planes are noted. Drill holes logs reviewed along the dam axis underlain by solid bed rock with different mineralogical formation. Rock bands show a general strike trend of EW and a dip angle varying from 25^0 to 40^0 towards N-W. Drilling crew noted where the bedrock is exposed below the Minipe Anicut that there are three (03) sets of joints in the rock mass. They are:

1) Foliation Joints.
2) Two (02) sets of Axial Joints intersecting each other at 120 to 140 degrees.

111. They also noted Axial Joints are moderate to deep weathering and many of the joints are filled with chlorite, kaolin and gouge. Also, many joint planes show pyrite formation. The joints are well opened joints, moderately open joints and closed joints could be observed in the core samples. Water seepages could be observed downstream of the Anicut due to the three intersecting sets of joints.

112. Water pressure test (Lugeon test) of DH -1, 2, 5 and 6 reflected some problematic foundation conditions are available due to above mentioned fractures and joint types. Hence, grouting will be necessary to control the expected seepage losses. For the well developed foundations, multiple line grout curtain is recommended at the middle of Anicut foundation and it is necessary to reach fresh rock layer in order to improve the mechanical properties and lowering permeability of the rock masses and it has to be verified with permeability tests. However, for treatment measures to be effective, a thorough understanding of the site conditions is essential.

113. The present geological observations made in the area around the proposed Anicut Location of the Minipe Rising project reveals that highly favorable geological conditions prevail in the area for implementation of a project of this nature. Presence of fresh solid bed rock along almost entire length of the Anicut axis appear to be a very promising and unique condition at this site.

114. Although the abutment slopes are often covered with a thin mantle of mixed residual and colluvial type of soils. Presence of solid bed rock is evident at shallow depths. This condition minimizes the potential of reservoir-induced earth slips along the periphery upon impoundment.

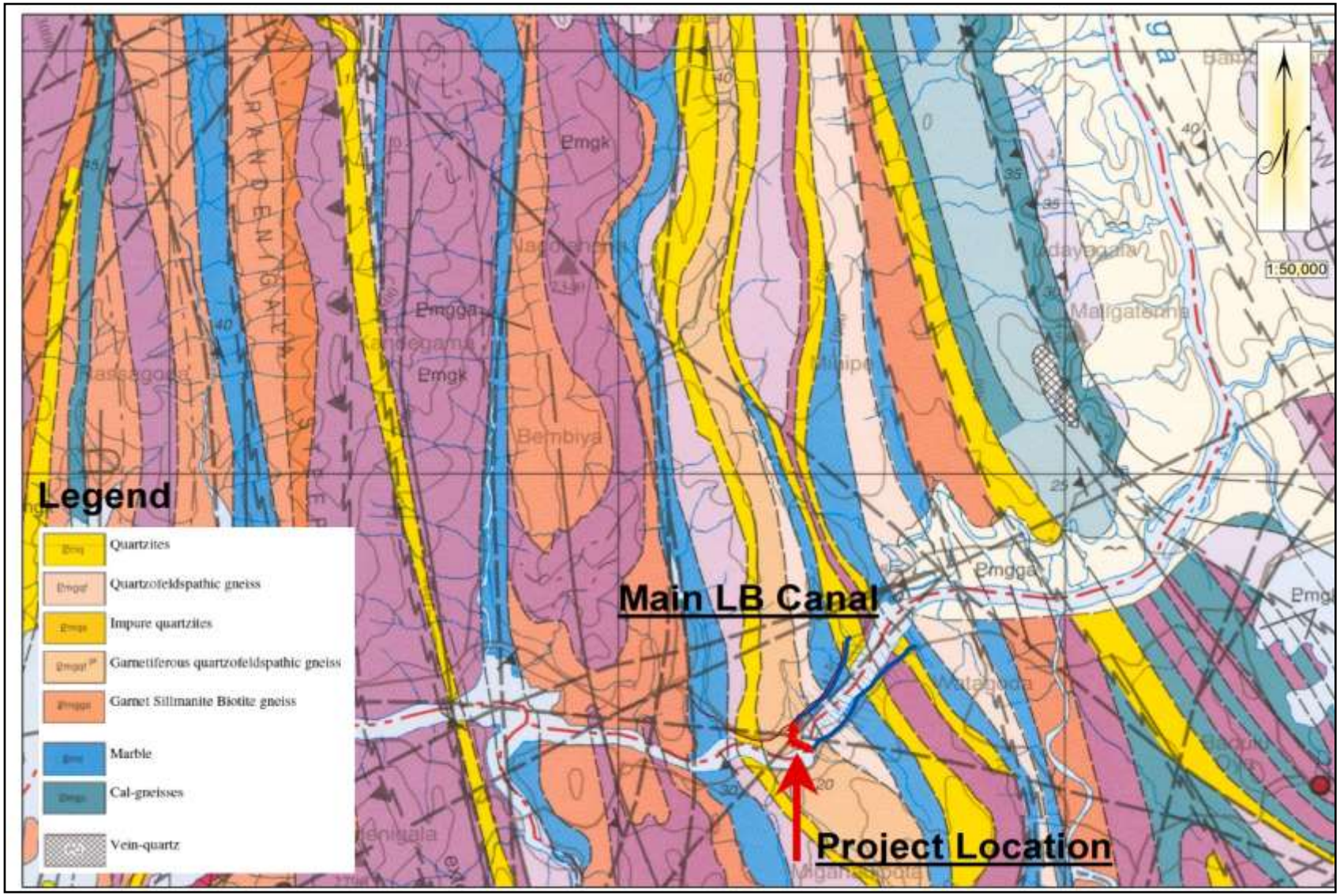


Figure 16. Generalized surface geology map of the project area

C.3 Land use patterns

115. The land use patterns observed in the project impacted area includes semi evergreen forest, river associated vegetation and scrublands. (Figure 17).

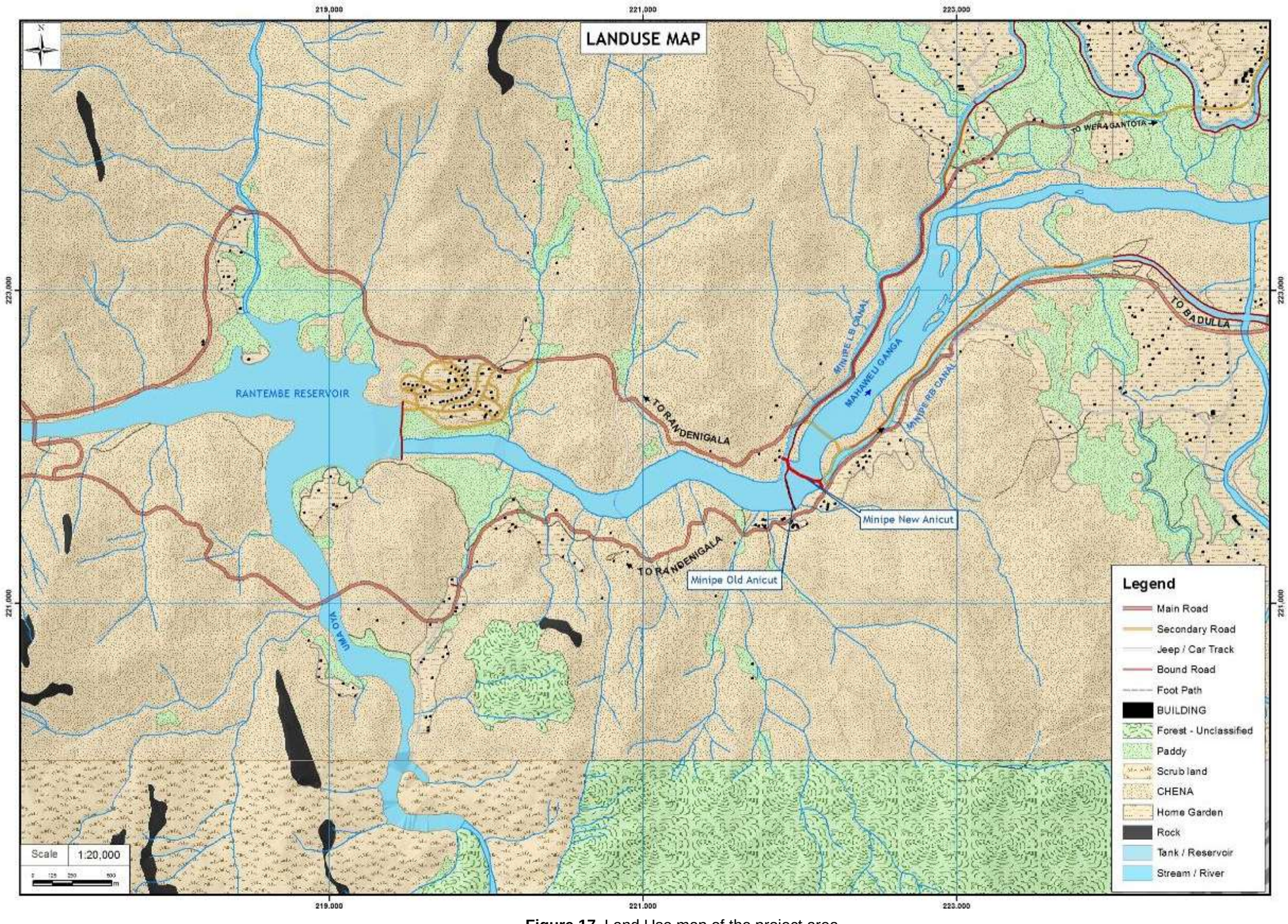


Figure 17. Land Use map of the project area

C.4 Biological Environment

116. Biogeographically, the proposed project area lies within the Intermediate Zone. Floristically it comes under the Eastern Intermediate Lowlands Floristic Zone. Tropical Moist Semi-evergreen Forests and Savannah Forests are the typical natural vegetation formations present in the Eastern Intermediate Lowlands Floristic Zone. However, no savannah forests exist in the area identified for the proposed project and only tropical moist semi-evergreen forests can be seen in the area. The river (Mahaweli River) and its associated forest vegetation (tropical moist semi-evergreen forests) are the only natural habitats observed in the proposed project area.

i. Status of the aquatic and terrestrial eco-systems present

The vegetation observed downstream of the dam

117. Aquatic and semi-aquatic plant species, *Cryptocoryne beckettii* (Athiudayan), *Cryptocoryne parva*, *Lagenandra praetermissa* (Ketala), *Colocasia esculenta* (Gahala), *Crinum defixum* (Heen Tolabo), *Cyperus aromaticus*, *Cyperus* spp., *Fimbristylis* spp., *Ludwigia decurrens*, *Ludwigia perennis*, *Ludwigia peruviana*, *Coix gigantea* (Heen Kirindi) are the plant species observed in the river associated vegetation. *Terminalia arjuna* (Kumbuk), *Pongamia pinnata* (Magul Karanda), *Ficus racemosa* (Attikka), *Nauclea orientalis* (Bakmi), *Ixora coccinea* (Ratambala), *Hydnocarpus venenata* (Makulu), *Polyalthia longifolia* (Owila), *Dillenia indica* (Hondapara), *Diospyros malabarica* (Timbiri), *Mangifera zeylanica* (Etamba), *Madhuca longifolia* (Mi), *Pandanus ceylanicus* (Dunu Keyya), *Phyllanthus myrtifolius*, *Cynometra zeylanica*, *Entada pusaetha* (Pus Wel), *Garcinia spicata* (Ela Gokatu), *Acacia caesia* (Hinguru Wel), *Phyllanthus reticulatus* (Kaila), *Horsfieldia iryaghedhi* (Ruk Gedhi), *Syzygium zeylanicum* var. *lineare* and *Syzygium cumini* (Madan) were the commonly encountered rhiophytes in the downstream area. *Dimorphocalyx glabellus* (Weli Wenna), *Combretum albidum* (Kaduru Ketiya Wel), *Derris parviflora* (Kala Wel), *Margaritaria indicus* (Karavu), *Semecarpus nigro-viridis* (Badulla), *Polyalthia korinti* (Ul Kenda), *Piper sylvestre* (Wal Gam Miris Wel), *Ventilago madraspatana* (Yakada Wel), *Cleistanthus pallidus*, *Croton aromaticus* (Wel Keppetiya), *Berrya cordifolia* (Hal Milla), *Ardisia missionis*, *Streblus taxoides* (Gon Gotu), *Pothos scandens* (Pota Wel), *Miliusa indica* (Kekili Messa), *Murraya paniculata*

(Etteriya), *Pterospermum suberifolium* (Welan), *Uvaria sphenocarpa*, *Cipadessa baccifera* (Hal Bebiya), *Vitex altissima* (Milla), *Discospermum sphaerocarpum*, *Lepisanthes senegalensis* (Gal Kuma), *Nothopegia beddomei* (Bala), *Lepisanthes tetraphylla* (Dambu), *Helicteres isora* (Lihiniya), *Anodendron paniculatum* (As Wel), *Anamirta cocculus* (Titta Wel), *Mitragyna parvifolia* (Helamba) and *Holoptelea integrifolia* (Goda Kirilla) were the other commonly observed plant species in the riverside vegetation. The detailed list of plant species recorded in the area downstream of the Minipe Anicut is listed in annex V (Table 2).

Figure 18. Endemic and Endangered plant species *Cryptocoryne parva*

Figure 19. Endemic and Vulnerable plant species *Cryptocoryne beckettii*

Figure 20: The habitat of the observed Endangered and Vulnerable Aquatic Plant Species around the Minipe Anciut

118. The most number of endemic (14) and Threatened (11) species were recorded in the river associated vegetation observed downstream of the Minipe anicut (see table 5 for detailed list). Out of the 14 species of endemic plants observed one species listed as an Endangered (EN), five species listed as Vulnerable (VU), one species listed as a Near Threatened (NT) and the remaining seven species are listed as Least Concern (LC) (MOE,

2012). In addition to these endemic species, five species of native plants listed as Vulnerable and eight species listed as Near Threatened were also observed in this habitat. Most of the threatened and endemic species were recorded in the small stream that flows along the left bank of the main river that originates at the LB end of the Minipe Anicut. Therefore, it has been proposed to release part of the e-flow in to this natural stream that supports a rich aquatic vegetation.

Vegetation in the Inundation area

119. Aquatic and semi-aquatic plant species, *Cryptocoryne beckettii* (Athiudayan), *Colocasia esculenta* (Gahala), *Crinum defixum* (Heen Tolabo), *Cyperus aromaticus*, *Cyperus* spp., *Fimbristylis* spp., *Lindernia antipoda* (Wila), *Ludwigia decurrens*, *Ludwigia perennis*, *Ludwigia peruviana* are the aquatic plant species observed in the river.

120. *Terminalia arjuna* (Kumbuk), *Pongamia pinnata* (Magul Karanda), *Ficus racemosa* (Attikka), *Nauclea orientalis* (Bakmi), *Ixora coccinea* (Ratambala), *Hydnocarpus venenata* (Makulu), *Polyalthia longifolia* (Owila), *Dillenia indica* (Hondapara), *Diospyros malabarica* (Timbiri), *Madhuca longifolia* (Mi), *Phyllanthus myrtifolius*, *Cynometra zeylanica*, *Entada pusaetha* (Pus Wel), *Garcinia spicata* (Ela Gokatu), *Phyllanthus reticulatus* (Kaila), *Syzygium zeylanicum* var. *lineare*, *Mesua ferrea* (Na), *Syzygium cumini* (Madan) are the plant species observed in the riversde vegetation.

121. *Dimorphocalyx glabellus* (Weli Wenna), *Combretum albidum* (Kaduru Ketiya Wel), *Derris parviflora* (Kala Wel), *Margaritaria indicus* (Karavu), *Polyalthia korinti* (Ul Kenda), *Piper sylvestre* (Wal Gam Miris Wel), *Ventilago madraspatana* (Yakada Wel), *Cleistanthus pallidus*, *Croton aromaticus* (Wel Keppetiya), *Berrya cordifolia* (Hal Milla), *Streblus taxoides* (Gon Gotu), *Pothos scandens* (Pota Wel), *Miliusa indica* (Kekili Messa), *Murraya paniculata* (Etteriya), *Pterospermum suberifolium* (Welan), *Uvaria sphenocarpa*, *Cipadessa baccifera*

(Hal Bebiya), *Vitex altissima* (Milla), *Discospermum sphaerocarpum*, *Lepisanthes senegalensis* (Gal Kuma), *Nothopegia beddomei* (Bala), *Lepisanthes tetraphylla* (Dambu), *Helicteres isora* (Lihiniya), *Alangium salviifolium* (Ruk Anguna), *Stereospermum colais* (Dunu madala), *Diospyros ovalifolia* (Kunumella), *Drypetes sepiaria* (Weera), *Macaranga peltata* (Kenda), *Mallotus rhamnifolius* (Molabe), *Phyllanthus polyphyllus* (Kuratiya), *Bauhinia racemosa* (Maila), *Hiptage benghalensis* (Puwak Gediya Wel), *Aglaia elaeagnoidea*, *Anamirta cocculus* (Titta Wel), *Syzygium cumini* (Madan), *Haldina cordifolia* (Kolon), *Mitragyna parvifolia* (Helamba), *Mussaenda frondosa* (Mussenda), *Psydrax dicoccos* (Panduru), *Dimocarpus longan* (Mora), *Grewia helicterifolia* (Bora Daminiya), *Holoptelea integrifolia* (Goda Kirilla) are the other plant species observed in the riverside vegetation. The detailed list of plant species recorded in the inundation area is listed in annex V (Table 2).

122. Altogether eight endemic plant species, two nationally endangered (EN) plant species, eight nationally vulnerable (VU) plant species (including three endemics) and ten nationally near threatened (NT) plant species (including one endemic) were recorded in the inundation area (see table 5 for the detailed list).

Vegetation associated with the LB Canal

123. *Blyxa* sp. (Diya Hawari), *Nympoides indica* (Kumudu), *Nymphaea pubescens* (Olu), *Ipomoea aquatica* (Kan Kun), *Eichhornia crassipes* (Japan Jabara), *Potamogeton nodosus*, *Salvinia molesta* (Salvinia), *Ottelia alismoides*, *Cyperus* spp., *Fimbristylis* spp., *Colocasia esculenta* (Gahala), *Crinum defixum* (Heen Tolabo), *Actinoscirpus grossus*, *Persicaria glabra*, *Ludwigia perennis* (Piduruwella), *Lasia spinosa* (Kohila), *Persicaria attenuata* (Sudu Kimbul Wenna), *Ludwigia peruviana*, *Limnocharis flava*, *Coix gigantea* (Heen Kirindi), *Saccharum spontaneum* (Wal Uk), *Pandanus ceylanicus* (Weta Keyiya), *Pandanus kaida* (Weta Keyiya), *Terminalia arjuna* (Kumbuk), *Pongamia pinnata* (Magul Karanda), *Ficus racemosa* (Attikka), *Erythrina fusca* (Yak Erabadu), *Nauclea orientalis* (Bakmi), *Phyllanthus reticulatus* (Kaila), *Sapium indicum* (Kiri Makulu), *Syzygium cumini* (Madan), *Bambusa*

vulgaris (Kaha Una), *Bambusa* sp. (Una), *Madhuca longifolia* (Mi), *Hibiscus tiliaceus* (Beli Patta) were the commonly occuring aquatic, semi aquatic and riverine plant species observed in and along the LB canal.

124. *Berrya cordifolia* (Hal Milla), *Pterospermum suberifolium* (Welan), *Vitex altissima* (Milla), *Lepisanthes tetraphylla* (Dambu), *Stereospermum colais* (Dunu madala), *Hiptage benghalensis* (Puwak Gediya Wel), *Haldina cordifolia* (Kolon), *Mitragyna parvifolia* (Helamba), *Ventilago madraspatana* (Yakada Wel), *Holoptelea integrifolia* (Goda Kirilla), *Cipadessa baccifera* (Hal Bebiya), *Trema orientalis* (Gadumba), *Schleichera oleosa* (Koon), *Morinda coreia* (Ahu), *Panicum maximum* (Rata Tana), *Azadirachta indica* (Kohomba), *Imperata cylindrica* (Illuk), *Ficus* sp. (Nuga), *Ficus microcarpa*, *Ficus hispida* (Kota Dimbula), *Hibiscus vitifolius* (Maha Epala), *Careya arborea* (Kahata), *Samanea saman* (Para Mara), *Peltophorum pterocarpum*, *Bauhinia racemosa* (Maila), *Flueggea leucopyrus* (Heen Katu Pila), *Croton aromaticus* (Wel Keppetiya), *Bridelia retusa* (Ketakala), *Merremia umbellata* (Kiri Madu), *Alstonia scholaris* (Ruk Attana) were the other commonly occuring plant species observed in the vegetation associated with LB canal. A detailed list of plant species recorded in canal and canal associated vegetation is given in Annex V (Table 2). Three endemic plant species, six plant species listed as Vulnerable (including one endemic) and five plant species listed as Near threatened (NT) were recorded in the canal and the canal associated vegetation (see table 5 for the detailed list).

Vegetation observed in and around the water bodies associated with the LB canal

125. Several water bodies are connected to the LB canal. Some of these have resulted due to extension of the main canal in to low lying areas and some of these have resulted due to construction of a dam or weir across a natural stream or river that joins the LB canal (small reservoir). Floristically, vegetation found in and associated with such water bodies are similar to the vegetation observed in and along the LB canal. A detailed list of the plant species recorded in and associated with water bodies is listed in Annex V (Table 2).

126. Three endemic plant species, three nationally vulnerable (VU) plant species, four nationally near threatened (NT) plant species ware recorded in water bodies and its associate vegetation during field ecological study (see table 5 for the detailed list).

Vegetation associated with Rivers and Streams

127. Few rivers and streams flow across the LB canal. Some of these rivers and streams flow under the LB canal via aqua ducts without releasing in to the LB canal. However, some rivers and streams cross the main canal as level crossings forming small reservoirs. In such cases a small dam or weir is built across the river or stream. Water to the downstream area of such a river or stream is regulated by gates built into the dam or weir. A detailed list of the plant species recorded in rivers, streams and associated vegetation is given in Annex V (Table 2).

128. Seven endemic plant species, five nationally vulnerable (VU) plant species including four endemics and seven nationally near threatened (NT) plant species ware recorded in rivers, streams and its associate vegetation (see table 5 for the detailed list).

129. **Home Gardens and Agriculture Lands:** Home gardens and agriculture lands are the most dominant land use type observed in the command area of the LB canal. Home gardens in the area are floristically rich and a wide variety of plant species were recorded in home gardens. *Cocos nucifera* (Pol), *Musa x paradisiaca* (Kesel), *Mangifera indica* (Amba), *Azadirachta indica* (Kohomba), *Leucaena leucocephala* (Ipil Ipil), *Areca catechu* (Puwak), *Artocarpus heterophyllus* (Kos) are some of the common plant species observed in home gardens. A detailed list of the plant species recorded in home gardens and agriculture lands is given in Annex V (Table 2). One endemic plant species and one nationally Vulnerable were recorded in home gardens (see table 5 for the detailed list).

130**. Flora of the Project Area:** A total of 240 plant species including seventeen endemic, seventeen nationally threatened and sixteen nationally near threatened (NT) plant species were recorded during the field study within the project impacted area (Table 4). Majority of the plant species recorded are trees (109) followed by herbaceous species (61), shrubs (34), climbers or creepers (33) and epiphytes (3) (Table 4). Further, about 26 % of the recoded plant species are exotic to the country and about 67% of the recorded flora is natives. None of the recorded plant species are unique or restricted to the project area. A detailed list of plant species recorded in the project affected area is given in Annex V (Table 2).

Table 4. Summary of the plant species recorded during the study

Plant Type	Total Species	Threatened and Near Threatened			Endemic	Native	Exotic
		EN	VU	NT			
Tree	109	1	7 (1)	10 (2)	8	74	27
Shrub	34	0	3 (2)	2	2	24	8
Herb	61	1 (1)	2 (2)	2	4	38	19
Epiphyte	3	0	1	0	0	3	0
Climbers or Creepers	33	1	1	2	3	22	8
Total	**240**	**3 (1)**	**14 (5)**	**16 (2)**	**17**	**161**	**62**
%		**1%**	**6%**	**7%**	**7%**	**67%**	**26%**

Abbreviations used: EN - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, No. of Endemic Plant Species Listed within the Bracket

131**. Endemic and threatened Plant species:** Out of the 240 plant species recorded seventeen are endemic to Sri Lanka. The plant species recorded included seventeen species that are listed as nationally threatened and sixteen species listed as nationally near threatened (NT) (MOE, 2012). Of the recorded seventeen nationally threatened plant species, six species are endemic to Sri Lanka. Of the recorded sixteen nationally Near Threatened (NT) plant species, two species are endemic to Sri Lanka. Highest numbers of endemic and threatened species were recorded in the area downstream of the Minipe anicut followed bythe inundation area, habitats associated with Minipe LB canal.

Table 5. Threatened and endemic plant species recorded in the project impacted area

Family	Scientific name	HA	TS	NCS	IA	DA	CA	WNP
Acanthaceae	*Rhinacanthus flavovirens*	H	E	VU	+	+	$+^{RS}$	
Alangiaceae	*Alangium salviifolium*	S	N	NT	+			
Anacardiaceae	*Mangifera zeylanica*	T	E	LC		+		

Anacardiaceae	*Semecarpus nigro-viridis*	T	E	LC		+	+[RS]	
Annonaceae	*Uvaria sphenocarpa*	C	E	LC	+	+		
Apocynaceae	*Anodendron paniculatum*	C	N	VU		+		
Araceae	*Cryptocoryne beckettii*	H	E	VU	+	+	+[RS]	
Araceae	*Cryptocoryne parva*	H	E	EN		+		
Araceae	*Lagenandra praetermissa*	H	E	LC		+	+[RS]	
Asteraceae	*Vernonia zeylanica*	C	E	LC			+[LC, WB]	
Clusiaceae	*Garcinia spicata*	T	N	NT	+	+	+[RS]	
Combretaceae	*Combretum albidum*	C	N	NT	+	+	+[RS]	
Dracaenaceae	*Sansevieria zeylanica*	H	N	NT	+			
Ebenaceae	*Diospyros ebenum*	T	N	EN	+			
Euphorbiaceae	*Cleistanthus pallidus*	T	E	LC	+	+		
Euphorbiaceae	*Drypetes gardneri*	T	E	NT				+
Euphorbiaceae	*Homonoia riparia*	S	N	NT			+[RS]	
Euphorbiaceae	*Margaritaria indicus*	T	N	VU	+	+	+[LC, WB, RS]	
Euphorbiaceae	*Phyllanthus myrtifolius*	S	E	VU	+	+		
Euphorbiaceae	*Sapium indicum*	T	N	VU			+[LC]	
Fabaceae	*Cynometra zeylanica*	T	E	NT	+	+		
Fabaceae	*Derris parviflora*	C	E	LC	+	+	+[LC, WB]	+
Fabaceae	*Erythrina fusca*	T	N	NT			+[LC, WB]	
Flacourtiaceae	*Hydnocarpus venenata*	T	E	LC	+	+	+[WB, RS]	
Hippocrateaceae	*Salacia reticulate*	C	N	EN	+			
Lauraceae	*Alseodaphne semecarpifolia*	T	N	VU	+			+
Loganiaceae	*Strychnos nux-vomica*	T	N	VU				+
Loganiaceae	*Strychnos potatorum*	T	N	VU	+	+	+[LC]	
Meliaceae	*Dysoxylum ficiforme*	T	N	NT			+[RS]	
Moraceae	*Artocarpus nobilis*	T	E	LC			+[HG]	
Myristicaceae	*Horsfieldia iryaghedhi*	T	E	VU		+	+[RS]	
Myrtaceae	*Syzygium zeylanicum var. lineare*	S	N	VU	+	+		
Nyctaginaceae	*Pisonia aculeate*	C	N	NT			+[RS]	
Orchidaceae	*Vanda tessellata*	EP	N	VU			+[LC, WB]	
Pandanaceae	*Pandanus ceylanicus*	S	E	VU		+	+[LC, RS]	
Poaceae	*Coix gigantean*	H	N	NT		+	+[LC]	
Rhizophoraceae	*Carallia brachiata*	T	N	NT		+		
Rutaceae	*Chloroxylon swietenia*	T	N	VU	+	+	+[LC, WB, HG]	+
Sapotaceae	*Madhuca longifolia*	T	N	NT	+	+	+[LC, WB, RS]	
Sterculiaceae	*Helicteres isora*	T	N	NT	+	+	+[RS]	
Ulmaceae	*Holoptelea integrifolia*	T	N	NT	+	+	+[LC, WB]	
Verbenaceae	*Vitex altissima*	T	N	NT	+	+	+[LC, WB]	

Abbreviations used: HA - Habit, **T** - Tree, **C** - Climber, **S** - Shrub, **Ep** - Epiphyte, **TS** - Taxonomic Status, **E** - Endemic, **N** - Native, **NCS** - National Conservation Status, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, **LC** - Least Concern, **IA** - Inundation Area of the Minipe Pool, **DA** - Downstream Area of the Minipe Anicut, **CA** - Minipe LB Canal, (**LC** - Left Bank Canal and Associated Vegetation, **WB** - Vegetation Assocaited with Water bodies, **RS** - Vegetation associated with rivers and streams, **HG** - Vegetation associated with Home Gardens), **WNP** - Area inside Wasgomuwa National Park.

132. **Fauna of the project area:** Total number of 147 faunal species was recorded in the project area representing butterflies, dragonflies, freshwater fish, reptiles, birds and mammals (Table 6). This included 14 species that are endemic to Sri Lanka. Further, the faunal assemblage included seven and three species listed as Nationally and Globally Threatened respectively (MOE, 2012; IUCN 2013). The faunal assemblage recorded in the project area also included one migrant bird species.

Table 6. Summary information of the fauna observed during the survey.

Taxonomic Group	Total	Endemic	Migrant	Exotic	CR	EN	VU	NT
Dragon flies	18	3					4	1
Butterflies	35	2					1	1
Freshwater Fish	10	2		1		(1)	1	2
Amphibians	5							
Reptiles	5							
Birds	64	6	1					1 (3)
Mammals	10	1				1 (2)		(1)
Total	**147**	**14**	**1**	**1**	**0**	**1 (3)**	**6**	**5 (4)**

Abbreviations used: **CR** - Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, numbers within parenthesis indicates global conservation status

133. **Dragonflies:** Total number of 18 species of dragonflies and damselflies were recorded including three species that are endemic to Sri Lanka. All of these species are common species encountered in man modified habitats. These dragonflies were recorded mostly in association of the river and streams. Four out of the 18 species are listed as Nationally Vulnerable and one species as Nationally Near Threatened.

134. **Butterflies**: Total numbers of 35 butterfly species including two endemic species were recorded. This included one species listed as Nationally threatened and one species listed as nationally near Threatened.

135. **Freshwater fish:** Altogether 10 species of freshwater fish were recorded from the project impacted area. This included two species that are endemic to Sri Lanka, one species listed as a Nationally Vulnerable, one species listed as Globally Endangered and two species listed as Nationally near Threatened. None of these species are restricted to the project area.

136. **Amphibians:** Altogether five species of amphibians were recorded from the project impacted area. None of these species are endemic to Sri Lanka or listed as threatened species. Both species are commonly occurring species in human dominated landscapes.

137. **Reptiles:** Altogether five species of reptiles were recorded from the project impacted area. None of these species are endemic to Sri Lanka or listed as threatened species. Both species are commonly occurring species in human dominated landscapes.

138. **Birds:** A total number of 64 bird species was recorded. This included six endemic species. None of the species observed at the site is listed as threatened species. One species and three species listed respectively as Nationally and Globally Near Threatened were recorded.

139. **Mammals:** A total number of ten mammal species including one endemic species were recorded. One of the mammal species observed (*Elephas maximus*, Elephant; Aliya) is listed as Nationally and Globally Endangered (MOE, 2012; IUCN, 2012).

140. **Endemic and threatened fauna**: None of the faunal species observed in the project affected area can be listed as rare species. The fauna recorded included 14 species that are endemic to Sri Lanka (Table 7). All the endemic species observed in the project affected area are common species showing a wide distribution in Sri Lanka. None of the endemic species observed are restricted to the study area. None of these endemic species will be significantly affected by the project as only a small proportion of their population occur in the area that will be directly impacted by the proposed project.

141. The faunal assemblage recorded in the study area included one Nationally Endangered, two Globally Endangered, six Nationally Vulnerable, five Nationally Near Threatened and four Globally Near Threatened species. As in the case of endemic species number of threatened species was also found to be low in the immediate impact zone. Some

of the mammal species such as wild boar (*Sus scrofa*) is consumed by the villagers as a source of food.

Table 7. Endemic and Threatened animal species observed

Family	Scientific Name	Common Name	TS	NCS	GCS	MA	LBC
Aeshnidae	*Anax immaculifrons*	Fiery Emperor	Na	VU	LC	+	
Cholorocyphidae	*Libellago adami*	Adam's Gem	En	VU	NE	+	+
Gomphidae	*Ictinogomphus rapax*	Rapacious Flangetail	En	LC	LC	+	
Libellulidae	*Orthetrum pruinosum*	Pink Skimmer	Na	NT	LC	+	
Libellulidae	*Trithemis festiva*	Indigo Dropwing	Na	VU	LC	+	
Protoneuridae	*Elattoneura centralis*	Dark-glittering Threadtail	En	VU	NE	+	+
Nymphalidae	*Pantoporia hordonia*	Common lasker	Na	NT	NE	+	
Papilionidae	*Papilio crino*	Banded peacock	Na	VU	NE		+
Papilionidae	*Troides darsius*	Ceylon birdwing	En	LC	NE	+	
Pieridae	*Appias galane*	Lesser albatross	En	LC	NE		+
Belontiidae	*Belontia signata*	Combtail	En	NT	LR:cd	+	
Cyprinidae	*Garra ceylonensis*	Stone sucker	En	VU	NE	+	+
Cyprinidae	*Tor khudree*	Mahseer	Na	NT	EN	+	
Bucerotidae	*Anthracoceros coronatus*	Malabar Pied Hornbill	Na	LC	NT		+
Bucerotidae	*Ocyceros gingalensis*	Sri Lanka Grey Hornbill	En	LC	LC	+	
Campephagidae	*Tephrodornis pondicerianus*	Common Woodshrike	En	LC	LC	+	+
Ciconiidae	*Ciconia episcopus*	Woolly-necked Stork	Na	NT	LC		+
Hirundinidae	*Hirundo daurica*	Red-rumped Swallow	En	LC	LC		+
Pelecanidae	*Pelecanus philippensis*	Spot-billed Pelican	Na	LC	NT		+
Phasianidae	*Gallus lafayetii*	Sri Lanka Junglefowl	En	LC	LC	+	+
Psittacidae	*Loriculus beryllinus*	Sri Lanka Hanging Parakeet	En	LC	LC		+
Threskiornithidae	*Threskiornis melanocephalus*	Black-headed Ibis	Na	LC	NT		+
Timalidae	*Pellorneum fuscocapillum*	Sri Lanka Brown-capped Babbler	En	LC	LC	+	
Cercopithecidae	*Macaca sinica*	Sri Lanka toque monkey	En	LC	EN	+	+
Cercopithecidae	*Semnopithecus priam*	Grey langur	Na	LC	NT	+	+
Elephantidae	*Elephas maximus*	Elephant	Na	EN	EN	+	+
Sciuridae	*Ratufa macroura*	Giant squirrel	Na	LC	NT	+	+

Abbreviations used: TS - Taxonomic Status, **En** - Endemic, **Na** - Native, **NCS** - National Conservation Status, **GCS** - Global Conservation Status, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, **LC** - Least Concern, **LR:cd** - Low risk conservation dependent, **NE** - Not Evaluated, **MA –** Minipe Anicut and Surroundings, **LBC** - Minipe LB Canal.

142. **Potentially nuisance species**: Several species of alien invasive species of flora were observed in the study area such as *Eupatorium odoratum* (Podisinnamaran), *Mimosa*

pigra (Yoda Nidikumba), *Ludwigia peruviana* and *Panicum maximum* (rat tana). However, they are unlikely to become a major nuisance as a result of the project.

ii. Present ecological conditions and functioning of the identified ecosystems

143. Two main natural ecosystems were observed in the project impact area. These include the tropical moist evergreen forest present along the left and right bank of the Minipe Pool and a stretch of the Mahaweli river ca. 6.5 km in length between the Minipe Anicut and the confluence of Badulu Oya and the river associated vegetation. Based on the observed species composition that is rich in Native species including many threatened and endemic species, it can be concluded that both of these habitats is of high ecological value.

C.5 Socio-cultural Environment and social aspects

i. Existing infrastructure and service facilities available for people of the area

144. Out of the two major activities, Minipe raising will not have direct impact on the social environment as all project activities will be restricted to Victoria-Randenigala-Rantembe sanctuary declared by the DWC and no human settlements are found inside the sanctuary. Therefore, discussion on the Socio-cultural environment will be focussing on the LB command area where the beneficiaries of this project are residing.

145. **Population Characteristics:** According to the 2011 Census, the total population of the Minipe DS division is 51577 (28,892 males and 29,760 females). Total number of families residing in the Minipe DS division is 17,014 and 8,134 in Wilgamuwa DS division. Total population of the Wilgamuwa DS division is 29298 (14,430 males and 14,868 females). Average family size is 3.03 and 3.6 in Minipe and Wilgamuwa DS divisions respectively.

Table 8. Gender wise Population in the Project related DS divisions

DS Division	Population	Male	Female
Minipe	51577	28892	29760
Wilgamuwa	29298	14430	14868

Table 9. GN Division wise Population in the Minipe DS division

GN division	Population	Male	Female	GN division	Population	Male	Female
Galamuduna	**104**	54	50	Keenapelessa	**1,399**	704	695
Dungolla	**198**	95	103	Mahagalaheenna	**810**	381	429
Thotillagas Ella	**1,686**	787	899	Hasalaka	**1,439**	758	681
Palugolla	**1,352**	667	685	Pallewatta	**1,892**	929	963

Wewere	**2,172**	1,062	1,110	Hasalaka Nagaraya	**1,400**	684	716
Dehemigama	**1,586**	768	818	Maha Eswedduma	**1,202**	566	636
Himbutuwa	**1,136**	583	553	Rathnella	**1,268**	602	666
Udattawa North	**786**	379	407	Gurulupotha	**792**	401	391
Pallegaladebokka	**324**	159	165	Waragolla	**1,033**	500	533
Udagaladebokka	**107**	57	50	Weragama	**1,631**	805	826
Udattawa	**995**	476	519	Bulathwelkandura	**1,692**	825	867
Dambagahawela	**1,184**	576	608	Weraganthota	**819**	398	421
Kindigoda North	**1,236**	623	613	Morayaya	**1,145**	544	601
Udawela	**1,558**	735	823	Lunumadalaketiya	**1,256**	611	645
Kindigoda South	**1,418**	719	699	Diyabubula	**1,126**	579	547
Ulpathagama	**922**	446	476	Handaganawa	**1,684**	781	903
Ambagolla	**737**	345	392	Batumulla	**1,428**	720	708
Dambepitiya	**1,339**	667	672	Udayagala	**688**	339	349
Welgahawadiya	**352**	163	189	Asamodagamyaya	**683**	328	355
Mahayaya North	**1,093**	496	597	Ambagahapelessa	**893**	432	461
08 Ela	**668**	327	341	Muttettuthenna	**1,113**	536	577
Welgala	**832**	397	435	Minipe	**1,317**	651	666
Mahayaya South	**1,175**	558	617	Kolonyaya	**616**	306	310
Thorapitiya	**801**	392	409	Bembiya	**583**	298	285
Minipe DS Division					**51,670**	**25,209**	**26,461**

Source: Population Data 2012- Census and Statistics Department

Table 10. GN Division wise Population in the Wilgamuwa DS division

GN division	Population	Male	Female	GN division	Population	Male	Female
Kumbukoya	**272**	138	134	Himbiliyakada	**249**	123	126
Thunhiriyawewa	**751**	357	394	Hettipola	**1,914**	972	942
Palupitiya	**594**	296	298	Naminioya	**913**	452	461
Rattotayaya	**605**	315	290	Dewagiriya	**776**	372	404
Dunuvilapitiya	**545**	277	268	Piduruella	**392**	190	202
Medakanda	**364**	163	201	Guruwelayaya	**579**	279	300
Aliwanguwa	**778**	396	382	Naminigama	**1,131**	572	559
Viharagama	**743**	357	386	Perakanatta	**835**	422	413
Handungamuwa	**677**	326	351	Wilgamuwa	**438**	246	192
Topwalapitiya	**393**	198	195	Wanarawa	**1,049**	509	540

Gemburuoya	**672**	337	335	Bathgampala	**1,487**	751	736
Kumbukandana	**846**	433	413	Nagolla	**778**	381	397
Lediyangala	**932**	462	470	Moragaha Ulpatha	**504**	257	247
Karawgahawewa	**867**	412	455	Nugagolla	**1,375**	672	703
Radunnewewa	**819**	403	416	Meewaobe	**1,054**	502	552
Maraka	**757**	384	373	80 Yaya	**950**	454	496
Malgammana	**648**	324	324	Sonutta	**825**	403	422
Bogahawewa	**873**	454	419	Uduwelwala	**672**	338	334
Aliyawala	**263**	135	128	Sulugune	**170**	90	80
Veheragala	**808**	417	391				
Wilgamuwa DS Division					**29,298**	**14,569**	**14,729**

Source: Population Data 2012- Census and Statistics Department

146. Taking in to consideration the population of all two DS divisions, religion wise; the majority of the population are Buddhist and it accounts for 99 percent in both DS divisions. Hindus and Christians and Muslims are less than 1 percent.

Table 11. Population according to the ethnic groups

DS Division	Population	Buddhist	Hindu	Muslim	Catholic	Christian	Other
Minipe	51577	51154	1	307	33	55	6
Wilgamuwa	29298	29261	5	5	10	16	1
Total	80875	80415	6	312	43	71	7

Source: Population Data 2012- Census and Statistics Department

147. When the population is divided into main age groups in Minipe DS division, 10,624 (28%) are in 0 – 14, age group, 39,184 (66%) are in 15 - 69 age group and 2794 (6%) are in 70+ age group. A similar pattern can be observed in the Wilgamuwa Divisional secretariat where 5406 individuals are among the 0-14 age group, 19,573 individuals in the 15-69 age group and 1,396 individuals are in the 70 or more age group.

Table 12. Population according to the age and sex in Minipe DS division

Age Group	Male	Female	Total
Less 5 years	2843	3009	5852
5-14	5347	5475	10822
15-34	10545	11074	21619

35-69	8752	8813	17565
70 or more	1405	1389	2794
Total	28892	29760	58652

Source: Population Data 2012- Census and Statistics Department

Table 13. Population according to the age and sex in Wilgamuwa DS division

Age group	Male	Female	Total
Less 5 years	1420	1503	2923
5-14	2670	2736	5406
15-34	5267	5532	10799
35-69	4372	4404	8774
70 or more	701	695	1396
Total	14430	14868	29298

Source: Population Data 2012- Census and Statistics Department

148. **Socio-economic status of the Population:** The total employment in the labour force is 7305 in Minipe DS division. In categorizing them according to main activities, the results are as follows.

Table 14. The population in the Minipe DS division by employment category

Occupation	Male	Female	Total
Farmers	835	766	1601
Government service	31	16	47
Forces	1165	36	1201
Private sector	10	3	13
Business	60	10	70
Technical	132	2	134
Unskilled labour	1964	785	2749
Skilled labour	813	5	782
Foreign	74	130	204
Retired	321	140	461
Other	7		7
Total	**5412**	**1893**	**7305**

149. The highest number of individuals (2,749) is working as unskilled labors. Majority of them are working in agricultural sector. The second largest occupation is farming (1,601). A significant number of people are employed by the Sri Lanka army or police (16%). The employment details of the Wilgamuwa DS division are not available.

150. According to the data available in the Minipe DS division, 7% of the families are receiving less than Rs. 1,000. 22% is receiving less than Rs. 2,500. Families that have an income of Rs. 10,000 or more is about 15 percent. Therefore most of the families are under the poverty level (Table 15).

Table 15. Income distribution in the Minipe DS division

Income category	Number of families	%
Less than 1000	1331	7.82
1000 -2500	3824	22.48
2500 - 4000	2163	12.71
4000 - 5500	1981	11.64
5500 - 7000	1994	11.72
7000 - 8500	1664	9.78
8500 - 10000	1560	9.17
10000 more	2497	14.68
Total	**17014**	**100.00**

Source: Official data – Divisional Secretariat of Minipe

151. **Housing**: The total number of housing units present is 14,080 and 8,190 in the Minipe and Wilgamuwa DS divisions respectively. Out of the total housing units more than 98 percent are single storey houses in both the DS divisions.

Table 16. The types of housing present in Minipe and Wilgamuwa DS divisions

	Minipe DS division		Wilgamuwa DS division	
Type of the house	**Number**	**Percentage**	**Number**	**Percentage**
Single Storey	13811	98.1	8027	98.6
Two Storey	136	1.0	47	0.6
More than 2 storey	9	0.1	14	0.2
Annex	23	0.2	10	0.1
Flat	2	0.0	3	0.0
Twin houses	40	0.3	26	0.3

Line rooms	40	0.3	2	0.0
Hut	2	0.0	5	0.1
Other	17	0.1	5	0.1
Total	14080	100.0	8139	100.0

Source: Official data – Divisional Secretariats of Minipe and Wilgamuwa

152. **Access to facilities:** A higher proportion of the population depends on well water to meet drinking and domestic water needs. In Minipe DS division 6,944 (49%) use wells while in Wilgamuwa DS division 5,980 (73%) use wells. Out of the population in Minipe DS division 31% receive water from rural water supply projects. However, in Wilgamuwa DS division only 15 percent of the population has access to pipe born water.

Table 17. Drinking and domestic water sources available in the Minipe and Wilgamuwa DS divisions

Type of the house	Minipe DS division		Wilgamuwa DS division	
	Number	%	Number	%
Protected well within premises	3,206	22.8	2,864	35.1
Protected well outside premises	2,763	19.6	2,548	31.2
Unprotected well	975	6.9	573	7.0
Tap within unit	676	4.8	193	2.4
Tap within premises but outside the unit	651	4.6	226	2.8
Tap outside premises	168	1.2	171	2.1
Rural water supply projects	4,482	31.8	1,240	15.2
Tube well	523	3.7	92	1.1
Bowsers	10	0.1	5	0.1
Bottled water	4	0.0	5	0.1
River, tank, spring and other	622	4.4	241	3.0
Total Number of families	14,080	100.0	8,158	100.0

Source: Infrastructure Data 2012- Census and Statistics Department

153. In both DS division 86 percent of the population has their own toilets in both DS divisions. 9 percent of families in Minipe and 11 percent in Wilgamuwa are sharing toilets with another household. About 4 percent do not have toilets and depend on public toilets.

Table 18. Availability of toilet facilities

Type of the house	Minipe DS division		Wilgamuwa DS division	
	Number	%	Number	%

Within the unit	Exclusively for the household	1,877	13.1	237	2.9
	Sharing with another household	262	1.8	19	0.2
Outside the Unit	Exclusively for the household	10,122	70.4	6,701	82.1
	Sharing with another household	1,341	9.3	942	11.5
Other	No toilets but sharing with another household	439	3.1	236	2.9
	Common/ public toilets	13	0.1	8	0.1
	Not using a toilet	26	0.2	15	0.2
Total Number of families		14,380	100.0	8,158	100.0

Source: Infrastructure Data 2012- Census and Statistics Department

Table 19. Availability of electricity

Energy Source	Number	%	Number	%
Electricity	11740	78.4	5903	72.4
Kerosene	2151	14.4	2134	26.2
Solar power	188	1.3	121	1.5
Other	1	0.0		0.0
Total	14080	94.0	8158	100.0

Source: Infrastructure Data 2012- Census and Statistics Department

154. **Land use patterns**: The Minipe LB canal is 74 kilometers long. The land use patterns observed along the canal was considered in three sections: (1) from Minipe to Hasalaka - (28 km), (2) from Hasalaka to Wilgamuwa (24km) and (3) from Wilgamuwa to Wasgamuwa (22km). In the first section, there are both agricultural lands and home gardens. Agricultural lands are dominant within this section, 95% of which is paddy. There are also a few *chena* lands within the first half of this section (12 km) and the main other field crops (OFC) cultivated in this area is Maize and Green gram. In Hasalaka to Wilgamuwa (24km) section, land use types consist of agriculture and home gardens; 90% of this section consists of paddy lands and the OFC cultivated includes maize and Green Gram. The third and the last section from Wilgamuwa to Wasgamuwa consist of agriculture land and home gardens. The agriculture land is the dominant land use type observed, where 95% of the cultivation are paddy, with few *chena* cultivated lands.

155. Agriculture is the dominant occupation in the command area. Plantations such as coconut, jack, banana, mango, papaya and lemon are also present to a significant extent. According to the official data, 72% of the lands are used for agricultural activities and 22% are used for residential agriculture. The remaining 6% are bare lands or of other types. The average land belonging to each family is 2.26 acres. Therefore, most of the people that reside in the project area are small scale cultivators. A large number of estates are located in the project and surrounding area and are used for commercial agricultural purposes, along with the smaller areas of lands belonging to house holders. These 'estates' can be categorized as coconut, rubber, tea, spices and other commercial crops.

Table 20. Land use patterns in the Minipe DS division

Type of land use	Acres	%
Paddy lands	12146	43.2
Uncultivated	102	0.4
Bare lands	210	0.7
Marsh	2	0.0
Forest reservation	13486	48.0
Other	2168	7.7
Total	28114	100.0

Source: Official data – Divisional Secretariat of Minipe

Table 21. Acreage under different types of irrigation in the Wilgamuwa DS division

Type of irrigation	Extent (Acres)	%
Major Irrigation	6874	60.4
Minor Irrigation	1637	14.4
Rainfed	2867	25.2
Total	11378	100.0

Source: Official data – Divisional Secretariat of Wilgamuwa

Table 22. Other field crops cultivated in Wilgamuwa DS division

Crop type	Hectares	Crop type	Hectares
Coconut	268	Orange	32
Pepper	21	Lemon	68
Cashew	32	Jak	59
Bettles	2	Banana	83
Aricanut	6	Papaw	7

Mango	60	Pineapple	5
Total			643

Source: Official data – Divisional Secretariat of Wilgamuwa

Table 23. Land ownership including the type and nature of the ownership and title

Type of land	No: of families	%
Sinnakkara	754	6.0
Jayaboomi	4576	36.6
Permits	4297	34.4
Encroached	2704	21.7
Religious	158	1.3
Total	12489	100.0

Source: Official data – Divisional Secretariat of Minipe

156. In the Minipe DS division, 4576 (36%) of the lands were received under land grants while 4297 (34%) are permit holders. They have settled in these lands more than 8 years ago. Most of them have faced land Kachcheries and awaiting the deeds. A significant number of encroachers are settled in government lands or reservations.

Table 24. Land categories recorded in the Minipe DS division

Land Category	Number	%
Less than 0.25 acres	2025	14.9
0.25 - 0.5	2369	17.4
0.5- 1	3175	23.4
1-2	2965	21.8
2-3	1547	11.4
3-4	413	3.0
4-5	330	2.4
5-10	80	0.6
10>	7	0.1
No lands	676	5.0
Total	13587	100.0

Source: Official data – Divisional Secretariat of Minipe

157. **Farmer Organizations:** Among the community organizations, Farmer Organizations are the most important and influential organizations in the Minipe LB canal project. Agriculture is the main livelihood of the community in the project area and these organizations are functioning for water management, canal maintenance, and other related irrigation and agricultural activities. The total number of farm families is 6,740. There are 146 distributional canals managed by 60 Farmer Organizations. The total irrigable area is 18,622 acres. The irrigation project area is divided into 4 stages and the following Farmer Organizations are come under each of the four stages.

Table 25. Farmer Organizations under stage 1

No	Name of FO	No. of D canals	Extent (Acres)	Farmer families
1	D1 Farmer Organization	7	292	48
2	D8 Farmer Organization	9	255	56
3	D12 Farmer Organization	1	250	52
4	D13 Farmer Organization	3	115	30
5	D16 Farmer Organization	2	408	88
6	D19 Farmer Organization	5	186	49
7	D21 Farmer Organization	1	420	123
8	D24 Farmer Organization	5	134	44
9	D25 Farmer Organization	1	287	100
10	D26 Farmer Organization	4	287	83
11	D31 Farmer Organization	3	295	61
12	D32 Farmer Organization	4	268	69
13	D34 Farmer Organization	1	263	110
14	D35 Farmer Organization	4	187	75
15	D39 Farmer Organization	3	230	55
16	D41Farmer Organization	2	259	125
17	D 43Farmer Organization	2	266	108
18	D45 Farmer Organization	2	185	115
19	D47 Farmer Organization	1	230	75
20	D49 Farmer Organization	2	140	68
	Total	62	4957	1534

Table 26. Farmer Organizations under stage 2

No	Name of FO	No. of D canals	Extent (Acres)	Farmer families

1	D1 Farmer Organization	1	230	88
2	D4 Farmer Organization	1	525	225
3	D5 Farmer Organization	2	209	59
4	D7 Farmer Organization	1	378	200
5	D8 Farmer Organization	1	125	65
6	D11 Farmer Organization	3	222	109
7	D12 Farmer Organization	2	186	70
8	D17 Farmer Organization	4	212	109
9	D18 Farmer Organization	3	124	66
10	D21 Farmer Organization	3	127	57
11	D24 Farmer Organization	1	184	111
12	D25 Farmer Organization	1	1294	250
13	D27 Farmer Organization	3	250	138
14	D29 Farmer Organization	3	240	81
15	D30 Farmer Organization	1	546	380
16	D31Farmer Organization	1	351	109
17	D 32Farmer Organization	1	251	126
18	D34 Farmer Organization	2	193	109
	Total	34	5647	2352

Table 27. Farmer Organizations under stage 3

No	Name of FO	No. of D canals	Extent (Acres)	Farmer families
1	D35 Farmer Organization	6	99	88
2	D42 Farmer Organization	3	176	76
3	D43 Farmer Organization	1	1235	310
4	D47 Farmer Organization	6	317	104
5	D51 Farmer Organization	6	250	133
6	D52 Farmer Organization	5	219	110
7	Mahawalathenna FO	1	420	185
8	D56 Farmer Organization	1	69	68
9	D57 Farmer Organization	1	616	225
10	Devagiriwewa FO	2	287	42
11	Bogahawewa FO	2	320	145
12	Malgammanawewa FO	1	322	36
13	Marakawewa FO	2	600	72
14	Radunnawewa FO	1	430	130

	Total	38	5360	1724

Table 28. Farmer Organizations under stage 4

No	Name of FO	No. of D canals	Extent (Acres)	Farmer families
1	D58 Farmer Organization	2	104	30
2	Karawgahawewa No1	1	531	252
3	Karawgahawewa No2	1	141	70
4	D1 Farmer Organization	2	186	89
5	D2 Farmer Organization	1	240	104
6	D3 Farmer Organization	1	723	325
7	D4 Farmer Organization	2	482	190
8	D5 Farmer Organization	2	251	70
	Total	12	2658	1130

ii. Threats from wildlife and potential for human-animal conflict in the project area.

158. The area surrounding the VRR sanctuary can be listed as an area where there is moderate human wildlife conflict. However, as stated in the previous section there are no settlements in the project affected area and therefore, potential for human animal conflict is very low.

159. In the case of the command area of the LB canal at present a low level of conflict occurs mainly towards the tail end of the canal closer to the Wasgomuwa National Park. With increased availability of water cropping patterns will change preventing elephants from accessing some of their dry season feeding grounds which could lead to escalation of the existing level of human elephant conflict in this region.

PART D DESCRIPTION OF THE ANTICIPATED ENVIRONMENTAL IMPACTS

D.1 Construction Impacts

160. **Soil erosion and sedimentation:** Excavation work in the river bed is required only for raising the weir which will involve expansion of the bottom width of the existing anicut. As most of river section is covered with rock there will not be any soil erosion. Further, this work will be carried out part by part during the dry periods diverting any available flow through LB and RB main canals, and the rest through the silt ejectors. Further, the construction area will be cordoned off with a coffer dam and water will be pumped out to keep the construction area dry which will further reduce the possibility of erosion. During the raising of LB sluice and other modifications there will be very little foundation excavation that will also be done during the dry period. Therefore, the proposed project activities will not result in significant erosion in the project affected area or sedimentation of the main river.

161. Construction activities produce many kinds of pollutants, which may cause storm water contamination. Grading and clearing/grubbing activities may remove vegetation on part of the existing structures and other protective ground cover resulting in exposure of underlying soil to be picked up by wind and or washed away by rain. Storm water or canal water carrying these particles will reach the streams causing increased sedimentation. Further, rehabilitation work on the Minipe LB canal such as removal of vegetation on the canal banks and removal of sediments from canal bed can also contribute to erosion and sedeimentation of the surface water bodies.

162. Unprotected stockpiling of construction materials at unsuitable places during rainy periods can also add to the sediments carried by storm runoff, if any rain events occur during the construction period.

163. Even after construction, contamination of water by oil and grease released from the vehicles and heavy equipment is likely to happen at construction sites if adequate precautions are not taken.

164. **Dust, noise emissions:** During site preparation and construction, heavy equipment and vehicle movement will result in generation of dust. Also emission coming from the heavy equipment and generators used at the construction site will produce short-term impacts on the ambient air quality. Therefore, increased levels of CO, NO_2 and SO_2 in the ambient air and increased noise levels are expected at construction sites. However, these impacts will not be significant since the construction will take place within a short period of time.

165. Further, there are no human settlements near the construction Minipe anicut and therefore these impacts will be limited to the workers which can be mitigated by following the proper safety precautions. However, since there are human settlements along the LB canal the impact due to dust, noise and vibration can affect the local communities. However, rehabilitation work in the LB canal is spread over a distance of 74 km and the impact at any given location will not be significant as the period of disturbance will be very brief.

166. Further, Minipe LB canal rehabilitation does not involve heavy construction and further construction activities will be scatted over the 74 km length of the canal. Site preparation, excavation, concreting etc., is mostly done by the labor force. Small machines like concrete mixers, Lorries, small vibration machines will be used in these construction sites. Therefore, amount of dust, noise and emissions resulting due to LB canal construction will not have a significant impact on the environment

167. **Transport and disposal of dredged material:** The proposed activities will not generate significant quantities of construction waste or solid waste. The generated waste will be disposed at sites specified by the local government agencies.

168. Dredged material is removed as silt from the Minipe LB canal. The total quantity is estimated to be around 74,270 m^3 (about 1000m^3 /km). Samples of material dredged will be tested for presence of pollutants and engineering properties and if found to be suitable will be used to form a bund in the left bank side of the canal keeping the provisions for existing drainage path as available now. Also with grass turfing, newly formed bund will be protected from erosion due to wind and rain. Some of the dredged material maybe suitable for use in agricultural lands – however, this will need to be determined after testing of dredged material. If the sediments were found to be unsafe for such use it will be disposed as a safe site selected with local authorities.

169. **Impacts on borrow areas:** Total materials requirement for the project is estimated to be ca. 1132 m^3. This is requirement can be met through existing licensed quarries in the area. Preliminary investigations have indicated that there are several licensed quarries in the area. However, the quarries form which the material will be procured will be determined based on the suitability of the material for the planned construction activities after testing the material in an accredited lab. Sand, metal, cement and earth requirement for the LB canal rehabilitation work will be purchased from approved local suppliers. Therefore, as the project will not set up borrow sites of its own this impact will not arise.

D.2 Impacts on hydrology:

170. **Drainage problems:** Due to the overall structural improvements, the drainage pattern will be improved. The disturbances to drainage paths during constructions shall be minimized by planning and phasing of construction activities.

171. **Inundation of reservoir area:** The water spread area of the Minipe pool will be increased by about 250,000 m^2 with the raising of the anicut. This area will be mainly limited to the area between the river banks. The inundation area will increase by ca. 25 ha from the present level of inundation. However, the inundation will not be permanent as water will recede within approximately 3-4 hours after the power generation stops due to diversion of water to the RB and LB canal and release of e-flow. As such the forest in the new inundation area will not be lost as it will not be subjected to permanent inundation due to the raising of the Anicut.

172. **Ground water recharge:** The proposed project activities will not have a significant impact on the ground water situation as the contribution to ground water from close by Randenigala and Rantambe reservoirs remain unchanged. There will be some reduction of ground water recharge along the LB canal due to introduction of canal linings. The effect will be insignificant as the paddy fields are most of the time flooded.

D.3 Impacts on land stability and landuse due to the reservoir

173. A study by the National Building and Research Organization (NBRO) on the land stability has been commissioned. According to their report (see annex vii for the full report) the entire project area falls within no landslide or low hazards zone and the field inspection has revealed that there are no unstable slopes or landslide prone areas. The report has concluded that the project will not cause any land instabilities provided that the recommendations (incorporated in the conclusions and recommendations section) given to enhance the safety and land stability are implemented during the construction phase of the project.

D.4 Impacts on biological environment

174. The two ecosystems that will be directly affected due to the implementation of the proposed project includes the tropical moist evergreen forest present along the left and right bank of the Minipe Pool and a stretch of the Mahaweli river approximately 6.5 km in length between the Minipe Anicut and the confluence of Badulu Oya.

175. An extent of approximately 25 ha of tropical moist evergreen forest on the right and left bank of the existing Minipe Pool will be inundated due to the raising of the Minipe Anicut. Based on the observed species composition that is rich in Native species including many

threatened and endemic species, it can be concluded that it is a habitat of high ecological value. This habitat even at present is subjected to a daily inundation regime during the peak energy generation periods of the Rantambe power house. However, due to the proposed development the area inundated will increase by about 25 ha. Second, as the proposed project will enhance the storage capacity of the Minipe Pool, the water will recede at a much lower rate compared to the present situation. Therefore, both the extent of the area inundated as well as the time span during which this area remain inundated will increase. However, this will not result in a significant impact as the vegetation will not be lost and therefore can still be uilised by most of the species that inhabits the newly inundated area except ground dwlling species. Based on the field studies none of the species observed to inhabit this layer is unique or restricted to the project impacted area.

176. The proposed raising of the Minipe Anicut by 4 m will result in retention of approximately 1 MCM of water that will be diverted from the Mahaweli River via the Minipe RB and LB canal. Therefore, the stretch of the river downstream of the Minipe anicut up to the confluence of the Badulu Oya (approximately 6.5 km in length) will be subjected to low flows as spilling of the Minipe anicut will be curtiled significantly and therefore, the environmental flow released from the Minipe Anicut will be the only assured inflow available for this stretch of the river. This will result in a reduction of the carrying capacity of this stretch of the river for aquatic fauna, mainly freshwater fish. Further, the daily wetted perimeter of this stretch of the river will also decrease due to the low flows which will have a negative impact on the aquatic plants. Based on the field investigations, this stretch of the river supports several species of threatened and endemic aquatic fauna and flora (Table 29) that may undergo a population reduction under the new flow regime.

177. **Impacts on fishery:** As explained above, the proposed project will result in a reduction of the fish population in the Mahaweli River from Minipe anicut up to the confluence of the Badullu Oya. However, this stretch of the river does not support a commercial fishery operation due to two reasons. First, the types of fish inhabiting this stretch of the river are not commonly consumed species. Second this stretch of the river is located within the Victoria-Randenigala-Rantembe sanctuary where capture of fish is prohibited by law. Therefore the proposed project will not have an impact on fishery.

178. However, based on the field observations the stretch of the habitat that will be subjected to low flows due to the proposed development is inhabited by number of endemic and threatened species (Table 29). Therefore, ensuring the ecological integrity of this stretch of the river should be given due consideration. An environment flow as described in the next section (Mitigatory Measures) is mandatory for the project.

Table 29. Endemic, threatened and near threatened species of fauna and flora observed in the stretch of the river that will be subjected to low flows

Family	Scientific Name	Common Name	TS	NCS	GCS
Aquatic Plants					
Araceae	*Cryptocoryne beckettii*	Beckett's water trumpet	E	VU	NE
Araceae	*Cryptocoryne parva*		E	EN	NE
Araceae	*Lagenandra praetermissa*		E	LC	NE
Poaceae	*Coix gigantean*	Giant Adley	N	NT	LC
Dragon Flies					
Aeshnidae	*Anax immaculifrons*	Fiery Emperor	N	VU	LC
Cholorocyphidae	*Libellago adami*	Adam's Gem	E	VU	NE
Gomphidae	*Ictinogomphus rapax*	Rapacious Flangetail	E	LC	LC
Libellulidae	*Orthetrum pruinosum*	Pink Skimmer	N	NT	LC
Libellulidae	*Trithemis festiva*	Indigo Dropwing	N	VU	LC
Protoneuridae	*Elattoneura centralis*	Dark-glittering Threadtail	E	VU	NE
Freshwater Fish					
Belontiidae	*Belontia signata*	Combtail	E	NT	LR:cd
Cyprinidae	*Garra ceylonensis*	Stone sucker	E	VU	NE
Cyprinidae	*Tor khudree*	Mahseer	N	NT	EN

Abbreviations used: TS - Taxonomic Status, **E** - Endemic, **N** - Native, **NCS** - National Conservation Status, **GCS** - Global Conservation Status, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, **LC** - Least Concern, **LR:cd** - Low risk conservation dependent, **NE** - Not Evaluated

179. None of the species listed in table 29 are restricted to the project area. The two aquatic plant species *Cryptocoryne beckettii* and *Cryptocoryne parva* has been listed as threatened species since both of these species are highly exploited by the aquarium industry as is the case for freshwater fish species *Garra ceylonensis*. The freshwater fish species *Tor khudree* is not considered threatened in Sri Lanka but is listed as a Globally Endangered species as this fish species is highly exploited as a food fish in Western Ghats, India. However, in Sri Lanka it is not exploited heavily and is found in several river basins (Figure 21). Therefore, the impact of the project on these species will not be significant as only a small proportion of the population of these species will be impacted by the proposed project.

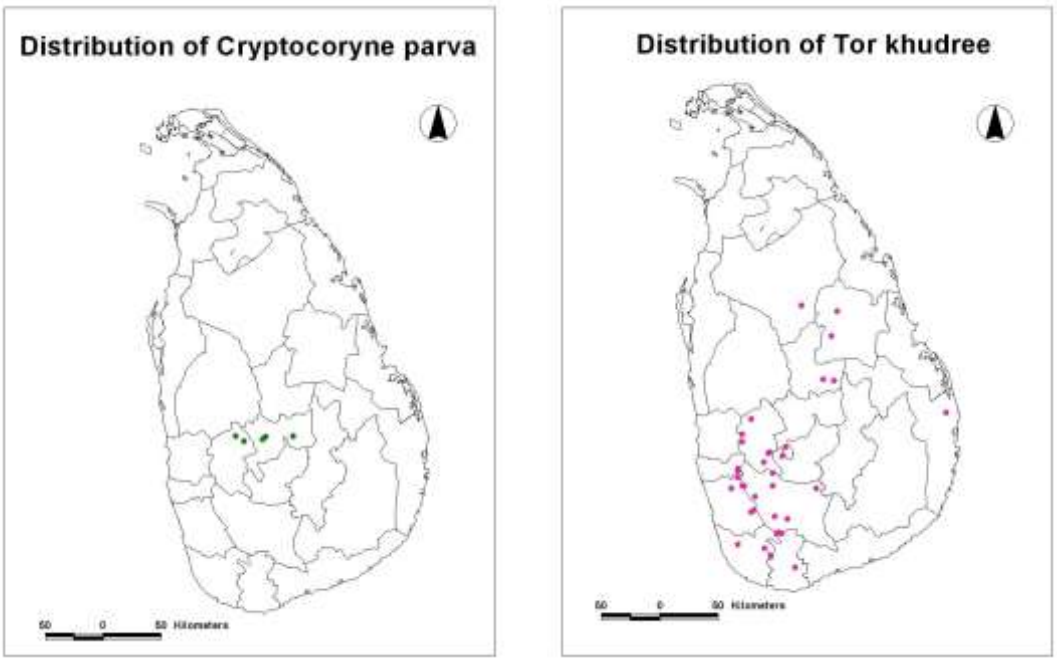


Figure 21. Distribution maps of the two endangered species observed in the stretch of the river that will be subjected to low flows Source: National Redlisting Database

180. **Effects on flood plain ecology:** This region is located in the second and third peneplains of Sri Lanka where the river banks are relatively steep. Flood plains on the other hand are mostly restricted to the lower reaches of the Mahaweli River where it flows through relatively flat first peneplain. Therefore, flood plains are not present in the stretch of the river affected by the proposed project. Therefore the proposed project will not have any significant impacts on the flood plain ecology of the Mahaweli River.

181. **Loss of flora and fauna:** The project activities are restricted to an area less than 30 ha in extent. The habitats affected by the proposed project, though they support a diverse species assemblage, cannot be considered as a critical habitat as defined by the ADB safeguard Policy document other than the fact that it is declared as a sanctuary under the Fauna and Flora Protection Ordinance of Sri Lanka. Though a number of threatened and endemic species were recorded in the project affected area, none of these species are restricted to the project affected area. Further, the project will not affect a significant proportion of the population of any of the species that were observed in the project affected area. Therefore, the proposed project will not result in loss of any species.

182. **Effects on protected areas:** The proposed project activities will take place in a Victoria-Randenigala-Rantambe sanctuary, the largest wildlife sanctuary in Sri Lanka decaled under the Fauna and Flora Protection Ordinance by the Department of Wildlife

Conservation (VRR sanctuary has an extent of 42,089 ha). Therefore, less than 0.1% of the protected area will be affected by the proposed project activities. Hence, the proposed project will not have a significant impact on protected areas.

D.5 Sociological Impacts

183. **Relocations of people:** No relocation of persons is involved.

184. **Impacts on economic activities:** During the construction phase activities such as de-silting, excavation of foundation for structures and construction of structures will be carried out in the canal bed and embankments of the LB canal. All construction activities will commence just after 2014/2015 Maha (November - February) cultivation. All construction activities are scheduled to be completed below Full Supply level of the canal before commencing of 2015/2016 Maha season while issuing water for the 2015 Yala season. However there will be water limitation and water shortage during 2015 Yala as the construction activities are progressing. Especially during foundation excavation, till structures will come up to FSL level and it will be necessary to build coffer dams reducing the canal width etc. Balance construction will be completed while issuing the irrigation water for coming season.

185. Therefore, all efforts will be taken to reduce the impact of rehabilitation work on agricultural practices in the LB command area. The construction schedule and anticipated disruptions will be discussed with the farmers during the Kanna meeting and an agreement will be reached with farmers as to how to manage any disruption of water distribution. Further, the farmers will be able to resolve any disputes pertaining to disruptions in water distribution through the GRC if the Department of Irrigation fails to honor the agreements reached at Kanna meeting.

186. Fisheries activities carried out in the canal and especially tanks (level crossing) will be temporarily disturbed during the construction period. However, all efforts will be taken by the Department of Irrigation not to reduce the water levels significantly.

187. **Impacts on land use patterns:** The water spread area of the Minipe pool will be increased by about 250,000 m^2 with the raising of the anicut. This area will be mainly limited to the area between the river banks. Further, inundation will be of temporary nature as the water will recede after several hours due to diversion into LB and RB canal. Rehabilitation of the LB canal will not result in development of new areas. However, with the availability of increased water cropping intensity of the existing command area will increase.

188. **Impact on altering water supply on users:** People use Minipe LB canal for bathing, washing clothes and watering animals. During construction period, people will not be able to enjoy the quality and quantity of water supplied at present as many coffer dams will be constructed in the canal bed restricting canal perimeter. Also these cofferdams are constructed using sandy materials and there will be lot of scouring reducing quality of the water.

189. However, during the operational stage the farmers under the LB canal will get a more reliable supply of water during both cultivation seasons. Further, water deficit faced by farmers at the tail end of the LB canal will also be addressed by the proposed project. Therefore, the overall impact on water users will be a significantly positive affect.

190. It should be noted that the flow of water in the Mahaweli River downstream of the Minipe Anicut will undergo a significant reduction due to the proposed project. However, there are no permanent water users downstream of the Minipe Anicut as there are no settlements in this area.

191. **Number of families to be affected and to be replaced by the development:** No families will be displaced due to proposed project activities. However, there is a possibility that the livelihood of some farmers might get affected by the disruptions in irrigation water supply during the construction period. The resettlement plan will have provisions as to how such farmers will be compensated for complete or partial loss of livelihood due to construction activities.

192. **Impacts on occupational health and safety and community health and safety:** Rehabilitation work will generate high levels of dust especially during the dry season where most of the construction will be undertaken. This can reduce the air quality and will also contribute towards higher incidence of respiratory diseases. Further, any open containers left behind unattended at construction sites may function as breeding sites for mosquitoes which may increase the incidence of vector born diseases. If proper precautions are not taken at construction sites to cover open pits, excavated areas or place proper signs to identify obstacles or open pits at night, both workers as well as community members could get injured by falling in to such pits.

193. Health issues can be created by improper disposal of solid and liquid waste, contamination of drinking and bathing water supplies or lack of proper sanitary practices at labor camps. Finally, increased level of noise, vibration, and vehicle emission that will arise

during the construction period will have a negative impact on the local communities, especially more vulnerable groups such as small children, elderly and persons in ill health.

194. **Increased threats from wildlife and potential for human elephant conflicts in the project area:** With the project there will not be any settlement. Minipe pool will be increased by about 250,000 m^2 with the raising of the anicut and this area will be mainly limited to the area between the river banks. As the project activities take place in an area with no human settlement the proposed project activities will not result in any human-animal conflicts.

195. However, after the project is concluded cropping patterns in the command area will change which may prevent access of wildlife to these areas especially during the dry season as is the case at present. Therefore, this could lead to increased human-wildlife conflict in the future especially human elephant conflict.

196. **Socio-cultural impacts due to migratory works:** Local area construction workers shall be used if they are available. Employing local people will not only benefit the communities but also eliminate the costs for constructing new huts and providing logistics and reduce on influx of people and tensions that come with it. In case of skilled labor such as machine operators, carpenters, masons come from outside areas temporary huts/camps shall be made available to accommodate them. However, since the construction corridor stretches over 74 km and will be packaged under six separate tenders at any given section large labour gangs are not expected and therefore large scale labor camp establishments is not envisaged in this project.

197. **Socio economic benefits (Other than employments) to be provided to the local people:** The command area of the LB canal has about 18,622 acres of irrigable lands. However, lack of a reliable water source makes it difficult to cultivate these lands on a regular basis as can be seen in the cropping intensities during the last 5 years.

198. Therefore, during the Yala season full extent of the land cannot be cultivated due to lack of water. The farmers are facing number of difficulties in water management, especially those who are cultivating under Stage 3 and Stage 4 of the canal. It is also difficult to receive water for tail end farmers. Therefore, during the rotation period many social conflicts arise among the farmers. Further the extent cultivated has been increased by approximately 20 – 30% subsequent to the original plan of water issue, and this increase has not been met with an expansion in the amounts of water issued.

199. The lack of sufficient water has made the community create additional unsanctioned waterways from the canal into their farms, which has led to a further lack of water for farers who are in the tail end. However, after the rehabilitation work is done such uncaptioned water extraction will not be allowed. All these problems, together, has caused not only reduced water for the cultivations thereby affecting the livelihoods of the people, but also has contributed to create a social conflict among the community primarily with reference to the creation of unsanctioned waterways.

Table 30. Extent cultivated under the Minipe LB canal during the last 5 years

Season	Cultivated Extent	%
2009 Yala	0.0	0.0
2009/10 Maha	18500	99.3
2010 Yala	13045	70.1
2010/11 Maha	18250	98.0
2011 Yala		0.0
2011/12 Maha	17712	95.1
2012 Yala	9300	49.9
2012/13 Maha	18385	98.7
2013 Yala	16192	87.0

Source: Official data of Irrigation Management Division

200. The proposed development will provide a clear solution to all these issues. Firstly, by de-silting the waters and restructuring the canal which involves the shut-down of all unsanctioned waterways feed off the canal will reduce the scarcity of water experienced by farmers in stages 3 and 4. Further, raising of the Anicut will provide additional water that can help address the water deficiency experienced at present.

201. The water insecurities faced by the farmers in the dry-periods due to the lack of water has resulted in low levels of investment in cultivation, due to the risk constantly posed by the lack of water. Increasing the water security of the farmers by providing a constant supply of water will result in added investments in farming that will result in an overall increase of the socio-economic standards of the area as a whole. This will lead to other added benefits such as

- Commercialization of smallholder agriculture through product diversification
- Shift to higher-valued crops
- Promotion of high-value export crops
- Support for the development of large-scale commercial agriculture

- Effective integration of farmers with domestic and external markets
- Increased cropping intensity on some 4,000 ha due to the provision of more irrigation water. However, this may lead to increased use of agrochemicals and other related impacts such as soil erosion.
- Increased crop yields due to improved drainage, inputs and crop husbandry
- Improved livestock husbandry and productivity
- Increased and stabilized household incomes from agriculture for some 6000 farm households

202. **Impacts on existing infrastructure and service facilities available for people of the**

area: No impacts on the existing infrastructure are anticipated due to the raising of the Minipe Anicut. However, rehabilitation of the LB canal will have an impact on the transport of local communities as Minipe LB canal bund is used as the main road and during the construction period the road will be obstructed at times.

203. **Impact on water users of LB and RB main scheme:** The proposed development activities will not have any impacts on the Minipe RB canal users as the only activity that would have an impact is introducing necessary protective measures to the RB sluice after raising the anicut. This work will be done duing the closed season and therefore will have no impact on water relased in to the RB canal and therefore water users of the RB canal will not be impacted at all due to the proposed project.

204. However, the entire LB canal and its intake structures will be rehabilitated and therefore water users of the LB canal will be affected by the project. However, it should be noted that most of the planned rehabilitation work will have no impact on the water conveyance in the LB canal other than the rehabilitation work that involves construction below the FSL. These activities are scheduled to be carried out during the closesd season of the LB canal as described in chapter 2 of this document.

205. Therefore, water users of the LB canal will get impacted only if the construction work that will have an impact on the conveyanace of water in the canal cannot be completed during the closes season as planned. Further, none of the planned construction work below the FSL will result in complete closure of the LB canal and therefore, a complete disruption of water conveyance is not anticipated at any stage of the construction phase. Thus even if construction work under the FSL spills over to the cultivation season, it will only result in reduction in the water availability for the users and the coping mechanism with such situations will be decided in consultation with the farmers during the Kanna meetings.

D.6 Opeational Impacts

206. Three major impacts could arise during the operational phase of this project. These are impacts arising due to cimate change, increased human-animal conflict that may arise due to change in cropping intensities and increased pollution that may arise due to intensification of farming with enhanced water supply.

a. Climate Change

207. While there are a number of climate change parameters, the principal ones directly relevant to the project for the assessment of risk and adaptation measures are changes in temperature and rainfall.

208. **Climate Change Trends:** The analysis of temperature records over a 100-year period showed an increase in air temperature in all meteorological stations from 1961 to 1990 (Fernando and Chandrapala, 1992[10]). The rate of increase over this period was of the order 0.016°C per annum or the equivalent of 1.6°C per 100 years.

209. Rainfall in Sri Lanka is characterized by high annual variability with alternate dry and wet periods observed from 1880 until about 1970 and a significant reduction thereafter (MIWRM, 2010[11]). Over the period 1931 to 1990 average annual rainfall is reported to have decreased from 2,005 mm to 1,861 mm, a decline of 7% (Jayatilake et al, 2005[12]). The decrease differed between seasons, with the highest decline in the March to April inter-monsoonal period. Also it was noted that the intensities and return period of extreme events appear to have become shorter.

210. **Climate Predictions:** The current trends and model predictions for temperature indicate that it is most likely to increase over the project lifetime, to 2050 and beyond. The best estimate is an increase of up to 3°C by 2100. Further, the frequency of extreme climate events is expected to increase in the future.

211. These predicted changes in the climate will have a significant impact on agriculture sector. For instance, a 0.5°C increase in temperature can reduce rice yield by approximately 5.9%. Extreme climate events such as extended dry spells and short intense rain periods

[10] Fernando, T.K. and Chandrapala, L. (1992). Global Warming and Rainfall Variability - Sri Lankan Situation. Proceedings of the 47thAnnual Session of Sri Lanka Association for the Advancement of Science (SLASS). Section E1. Pp. 138.

[11] MIWRM (2010). Sri Lanka Water Development Report 2010

[12] Jayatillake, H.M., Chandrapala, L, Basnayake, B.R.S.B, Dharmaratne, G.H.P, (2005). Water Resources and Climate Change. Proceedings of the Workshop on Sri Lanka National Water Development Report, World Water Assessment Programme, Paris.

with excessive cloudiness during the wet season can result in yield reductions.

212. The situation regarding precipitation patterns is somewhat contradictory, with current trends indicating a general decline in rainfall over the past 60 or more years, and climate change models giving mixed predictions of both higher and lower future rainfall. Though there appears to be consistency that in terms of seasonal change, with South West Monsoon (SWM) precipitation increasing and a decline North West monsoon (NWM) precipitation. Changes in precipitation would have a number of impacts on the project, lower rainfall would reduce water availability, both at field level (reduce effective rainfall) and basin level i.e. transfer from the Mahaweli, and higher rainfall would increase water availability and reduce irrigation demand, and therefore could be an opportunity for increased productivity (increase irrigated areas and higher cropping intensity). Changes in rainfall intensity may also have implications for system design, and duties of canals, cross drainage structures and reservoirs capacities. However, increased ability to regulate water is one of the best adaptations for climate change and this project will help achieve that objective.

b. Increased wildlife-human conflict

213 The proposed project will increase water availability within the command area of the Minipe LB canal which will result in an increase in cropping intensity as well as cultivation of areas that has not been cultivated regularly due to lack of water. These changes will result in loss of habitat for some large ranging species such as Asian Elephants that have been using the agriculture land during the fallow period. This problem is only expected at the tail end of the Minipe LB canal (Stage IV) which lies adjacent to Wasgomuwa National Park where already a human-elephant conflict exist and the situation is likely to be exacerbated with the proposed changes. Further, changes in cultivation patterns can also result in conflict with number of other mammalian species such as Wild boar, Toque Monkey, Giant Squirrel etc.,

c. Increased Pollution

214 The proposed development as indicated in the previous section will result in significant changes in the cropping intensity. The findings of the water quality study demonstrates that the command area of the LB canal is already polluted due to excessive erosion arising due to unsustainable land preparation methods and chemical pollution due to excessive use of agrochemicals. This situation is likely to get even more pronounced after the culmination of the proposed development.

PART E MITIGATORY MEASURES

215. **Soil Erosions and Sedimentation:** During earthwork activities the contractor shall be

responsible for the construction of slope stabilization and protection measures required for location other than those specified in the plans to minimize soil erosion, such as raising of canal embankment or filling after construction of new structures. Disposal site of excavated materials and waste shall have to be approved by the implementing agency. Contain excavation and construction activities within coffer dam for any construction under water.

216. The contractor shall comply with the environmental requirements/ guidelines issued by the CEA/GSMB and LA with respect to locating and operating borrow or quarry areas as well as transportation of material from such sites. In the event gavel, sand and rock are to be purchased by the contractor, the required material for construction should be obtained from operators that carry proper EPL issues by CEA or GSMB.

217. The contractor shall ensure that the stockpiles and spoil dumps are shaped to blend with the local topography as far as it is practicable. All stock piles should be away from any water bodies and covered. Finally exposed surfaces of spoil dumps shall be stabilized by re-vegetation of these areas.

218. **Dust, Noise Emission:** The contractor shall take appropriate measures to minimize the generation of dust as a result of his work, operation and activities to the satisfaction of the Engineer. Such measures shall include, but not limited to, regular and effective treatment of gravel access roads and working areas, and use of water sprays. To prevent fine dust from open-topped dump trucks during transportation, it is necessary to ensure that the loads are covered when transported.

219. The contractor shall provide all plant and equipment with suitable silencers or adopt other measures such that the noise level in adjacent communities will not increase by more than 2db (A) above residual sound levels. In communities adjacent to access roads maximum noise levels shall not exceed 55 dB (A).

220. **Disposal of dredged material:** As indicated in section B.4 all the suitable material (after testng the material at an accredited laboratory) arising from de-silting will be used to form a bund in the LB side of the canal (to be used as an operation and maintenance road in the future). The newly formed bund will be turfed to protect it from erosion. However, in the event that some of the dredged material will not meet the required standard for the construction of the bund, such material will be disposed at a safe site agreed upon with local authorities following the procedure outlined in section B.4.

221**.** **Social Impacts:** The transportation of material should take place with minimum interference to public transportation and should be ceased at peak hours. Further, the contractor should maintain the roads so as to reduce structural damage to the road as a result of heavy materials being transported. Contractors must ensure that vehicles adhere to appropriate speed limits when plying through residential areas.

222. Generation of high levels of dust, especially during the construction work undertaken during the dry season, excessive levels of noise, vibration, and vehicle emission will inconvenience the local communities, especially more vulnerable groups such as small children, the elderly and persons in ill health. Therefore, the contractors should take necessary steps to minimize the creation of health hazards to the community. This also applies to the disposal of toxic or harmful waste where the contractor must take steps to the dispose these materials with minimum damage to the community.

223. The contractor must use proper signage in storage areas of construction material, tape off open pits and construction sites to ensure the safety of workers as well as the community. Further, if there are disruptions caused to normal day to day activity of local communities such as generation of noise, dust, closure of a public access road, prior notification should be provided to the local communities. Also consultation of local community is recommended if the proposed nuisance is going to have a long term impact on the community. Further, steps should be taken to provide alternatives and place proper signage to inform persons of such alternatives.

224. During the construction stage, the users of LB canal will have to face disruptions in water supply due to temporary diversions that will be needed in order to conduct repair works. The contractor should take steps to schedule such events during the non cultivation period and also should avoid public holidays or festive season to ensure that local communities are not severely inconvenienced by such a diversion. However, if it is not possible to restrict such activities to periods of non cultivation the affected farmers must be consulted regarding the disruption in water supply. As indicated in the previous section, even if the construction work continues into cropping season it will not result in complete stoppage of water supply. What will happen is there will be changes from the regular supply scheme and therefore an alternative coping mechanism should be developed in discussion with the farmers. The ideal forum for such mediation will be the kanna meeting during which water distribution issues are discussed in detail.

225. **Other Mitigation Measures:** The project proponent will take all steps to ensure that importation of construction material as well as heavy equipment will not result in the

introduction of weeds or alien invasive plant species (AIS) to the project area, especially the VRR sanctuary. The contractor will not be permitted to establish any construction material storage sites, vehicle parks or vehicle wash down areas within the VRR sanctuary. Further project proponent must take necessary steps to continuously monitor project sites for establishment of such weeds or alien invasive species and if found take expert advise as to how to manage such an infestation. It is strongly advised that project proponent should not attempt to manage any weed or AIS without the supervision of a technical expert as this could further aggravate the problem.

226. A project of this magnitude will employ a variety of crews at various times and therefore, it will be a necessity to adopt occupational, health and safety guidelines noting that a project of this nature can result in many types of hazards and risks at various stages of construction. It will be imperative for the appointed Contractor to employ an Occupational Health and Safety Manager (with OHS supervisors). The Occupational Health and Safety Manager need to undertake the responsibility for the Safety and Health of all employees at the construction site as well as health and safety issues of the communities that live close to the construction sites. He/she should take the initiative to make changes where necessary to the Safety and Health Plan during the construction period by liaising with relevant authorities. The Occupational Health and Safety Manager needs to be responsible for the coordination and alignment of all site activities with Safety and Health Guidelines

227. The contractor must also take steps to dispose construction waste, dredged material, solid waste and liquid waste according to standards specified by the CEA as well as local authorities. Waste material should not be released directly to any water body at any time.

228. The project proponent must also take steps to release the environment flow requirement as prescribed in section B.6 (8 m^3/sec and 16 m^3/sec during the cultivation and non cultivation season (30th January to 15th April and 25th August to 15th November) respectively) to ensure that the ecological integrity of the area downstream of the Minipe anicut is not adversely impacted by the proposed project.

229. The existing level of human elephant-conflict that exist in the Minipe LB canal stage 4 can get exacerbated after completion of the project due to increased cropping intensities that will prevent elephants from using some of the cultivated lands that are left to fallow during the dry season. Therefore, the existing eclectic fence system should be reviewed for their effectiveness and strengthened where necessary. Also temporary electric fences should be provided for paddy fields that are subjected to conflict which should be removed at the end of the cropping season to allow elephants to access these areas during the fallow period.

Isolated villages that cannot be protected with existing electric fence system, village electric fences should be provided. For this purpose the project will set aside funds to establish 200 km of new fences and to repair the existing fences where necessary.

230. The project proponent shall undertake an extensive awareness campaign within the command area of the Minpe LB canal to promote soil conservation measures, crop selection, effective use of water and wise use of agrochemicals.

231. Demarcation of the LB canal reservation is one of the rehabilitation activities that have been identified. The project proponent after demarcating the canal reservation will undertake reforestation of the LB canal reservation with indigenous plant species (refer tabe 4 in Annex V). This will result in the establishment of riverine vegetation over an extent of 145 ha. This will not only compensate for the loss of habitat (25 ha) that will arise due to the project, but will also function as an ecological corridor between three protected areas (VRR sanctuary, Knuckles Conservation Forest and Wasgomuwa National Park) which would facilitate gene flow between forest restricted species that occupy these three protected areas. Further, it will prevent future encroachment of the canal reservation as well as reduce sediment runoff to the canal during rainy season.

232. The contractor must take steps to decommission any temporary sites such as borrow areas, camp sites, site offices, vehicle parking areas etc., and rehabilitate these sites to prevent degradation of land.

233. The mitigation measures are specified in the detailed Environment management Plan and it should be implemented with proper monitoring to ensure enviornemental sustainability of the project. If there are any changes in the project design during the construction period the EMP should be amended duly to ensure that the change in design does not have any adverse impacts on the environment.

PART F INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

234. During the project design and feasibility studies there was a continuous disclosure of information engaging stakeholders at all levels. During the initial period, discussions were carried out with Divisional Secretaries, Irrigation Engineers, Residential Project managers and government officers who were informed about the project by the EIA team. Such meetings were held in Minipe and Wilgamuwa Divisional Secretary offices.

235**. Public Consultation:** A public consultation meeting was held on 5th May 2014 at the Resident Managers Office of the Morayaya Scheme to address the communities in the project area were consulted in order to raise awareness about the project and the possible impacts that may arise due to the project. The meeting was attended by Divisonal Secreatries of Minpe and Wilgamuwa, Grama Niladahris of relevant GN Division and government officals representing relevant line agencies and farmer rganizations. The issues that were raised and discussed were,

- Issues pertaining to the details and implementation of the project
- Possible disruptions in the irrigation water supply during repair works
- The possibility of relocation for some of the affected families and other issues connected to this.

236. The participatory approach system was utilized in order to gauge the responses of the communities to the project and its impacts. The parties with whom these issues were discussed included the community members, government officials, as well as all parties liable to be affected by the implementation of the project. The grievances that were raised by the affected parties were discussed and solutions given where necessary and practicable.

237. Also, the details pertaining to the project were explained to the communities with the maximum transparency. This was considered to be especially important since the communities that are impacted by the proposed project are also the final beneficiaries of the project outcomes.

238. **Questions raised by the community and responses**

- People asked whether they will receive more water after completion of the project. Most of them expressed a desire to get water for the paddy fields which are located at the tail end of the canal and which currently do not receive sufficient water. The provision of water for drinking and domestic purposes was also discussed.
- In analyzing the findings from the community, it appears that the farmers perceive no negative impacts that are likely to arise as a result of project interventions; however, virtually all see that the project interventions has the effect of creating and multiplying a

number of positive impacts. The positive outcomes of the project include the solving on numerous water issues including the lack of water due to the dilapidated state of the canal. The renovation of the canal would mean that the structural damages would be refurbished, resulting in the closure of illegal waterways, curb water wastage and, in general, solve all the persisting problems in relation to water ways.

- The community members stated that many problems arose due to the lack water for their lands. When there is a lack of water, and in order to save the crops, farmers try to obtain water destroying the canal gates, sluices and canal bunds. Their livelihood mainly depends on the crop cultivation and in the dried period canal end farmers face losing their crops. All the participants expressed their agreement to this rehabilitation programme.
- Some famer leaders asked if there a programme to carrying out water to other parts of the country through raising Minipe Anicut and rehabilitation of the Minipe canal (since they traditionally face severe droughts in the Yala season and the additional saving water is only allocated to the farmers in the project area). If not, they do not give their agreement for this.
- No objections were expressed by the participants about the construction of the Minipe Anicut or canal rehabilitation. Their view was after completion of the project they receive more income and will have improved water security.
- They asked if there were temporary impacts to the community during the construction period such as a necessity to forego a season. They also expressed that they would like to dedicate a season too. But the consultants clearly stated there will not be any negative impacts to the community as a result of construction.
- They also querried about the employement opportunities that will be created during the construction work of the Minipe rasing project.

239. The list of participants that have attended the public consultation programme meeting is attached in Annexure 6.

240. This IEE report will be translated to Sinhala and Tamil and will be kept at Minipe and Wilgauwa Divisional Secraries office. The communities will be made aware about the document and their role through the Grama Seva Niladahris.

241. Through out the project period consultations will be held with the farmers and the main mechanism available is the Kanna meeting held between farmers and the Irrigation officials.

PART G GRIEVANCE REDRESS MECHANISM

242. **The Rationale**: During the construction and implementation phases of any development project, a person or group of people can be adversely affected, directly or indirectly due to the project activities. The grievances that may arise can be related to social issues such as eligibility criteria and entitlements, disruption of services, temporary or permanent loss of livelihoods and other social and cultural issues. Grievances may also be related to environmental issues such as excessive dust generation, damages to infrastructure due to construction related vibrations or transportation of raw material, noise, traffic congestions, decrease in quality or quantity of private/ public surface/ ground water resources, damage to home gardens and agricultural lands *etc*.,

243. Should such a situation arise, there must be a mechanism through which affected parties can resolve such issues in a cordial manner with the project personnel in an efficient, unbiased, transparent, timely and cost-effective manner. To achieve this objective, a grievance redress mechanism (GRM) has been included in the overall Environmental Management framework of this project.

244 In order to ensure that any grievance that may arise is resolved in a manner that will accrue maximum benefits to both the project and affected parties, the following aspects were taken into consideration in developing the proposed GRM:

- Establish an effective communication link between the project and affected parties
- To build up productive relationships among the stakeholders including affected parties
- Provide a mechanism for the affected parties to negotiate and influence the decisions and policies of the project which might adversely affect them
- Mitigate or prevent adverse impacts of the project on the environment and produce appropriate corrective or preventive action
- To harmonize project activities with the activities of potentially affected parties to avoid grievances or disputes if possible before they arise
- Should a grievance or dispute arise, provide a forum for addressing such issues at the lowest possible level so that they are resolved as and when they occur

245. **Complaints Management:** All complaints regarding social and environmental issues are usually received either orally or in writing by the Project Proponent (PP) or the Construction Contractor (CC). A key part of the GRM is the requirement for the PP /CC to maintain a registry of complaints received at the respective project site offices. All complainants shall be treated respectfully, politely and with sensitivity. Every possible effort should be made by the PP or the CC to resolve the issues referred to in the complaint within

their purview. However, there may be certain problems that are more complex and cannot be solved through project-level mechanisms. Such grievances will be referred to the Grievance Redress Committee (GRC, see below).

246. The proposed complaint handling and Grievance Redress Mechanism is illustrated in Figure 22.

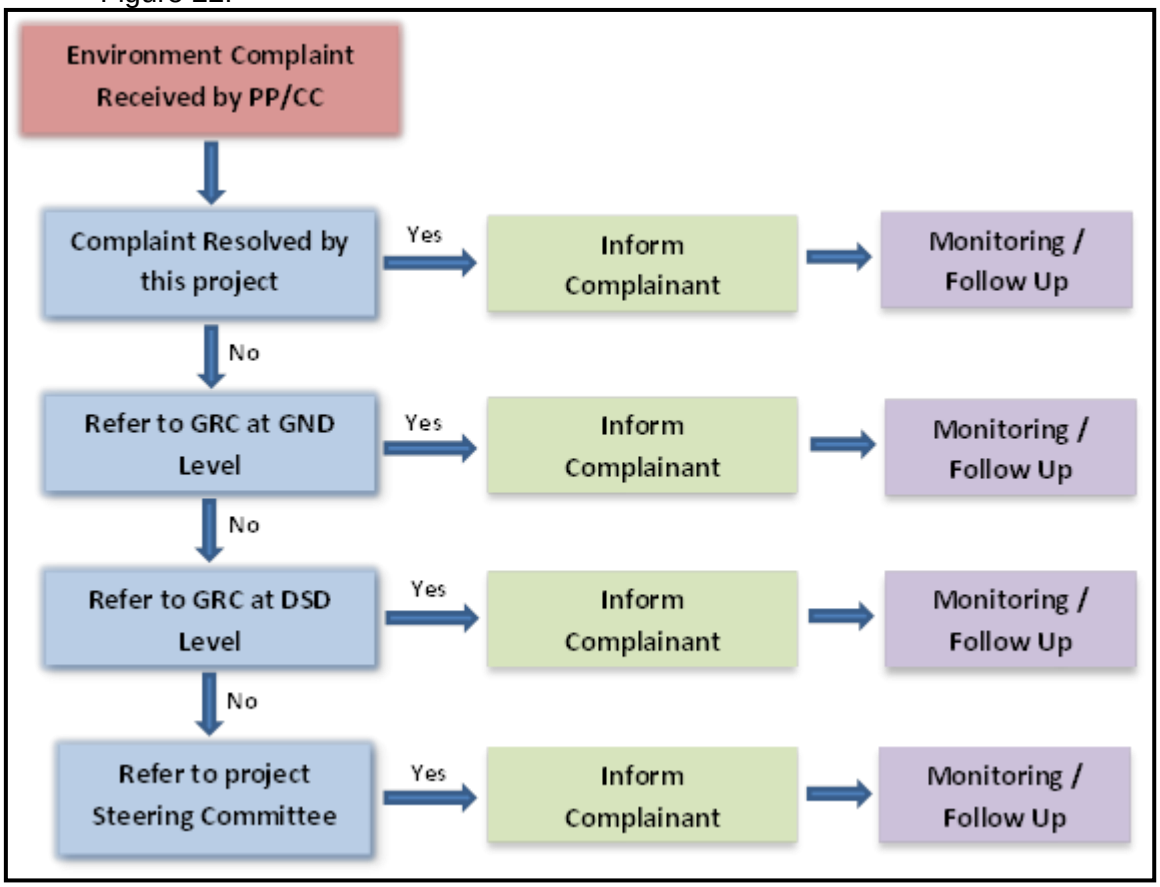


Figure 22. Complaint handling and Grievance Redress Mechanism **(PP = Project Proponent (MMDE); CC = Construction Contractors)**

247. **Grievance Redress Committee (GRC):** The Minipe Anicut Raising and LB Canal rehabilitation Project, in keeping with the ADB and national safeguard policies, will set up Grievance Redress Committees (GRC), which will function as an independent bodies to find solutions to the grievances and disputes of the affected and concerned parties.

248. The appointment of the GRC will be notified to the general public by publication of a notice in national newspapers in three languages i.e., Sinhala, Tamil and English. The local community will also be informed about the grievance handling procedures of the project through Grama Niladharis of the area and displaying notices at important public places including key construction sites within the Divisional Secretariat Divisions of Minipe and Wilgamuwa.

249. **Institutional Arrangements for GRM:** Grievance Redress Committees will be set up at two levels, the Grama Niladhari level and Divisional Secretary levels of the Wilgamuwa and Minipe DS Divisions. The Grama Niladhari or the Divisional Secretary will function as the Chairperson of the respective GRC's. Members to represent the Affected Persons (AP) at the GRC will be appointed from among respected persons in the area on the recommendations of the Divisional Secretaries of Minipe and Wilgamuwa. Other members of the GRC shall be the Project Director (PD) or relevant officers from the PIU, representative(s) from relevant Community Based Organizations, representative(s) of the Contractor(s) and representative(s) from relevant line agencies. An officer nominated by the Project Director of the Minipe Raising project will serve as the Secretary to the GRC. An honorarium will be paid to the members of the GRC and the required funds for operation of the GRC will be borne by Irrigation Department.

GR Committee at GND level

250. **Committee Structure**: Grama Niladhari, Village level government officer (agrarian services/ ID), CBO leaders, Project representative (environment and social resettlement officers). Project affected parties, Contractor or his representative and any other person/government officer if required based on the issue.

251. **Role of the Committee**: Receiving complaints and grievances pertaining to the project activities submitted by the affected person or community

252. Investigate, discuss and analyze the problems within the committee and propose fair and just solutions or remedies if possible. Otherwise, pass it to the committee at the next level with suitable recommendations.

GR Committee at DSD level

253. **Committee Structure**: Divisional Secretary**,** Grama Niladaris of relevant GNDS, Project director or his representative of PIU, CBO leaders, Contractors or his representative, relevant line agencies

254. **Role of the Committee**: Investigate, discuss and analyze the problems in broad detail within the committee and propose fair and just solutions or remedies if possible.

255. If the GR committee at the DSD level fails to resolve the issue, it will be directed to the project steering committee where it has to be resolved.

256. A regular time table should be prepared for the meetings of the relevant committees setting dates and times and a regular process should be developed to inform the committee members of the meeting dates and times.

257. At Grama Niladari level the community should be informed of the places, times and procedures of accepting and hearing grievances & complaints from the community.

258. A minimum time period should be set to deal with the problems at each level (2 weeks maximum).

259**. Terms of Reference of GRC:** The GRM will be established by Irrigation Department during the pre-construction stage, so that the GRC and grievance redress procedures are in place and functioning before land acquisition, resettlement and project construction activities begin. The following is a draft ToR for the GRC, which Irrigation Department will consider and incorporate or amend as necessary:

- The GRC will examine any kind of dispute or grievance arising out of implementation of the Resettlement Plan (RP) and Environmental Management and Monitoring Plans (EMP and EMoP) and resolve such disputes and grievances in a transparent manner.
- GRC will not deal with matters that are pending in a court of law.
- The GRC will not have any jurisdiction over the amount of compensation determined by the Chief Government Valuer.
- The decision of the GRC is deemed final, although a dissatisfied complainant may seek redress through the Sri Lankan legal system, if they so wish.
- Only authorized members will be allowed to participate in the GRC meetings (including the relevant Affected Persons and their representatives).
- A decision on a particular dispute/grievance will be made unanimously or on a majority vote basis.
- The disputes and grievances will be resolved on the first day of the hearing or within 2 – 4 weeks of the first hearing where the issues may be more complicated and more information is required to arrive at a decision.
- A Hearing of certain disputes or grievances may be postponed and a new date be fixed if more evidence is required to make decisions.
- The decision of the GRC will be intimated to the Project Director and the aggrieved party in writing within a week from the meeting.

260. A suitable place and other facilities to conduct the meetings of the GRC will be provided by the Minipe Project. However, GRC meetings can also be held at any other suitable location for the convenience of the affected parties (e.g. in case of ill health or any

other valid reasons).

261. The GRC is expected to meet at least once a month, although more meetings may be held depending on the number of complaints received. The GRC may make field visits where necessary and these will be facilitated by Minipe Project.

262. **The following general conditions should also apply**: Persons who make appeals to the GRC shall attend the meetings of the GRC in person. In a case where the appellant is unable to attend the meeting on the appointed date due to sickness or other unavoidable circumstances, he/she can nominate a close relative or other representative in writing.

263. No legal professionals are allowed to represent an appellant.

264. Appellants may request an alternative date to attend at a particular meeting of the GRC if they are physically unfit to attend the meeting or due to other unavoidable circumstances.

265. There is the need of establishment of an internal mechanism in the MMDE to look into individual or collective complaints and grievances of the Project Area community pertaining to matters connected with the project activities. They should be able to analyze public grievances received to help identification of the problem areas in which modifications of policies and procedures could be undertaken with a view to making the delivery of services easier and more expeditious. They should deal with every grievance in a fair, objective and just manner and issue written reasons for every grievance rejected. This would lead to develop a finer rapport between the Project and the affected community and also reduce the hardships connected with problems the community is facing individually or collectively. This mechanism should also provide counseling and awareness on following**.**

- Awareness of the Project
- Identifying the affected families
- Payment of compensation
- Establishment if infrastructure facilities

266. The structure of the Grievance Redress Mechanism has been built in a manner that the community will be able to participate in discussions with relevant officers in solving their problems starting at the grass root level and linked to the higher level.

PART H ENVIRONMENTAL MANAGEMENT PROGRAMME

267. **Institutional Arrangement for implementation of Environment Management and Monitoring Plan (EMoP)**

As a part of this environmental assessment an Environment Management Plan (see section H1) and an Environment Monitoring Plan (see section H2) has been developed with cost estimates and responsible parties to ensure environmental best practices during instruction and operation phases of this project. The contractor should develop a Contractors Enviornment Mnagement Plan based on the EMP presented here and the guidelines for CEMP are given below as well as the enviornmental compliance mechanism in place to ensure that the EMP is implemented properly.

268. **Contractors Environment Management Plan (CEMP):** The CEMP will present the detailed implementation plan based on the Contractor's actual construction methodologies, work schedule, type or specifications. The CEMP shall be consistent with the project EMP and prepared based on the Contractor's activities and corresponding locations. The CEMP will provide the following:

i. Contractor's organizational structure showing the implementation, supervision and reporting and responsibilities of key personnel

ii. The project program and work activities

iii. The Contractor's specific plans as follows
    1. Utilities re-positioning if required (to minimize/avoid disruption of services such as power, water supply, etc.)
    2. Facilities Management Plan (detailed designs, methodologies and installation locations of all construction-related facilities such as access roads, workers' camps, storage areas, equipment maintenance areas etc., as well as pollution control facilities, such as drainage channel, settling tank/ponds, septic tanks, temporary noise barrier, etc.,) to manage impacts due to operation of various facilities.
    3. Air Pollution (dust and gaseous emissions) Control Plan
    4. Noise and Vibration Control Plan
    5. Waste Management Plan (solid, liquid, hazardous)
    6. Spoil Disposal Plan
    7. Drainage Management Plan
    8. Erosion and Sedimentation Control Plan
    9. Traffic Management Plan
    10. Chemicals and Hazardous Materials Management Plan

11. Workers and Public Safety Plan
12. Emergency Response Plan

iv. The approach and program for implementing various mitigation measures specified in the Project EMP
v. Plan for self-monitoring and reporting to ensure compliance with EMP/CEMP provisions

269. **Environmental Compliance Monitoring:** Environmental Compliance Monitoring is essential for successfully implementing the project specific environmental management program developed through the Environmental Assessment done for the project and the EMP prepared taking in to account project specific environmental impacts that may arise and mitigation measures required to make the project both environmentally and economically viable.

270. Environmental Compliance monitoring involves a systematic collection and analysis of environmental mitigation/compliance related information as the project progresses. It is aimed at improving the efficiency and effectiveness of the project. Monitoring will help determine whether the project is meeting the environmental standards and whether the Environmental Mitigation component results in the expected outputs. It is important that the Resident Engineer of the project and all appointed Environment Compliance Officers reporting to the Resident Engineer understand the importance of Monitoring as a tool for analyzing and understanding the status of the project.

271. During the construction phase all forms of internal monitoring should be accompanied by weekly or monthly reports with dated photographs, interview results, and test reports produced by independent firms where necessary. Test reports such as water, air and sediment quality if deemed necessary should be obtained from an accredited laboratory. All the reports produced should be kept with the resident engineer and made readily available to any interested party.

272. **Responsible parties:** The contractor is responsible for implementation of the EMP while the client is responsible for compliance monitoring. The project manager is responsible for monitoring and to assist the project manager in carrying out the monitoring an environmental officer will be assigned to the project manager. In addition the project management unit will employ an environmental specialist who will be responsible for preparing monitoring protocols and training the enviornemental officer as well as supervise the work done by environment officer. In addition a national and international environment expert will be hired by the project management unit to provide technical support for the environment monitoring work.

273. During the implementation of the project the contractor is responsible for carrying out all the mitigation measures specified in the EMP. Monitoring will ensure that the contractor complies with the terms and conditions of the EMP. For this purpose and environmental officer should be appointed under the project manager to carry out routine monitoring and an independent environmental specialist should be involved in periodic review of the work carried out by the environmental officer. The environmental specialist should be mobilized at the beginning of the project where he/she shall carry out initial monitoring and at the same time provide necessary training to the environmental officer on data collection and report preparation.

274. Thereafter it is the responsibility of the environmental officer to conduct routine monitoring. The environmental specialist will have to carry out periodic reviews (at quarterly intervals) to ensure that all the mitigation measures proposed have been carried out as specified in the EMP. Both environmental officer as well as the environmental specialist will directly report to the project manager who has the final responsibility of ensuring that the contractor complies with EMP requirements of the project who in turn will report to the project director. The project director must convene the CEA monitoring committee once every four months at the project site where the environmental officer and the environmental specialist will report progress and the Monitoring followed by a site visit by the monitoring committee to clarify any issues pertaining to monitoring. Further, environment specialist will prepare and submit a monitoring report to the ADB which will be displayed in the ADB website.

H1. Environment Management Plan (EMP)

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
Construction							
Raising the Minipe Anicut	Inundation of the riverine forest (25 ha) of the Mahaweli river upstream of the Minipe anicut	Plant native riverine forest species within the canal reservation (see table 4 of annex V for a list of recommended plant species) of the LB canal and catchment areas of the water bodies associated with the LB canal (estimated extent is 145 ha)	Canal reservation of the Minipe LB canal and catchment areas of the water bodies replanted	Contract specifications	ID to give directions and monitor Contractors to execute mitigation measure	LB canal construction period	75 million at approximately @ SLR 0.5 million per ha of aforestation **(to be added to the contractors bid document)**
Land clearing for construction (Site clearance)	Increased soil erosion due to rain and wind	Plan and conduct earth work during the dry season. Minimize clearing vegetation for construction activities Construct silt traps in drainage paths.	Sediment load in the downstream areas Public complaints	Contract Specifications	ID to give directions and monitor Contractors to execute mitigation measures	Throughout the construction period	0.5 million for the construction of silt traps (**included in the civil works)**
	Vegetation removal	Strict control on clearing activities to ensure minimal clearance as specified in contract documents (this will be decided by the design team to include only the space necessary for the temporary structures, storage areas for construction materials and vehicle parking areas)	Vegetation marking and clearance control (area in ha as specified in BOQ)	Clearance strictly limited to target areas	ID to supervise and Contractors to implement through contract provis	Construction period	included in civil works for clearing and PMU monitoring is environmental officers responsibility
	Water pollution	Construction activities involving significant ground disturbance near surface water bodies should not be undertaken	Starting and finishing times of major earthworks	Technical specification	ID and consultants for supervision	Construction period	No Cost

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
		during the monsoon season.	near water bodies		and contractors will execute		
Provision of facilities for construction workers, temporary office and storage areas	Contamination of receptors (land, water, air)	Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities. Construction camp sites and storage areas shall be located away from any local human settlements, water bodies and forested areas (minimum 0.2 km away) and preferably located on land which is not productive (barren/waste lands presently). If these are not possible private land maybe taken on lease as standard practice. The construction camps, office and storage areas shall have provision of adequate water supply, sanitation and all requisite infrastructure facilities. The construction camps, office and storage areas shall have provision of septic tank/soakage pits of adequate capacity so that it can function properly for the entire duration of its use.	Amenities for Workforce facilities	Presence of proper sanitation, water supply and waste disposal facilities Use of safety equipment by construction workers	ID and consultants for supervision and contractors will execute	Construction period	10 million to provide the necessary sanitation facilities and safety equipment for construction workers **(included in the civil workers)**

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
		The construction camps, office and storage areas shall have proper storm water discharge systems to prevent water stagnation All construction camps shall have provision of rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided to the extent possible. The construction camps, office and storage areas shall have provision of first aid facilities. Awareness creation about health and safety aspects to all workers and preparation and implementation of a health and safety plan Personal Protective Equipments (PPEs) such as helmets, boots, earplugs for workers, first aid and fire fighting equipments shall be made available All temporary structures, storage areas removed and rehabilitated					
Surplus	Runoff will	Avoid dumping excess earth	Location and	Appropriate	ID and	Construction	No Cost

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
earthwork/soil	cause water pollution, by increased sediment deposits along water ways.	near water ways. If kept for a long time soil heaps are to be covered properly. Dump excess soil only in designated locations approved by the engineer.	amount of soil disposed. Excess soil storage areas	selection of fill disposal and dispersal locations	consultants for supervision and contractors will execute	period	
Mechanized construction	Noise and vibration impacts	Ensure correct operation, maintenance and site practices Construction equipment to be well maintained. Use silenced equipment and minimize the use of noisy equipment Schedule activities to avoid high noise levels Use noise barriers when required. Proper traffic management in the sites Avoid activities that generate high noise near schools and religious centers Noise generating activities close to residential and public areas should be carried out between 7	Construction equipment - estimated noise emissions and operating schedules Allowable noise levels in the boundary of construction sites are kept below 75 dB in day time. Avoid or Restrict night time operations.	Strict adherence to noise control regulations of CEA	ID and consultants for supervision and contractors will execute	Construction period	Part of civil works costs

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
		am and 6 pm Limit maximum noise level at residential areas and close to public places to 55dB					
	Air pollution due to construction related vehicles	Ensure vehicles have been properly maintained and are in compliance with emission regulations of Sri Lanka Stipulate speed limits and load limits	Vehicle fleet Transport routes taken by construction related vehicles	All vehicles must comply with Sri Lankan regulations on emissions and noise	Contractors	Construction period	No cost
	Dust from construction sites	Regular wetting of exposed surfaces. Watering frequency to be increased during the dry season and periods of high wind Maintain road surfaces and if possible pave roads Turf exposed surfaces where ever possible	Regular watering of access roads Turfing of finished earthen structures	Contract specifications	ID and consultants for supervision and contractors will execute -	Construction period	No cost
	Generation of solid waste	Plastics etc should be disposed for recycling. Provide facilities to reuse, recycle and dispose solid waste properly Restrict open burning Waste oils, chemicals and other hazardous material to be collected and removed through	Contractors are encouraged at bidding stage Identify solid waste recyclers in the area	Contract specifications	Design team/Consultants	Construction period	0.1 million for purchase of heavy duty trash bins to be placed at all construction sites **(included in the civil workers)**

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
		a contractor. Storage areas of such material should be bunded	Disposal should be only under the permission of the engineer				
	Generation of dredged material	Test and reuse dredged material either in agricultural fields or to form a bund in the left bank side of the canal Dredged material that are unsuitable for reused will be disposed in a site acceptable to local authority and ID A transport plan is to be drawn for the transport of dredged material to minimize traffic Any spills during transport are to be cleaned immediately Drainage management plan to be drawn up for the disposal site	Locations where dredged material are disposed	Contract specifications	Design team/ Consultants and contractors	Final design and construction period	0.1 million for testing of material 0.1 million to prepare a drainage management plan for the dredged material disposal site **(to be included in the PMU budget)**
	Pollution of water due to contaminant leakage from machinery and work sites	Use of bio degradable detergents for cleaning of machinery Waste lubricants and fuels should be collected and discharged as per contract specifications	Monitored by the project team	Design specifications For waste water SLS standards (1990) For sewage	ID/Consultants supervision and contractors to implement	Construction period	No cost

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
		Solid and liquid waste from resident work camps should not be released directly to waterways		SLS standards (2004)			
Transportation and storage of materials	Nuisance to the general public due to generation of dust, traffic congestions and damages to road surfaces Storage of construction material on roadside without proper signage can pose a threat to road users	Construction material or waste should not be transported in open vehicles. If transported in open vehicles material should be properly covered to prevent fall off from the vehicle bed Noise levels of heavy vehicles should be kept within allowable range Construction material and dredged material should not be stored on roadside and if this has to be done proper signage must be placed to warn road users Soil stockpiles should be covered if stored for a long period without use Any damages to road surface should be repaired immediately A traffic plan should be drawn out if traffic congestions are anticipated due to material transport	Water and air quality Noise levels Road surface of roads used for transport of construction material Construction material storage areas	National Environment Act Laws National Emission Standards and CEA water and air quality standards	ID/Consultants supervise and contractors implement	Construction period	No cost

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
Anicut construction and LB canal rehabilitation	Soil erosion from cleared sites	Existing drainage should not be disturbed and temporary paths should be created to avoid drainage congestion. Silt traps should be constructed to avoid siltation of downstream areas Excess soil should be dumped only in designated dumping areas.	Turbidity of downstream water ways Public complaints	Technical specifications regarding total suspended solids	ID/Consultants supervise and Contractor implements	Construction period	No cost
	Establishment of weed species (invasive plant species) in the project area due to introduction through imported raw material, construction equipment or unplanned dumping of cleared weed species.	Nominate appropriate wash down facilities and locations for vehicles and equipment. Conduct periodic surveys to identify new weed infestations and take appropriate measures to manage them.	Monthly inspection of soil storage areas, wash down areas, vehicle parking areas and disposal sites for the presence of weeds or alien invasive species	Contract specifications	Design team/Consultants	Construction period	Rs 0.5 million to support periodic surveys for weeds or alien invasive species by an weed scientist and provide advice on weed management **(to be included in the PMU budget)**
	Shortage of water to farmers due to diversion of water for repair	Plan activities that require diversion during non cultivation periods If this cannot be done discuss	Number of farmers affected by diversion Complaints	Contract specifications	ID/Consultants and Contractor	LB canal construction period	No cost

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
	work	with farmers as to how this would impact their livelihoods and ways to respond to such disruptions in water supply	received or public consultation				
	Blockage of movement across the LB canal	Prior notification to road users during a closure in appropriate local language (Sinhala or Tamil) Provide alternate routes with proper signage Minimize road closure through proper planning Provide alternate and safe bridges if a longer period of closure is required.	Number of public complaints received	Contract specifications	ID/Consultants and Contractor	LB canal construction period	1 million for signage and provision of temporary access where road closure for long periods is anticipated **(included in the civil workers)**
	Changes in cropping patterns in the command area of the LB canal resulting in escalation of the human-wildlife conflict	Carry out and survey in the areas where human-wildlife conflict exist within the LB canal command area at present and evaluate the effectiveness of mitigation measures that are implemented and strengthen these mitigation measures further	Stage IV of the LB canal where the conflict is likely to take place	Contract specifications	ID/Consultants and Contractor	LB canal construction period	25 million to commission a study to evaluate the present mitigation measures and to finance measures to strengthen the ongoing conflict management practices **(to be included in the PMU budget)**
Operational and Maintenance							
Water management	Inadequate water delivery	Prepare a water delivery plan for the whole system	Number of public	ID guidelines	ID	Annually	No cost

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
of the system	to some of the outlets	Liaison with MASL to obtain required quota of water	complaints received				
Maintenance of the system	Degradation of the system	Ensure utilization of a proper maintenance gang for regular maintenance	Visual inspection of the LB canal	ID guidelines	ID	Annually	No cost
Release of e-flow from the anicut	Degradation of the river habitat downstream of the Minipe anicut	Ensure that the e-flow is released as specified (8 m^3/sec and 16 m^3/sec during the cultivation and non cultivation season (30th January to 15th April and 25th August to 15th November) respectively)	Inspection of the habitat quality below the anicut	Water quality parameters such as pH, DO, TSS and fish sample counts to be used as an abundance index	ID	Bi annually	1 million to cover the cost of inspections by an expert team and to cover the expenses of any water quality tests that needs to be done **(to be included in the PMU budget)**
Enhanced water supply to the command area of the Minipe LB canal	Changes in cropping patterns in the command area of the LB canal resulting in spreading of human-wildlife conflict into new areas Increase the disturbance to soil resulting in increase in the sedimentation rates.	Provide measures to reduce the human wildlife conflict such as construction of electric fences (termagant fences around dwellings and perennial crop fields and temporary fences around seasonal crop fields which can be removed at the end of the cropping season to allow access to crop fields during the fallow period) Conduct an extensive awareness campaign within the command area of the Minipe LB canal to promote soil conservation and water	Stage IV of the LB canal where the conflict is likely to take place Command area of the Minipe LB canal	Contract specifications	ID/Consultants and Contractor MMDE	LB canal construction period	25 million to finance measures to manage human-wildlife conflict in newly developed conflict areas **(to be included in the PMU budget)** 20 million to hold three awareness programs each for the 60 farmer organizations within the

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule	Cost of implementation (SLR)
	Increased use of fertilizer and pesticides that will result in increased pollution	conservation measures as well as reduce the use of agrochemicals through practice of an integrated pest management approach					command area of the LB canal and develop awareness material such as posters, booklets, brochures etc., **(to be included in the PMU budget)**

H2. Environment Monitoring Plan (EMoP)

	Mitigation Activities and Method of monitoring environmental Changes	Location / timing of sampling	Parameters to be monitored	Frequency of monitoring	Institutional framework for mitigation of impacts	Responsibility	Cost of monitoring
Construction Phase							
1.	Establishment of a rivereine vegetation in the LB canal reservation	Along the LB canal trace	Number of Ha successfully planted	Once in 4 months	Check whether the action proposed is implemented properly	Environmental officer and the environmental specialist	Funds for the purpose of monitoring will be allocated by the Project Proponent The main cost items are: Salary and transport allowances for environmental officer and the environmental specialist for the duration of the project = 20 million Sri Lankan Rupees **(to be included in the PMU budget)** Obtaining test reports on water and air quality
2.	Surface Run-off, soil erosion, slope failures from hill slopes,	Minipe anicut and Minipe LB canal	Soil erosion from cleared ground sections along anicut axis and LB canal trace	Every 2 weeks	Check whether the action proposed is implemented properly to minimize soil erosion	Environmental officer and the environmental specialist	
			Disposal of excavated unusable soil materials, dredged material and construction wastes	Every 2 weeks	Check whether the action proposed is implemented properly	Environmental officer and the environmental specialist	
			Soil erosion from excavated soil materials along canal traces	Every 2 weeks	Check whether the action proposed is implemented properly to dump excavated soil materials in identified dumping sites	Environmental officer and the environmental specialist	
			Placement of soil stockpiles and other erodable construction material	Every 2 weeks	Check whether the action proposed is implemented properly to dump excavated soil materials in identified dumping sites	Environmental officer and the environmental specialist	

							from 7 permanent sampling points established in the LB canal and command area of the LB canal at quarterly intervals during the construction phase and first three years of the operational phase as well as analyzing the sediment samples during the rehabilitation of the LB canal = 20 million Sri Lankan Rupees **(to be included in the PMU budget)** Facilitate monitoring missions by the CEA monitoring committee at quarterly intervals during the construction phase and three years of operational phase = 5 million Sri Lankan Rupees
3.	Dust, noise and vibrations from construction sites	Along the LB canal trace	Noise and Dust levels at construction site Emission certificates of motor vehicles Method of transport of construction material Wetting frequency of dust generating surfaces House hold survey for cracks Number of public complaints	Every 4 weeks	Check whether the action proposed is implemented properly for dust, noise and vibrations arising from construction sites	Environmental officer and the environmental specialist	
4.	Nuisance to general public	Along the LB canal trace	Traffic reports Road surface of routes used to transport material Public complaints	Every 4 weeks	Check whether the action proposed is implemented properly to reduce public nuisance	Environmental officer and the environmental specialist	
5.	Water shortages to farmers due to canal diversion for repair work	Along the LB canal trace	Public complaints Interview survey of selected farmer organizations	Every 4 weeks during the cultivation period	Check whether the action proposed is implemented properly to reduce public nuisance	Environmental officer and the environmental specialist	
6.	Proper disposal of solid, liquid and construction waste	Minipe Anicut and along the LB canal	Visual inspection of camp sites, project offices and construction sites Public complaints Interviews with local authorities for compliance	Every 4 weeks during the cultivation period	Check whether the action proposed is implemented properly with respect to disposal of solid, liquid and construction related waste	Environmental officer and the environmental specialist	
7.	Introduction of weeds and Alien invasive species	Construction material storage areas, vehicle wash down	Visual inspection to determine growth of weeds or Alien invasive plant species	Every 4 weeks during the constructi	Check whether the necessary actions have been taken to manage weeds and alien invasive	Environmental officer and the environment	

		areas		on period	plant species by the contractor	al specialist	**(to be included in the PMU budget)**
Operation Phase							
1.	Water management in the system	Command area of the Left Bank	Interview survey of selected farmer organizations	Twice per cropping season for three years	Check whether the water deficit issue has been sufficiently addressed	Environmental officer and the environmental specialist	
2.	Management of the system	LB Canal and Minipe Anicut	Visual inspection of Anicut, LB Canal and associated structures	Twice a year for five years	Check whether the Anicut, LB canal and associated structures are properly maintained	Environmental officer and the environmental specialist	
3	Development of burrow areas, temporary material storage areas and Areas used for labor camps and offices	All Burrow Areas, material storage areas, sites where temporary labor camps and offices were located, areas used for parking construction related vehicles and wash down areas for vehicles	Visual inspection to determine whether these areas have been properly rehabilitated Identify whether sites have been invaded by weeds or alien invasive plant species	Every quarter for three years	Check whether the temporary usage areas have been properly rehabilitated and introduction of weeds and alien invasive species have been avoided	Environmental officer and the environmental specialist	
4.	The prescribed e-flow is released as specified	Area downstream of the Minipe anicut	Visual inspection to determine whether the e-flow is being released as specified Inspection of any changes in the aquatic species composition in the area downstream of the Minipe anicut	Every quarter for three years	Check whether the prescribed e-flow has been released as specified and the general health of the area downstream of the Minipe anicut is maintained	Environmental officer and the environmental specialist	

5.	Water quality of the LB canal	7 Permanent monitoring sites along the LB canal. Location to be determined prior to start of construction by Senior Env Officer attached to PMU	Physical and chemical quality of water samples	Every quarter for three years	Water quality is up to SLS standards for use	Environmental officer and the environmental specialist	
6.	Human-wildlife conflict mitigation	Command area of the Minipe LB canal stage IV	Level of conflict and effectiveness of the mitigation measures	Once a month during the cropping season	Check whether the prescribed mitigation measures have been carried out as specified and suggest and any adaptive changes that should be introduced	Environmental officer and the environmental specialist	
7.	Awareness campaign to promote sustainable farming practices	Throughout the command area of the LB canal	Changes in farming practices towards more sustainable ways supported by water quality data generated	Every quarter for three years	Check whether the prescribed mitigation measure has brought about positive change in farming practices as well as positive change in the water quality	Environmental officer and the environmental specialist	

CONCLUSIONS AND RECOMMENDATIONS

275. The proposed project involves rehabilitation of an already existing infrastructure. Further, the construction work will be limited to a short duration and the area impacted is less than 40 ha in extent. Therefore, the impact on the physical environment will be minimal and can be easily mitigated through execution of the proposed enviornemental management plan. The site selected for the proposed project is located within a sanctuary declared by the DWC. Therefore, no human settlements are found in the project impact area. Thus the proposed project will not result in any negative socio-economic impacts such as loss of livelihoods and resettlement of people. However, the project will have positive influence on the socio-economic status of the farmers that inhabit the irrigable area of the LB canal as the project will resolve their two major water issues, fluctuation of flow in the canal and deficit of water at the tail end of the canal.

276. Two natural ecosystems will be directly affected due to the implementation of the proposed project activities. First, ca. 25 ha of tropical moist evergreen forest present along the left and right bank of the Minipe Pool will be subjected to transient inundation during operation of Rantambe power house. Second, a stretch of the Mahaweli river ca. 6.5 km in length, between the Minipe Anicut and the confluence of Badulu Oya will be subjected to low flows as spillage over the Minipe Anicut will be significantly reduced upon implementation of this project.

277. In conclusion, the proposed project will not have any significant impacts on the environment other than the loss of 25 ha of habitat due to increased inundation area after raising the Minipe anicut and reduction of flow in the Mahaweli River due to the implementation of this project.

278. Therefore, an enviornemental flow of 8 m^3/sec and 16 m^3/sec during the cultivation and non cultivation season (30th January to 15th April and 25th August to 15th November) respectively shall be released from the Minipe Anicut to meet the ecological demands of the river.

279. In order to compensate for the loss of habitat the project proponent shall undertake to reforest the LB canal reservation which will result in the establishment of rivereine vegetation in an extent of 145 ha.

280. It is also recommended that the project proponent should execute the proposed environmental management plan to ensure best practices during construction and operation of this project.

281. Since all the project activities will take place in a protected area, it is strongly recommended that an appropriate independent monitoring mechanism with relevant funds are established for this project to ensure that the project proponent complies with the proposed mitigation measures as well as carry out the recommendations of this study.

282. The water quality study indicates that some of the water parameters such as Color, Phosphate, Aluminum and Coliform counts contributed by non-point soil erosion and surface runoff exceed the safety levels for bathing and drinking water during certain times of the year. This indicates excessive use of agrochemicals and lack of proper sanitation practices in the catchment area of the LB canal. Further, the LB canal is also subjected to high sedimentation rate due to high erosion rates in its catchment. Whilst rehabilitation of the LB canal has provided many solutions to reduce pollution and siltation of the LB canal it is strongly recommended that a programme is instituted by the project to create awareness among the farmers that inhabit the catchment area of the LB canal on safe use of agrochemicals, wise use of water, soil conservation measures and safe sanitation practices.

283. All the construction work, especially the construction of the concrete anicut, earth bund and other civil works should be carried out under the supervision of qualified geotechnical/civil engineers. Further, the foundations of civil structures including retaining walls should be on solid ground by-passing the overburden. All design and constructions should be carried out under the supervision of qualified geotechnical and structural experts.

284. As the earth slopes submerge it is recommended to lay suitable size boulders to protect the toe of the slope from erosion and instabilities due to the fluctuation of the water level. Therefore, about 100m from the gate at the right bank should be protected with a gabion structure covering at least the high flood level of the total slope height. Furthermore, the bare soil slope should be protected against river erosion using boulder packing or with a suitable rip-rap.

285. Disturbance to the steep slopes should be minimized. It is recommended to carry out construction work during the dry period to minimize heavy erosion. Necessary protective measures against soil erosion should be applied. Blasting in steep slopes is not recommended. However, if rock excavation is required control blasting should be used under the supervision of a blasting expert.

286. Since the first part of this project (raising of Minipe Anicut) takes place within the Victoria-Randenigala-Rantembe Sanctuary, it is strongly recommended that a member from the Department of Wildlife Conservation is present at the construction site during the entire

construction period to safeguard the interests of the wildlife and to ensure that the project activities complies with the provisions of the Fauna and Flora Protection Ordinance. Further, all construction work done inside the VRR sanctuary must be done in manner that will not cause any harm to animal habitats. Finally, the project proponent should ensure that Kadurupitiya Tank I and II located inside the Wasgomuwa National Park will receive an uninterrupted water supply after rehabilitating the Minipe LB canal.

Annexure I. Terms of Reference

(The ToR also includes requirements to fulfill ADB's Safeguard requirements. Please refer to ADB's Safeguard Policy Statement 2009 available on www.adb.org for more details.)

Note: *The developer should in consultation with technically qualified personnel, complete the following questionnaire. Separate sheet should be used where detailed information is required. It is in the developer interest to filling all information as completely and as accurately as possible. The duly completed questionnaire could be considered as an initial Environmental Examination Report, if duly perfected by the developer. It is important note that this information is being used in decision making.*

Project Title **:** Raising of Minipe Anicut Project in Kandy District

Project Proponent : Ministry of Irrigation & Water Resources Management

Project Approving Agency **:** Central Environmental Authority

Validity **:** This Terms of Reference is valid only for 18 months from the date of issue. The IEE report should be submitted within the validity period

Date of issue **:**

Outline of the Report

Executive Summary

PART A General information
PART B Project details
PART C Information on environmental elements of the study area.
PART D Description of the anticipated environmental impacts.
PART E Mitigatory measures
PART F Information disclosure, consultation, and participation
PART G Grievance redresses mechanism
PART H Environmental management programme

Appendices:

i. Terms of reference
ii. Sources of data and information
iii. Reference
iv. List of persons responsible for study including their work allocation
v. Complete set of relevant maps, table chart, layout plane and other details

1 EXECUTIVE SUMMARY

The summary should be brief non the technical summery of the salient features of the proposed project, the exiting environment of the project site and its environs, key environmental impacts and proposed to mitigate the environmental impacts.

PART A GENERAL INFORMATION

A.1 Name of the Project:

A.2 Name of the Developer: (Company / Firm/ Individual)
Postal Address:
Phone, Fax No:
Contact person/ Name/ Designation/ Phone, Fax:

A.3 Nature of the project:
Main objective/s of the project:
Justification:

A.4 Location of the project:

- **i.** Pradeshiya Sabha:
- **ii.** Divisional Secretariat:
- **iii.** Provincial Council:
- **iv.** Provide a location map indicating the project site, access to the site, surrounding development and infrastructure within 500 m of the site (At Appropriate scale)

A.5 Applicable laws, regulations, standards and requirements covering the proposed project:

A.6 Clearances/ permits obtained or should be obtained from relevant state agencies and /or local authority. (Attach required copies of same)

PART B PROJECT DETAILS

B.1 Project layout (drawing showing project layout plan covering the entire identified site including all major component of the project.)

B.2 Project components including its principal features,

(a) Irrigation infrastructure(dam and structures to be formed in the dam and their functions, reservoir details, irrigation and drainage works, proposed

improvements to the existing structures canals etc, command area - new and existing).

Size, Capacity and extent of all components relevant to the project

(b) Proposed rehabilitation works of the anicut, canals and the reservoir Construction techniques, equipment to be used.

(c) Improvements of command area. If applicable (E.g. : LB, RB etc)

B.3 Raw materials to be used for constructional purposes (Quantity, source and location of borrow areas transportation and storage of raw materials etc.)

B.4 Disposal of dredged materials - if any (quantity and disposal sites)

B.5 Infrastructure facilities [details of any access road to be built/ improved (exiting condition and anticipated)]:

B.6 Operational procedure including environmental flow to be maintain and justification of the downstream flow release below the dam

B.7 Any future additions, expansions envisaged:

B.8 State the proposed time schedule for construction:

PART C INFORMATION ON ENVIRONMENTAL ELEMENTS STUDY AREA

The study area for the assessment shall include the following;

1) Project site (Minipe Anicut and Reservoir Area)
2) Immediate surrounding of the project site.

Following details to be provided.

C.1 Hydrology

i. Natural drainage system in the scheme, its functions and the associated flooding pattern.

ii. Exiting Irrigation structures and their operation.

C.2 Geology and Soil types in the area

C.3 Land use patterns

C.4 Biological Environment

i. Status of aquatic and terrestrial eco-systems present.

ii. Present ecological conditions and functioning of the identified ecosystems.

C.5 Socio-cultural Environment and social aspects

i. Exiting infrastructure and service facilities available for people of the area.

ii. Threats from wildlife and potential for human-animal conflict in the project area.

PART D DESCRIPTION OF THE ANTICIPATED ENVIRONMENTAL IMPACTS

D.1 Constructional Impacts

- Soil erosion and sedimentation
- Dust, noise emissions
- Transport and disposal of dredged material
- Impacts on burrow areas.

D.2 Impacts on hydrology:

- Drainage problems
- Inundation of reservoir area
- Ground water recharge

D.3 Impacts on land stability and land use (additional inundation area etc.,) due to reservoir

D.4 Impacts on biological environment

- Impacts on fishery
- Effects on flood plain ecology
- Loss of flora and fauna
- Effects on protected areas

D.5 Sociological Impacts

- Relocations of people (if any)
- Impacts on economic activities
- Impacts on land use pattern
- Impact on altering water supply on users
- Number of families to be affected and to be replaced by the development

- Impacts on occupational health and safety and community health and safety
- Increased threats from wildlife and potential for human elephants conflicts in the project area
- Socio-cultural impacts due to migratory works (if any)
- Socio economic benefits (Other than employments) to be provided to the local people
- Impacts on exiting infrastructure and service facilities available for people of the area
- Impact on water users of LB and RB main scheme (During the construction & operation)

This chapter should also assess the potential impacts of climate change on proposed investments. Impacts at borrow sites, quarry pits, disposal sites too should be discussed

D.6 Any other impact which has not being anticipated at this stage but may come up in the future.

PART E MITIGATORY MEASURES

Proposed measures to minimize the impacts identified in Part D to acceptable levels including conformity to gazette Sri Lankan standards. Mitigation methods should be identified in specific practical terms.

PART F <u>INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION</u>

Should describe

(i) The process undertaken during project design and preparation to engage stakeholders, including information disclosure and consultation with affected persons and stakeholders

(ii) Summarize comments and concerns received and describe how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and indigenous peoples; and

(iii) Describe the planned information disclosure measures (including type of information to be disseminated and method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation

Annexure II. Sources of Data and Information

No	Name	Position	Contact Details
1	Mr. M.A.D Bandara	Project Manager Irrigation Management Division Minipe	0716104931
2	Eng. (Mr.) Kaleel	Minipe Irrigation Office	0714490622
3	Mrs. Nagahawatta	DS - Minipe	0718474414
4	Mr. K.G. Darmatilake	DS - Wilgamuwa	0714471140
5	Eng. (Mr.) P.W.C Dayaratne	Team Leader NCP Canal Project	0777641630
6	Eng. (Mr.) Liyanagama	Hydrologist Design Team	0775587151
7	Eng. (Mr.) K.A.U.S Imbulana	Design Engineer	0773484551

Annexure III. References

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Annexure IV. List of preparers including their work allocation and the schedules

Name	Position	Responsibilities

Prof. D. K. Weerakoon	Team Leader and Fauna Ecologist	- Overall coordination of the IEE team - Collect primary and secondary data on fauna present in the project area and provide inputs for the relevant sections of the IEE report as defined in the attached TOR - Compilation of the draft final reports based on individuals consultant outputs - Compilation of the final report - Presenting the outcome of the IEE to the project approving agency
Eng. P.H.Jayawaradana	Deputy Team Leader and Civil Engineer and Noise & Vibration Specialist	- Collect primary and secondary data on the engineering and construction related aspects of the project and provide inputs for the relevant sections of the IEE report as defined in the attached TOR
Mr. T.N.Peries	Flora Ecologist	- Collect primary and secondary data on flora and habitats present in the project area and provide inputs for the relevant sections of the IEE report as defined in the attached TOR
Mr. P.D. Leelaratne	Sociologist	- Collect primary and secondary data on the sociological aspects of the project area and provide inputs for the relevant sections of the IEE report as defined in the attached TOR
Eng. R.M.W.Ratnayaka	Hydrologist	- Collect primary and secondary data on the hydrological aspects of the project area and provide inputs for the relevant sections of the IEE report as defined in the attached TOR

Mr. A.Welagedara	Geologist	- Collect primary and secondary data on the geological aspects of the project area and provide inputs for the relevant sections of the IEE report as defined in the attached TOC
Mr.I.Wijesekara	GIS Specialist	- Preparation of the required maps for the IEE study

Annexure V. Relevant maps, tables, charts, layout plan and other details

Table 1. Construction Schedule

No	Task	Time Duration (Months)																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	Protection Wall for RB Sluice and RB Silt Excluder																														
2	By pass to issue water to Minipe LB Scheme																														
3	Modifications to LB Sluice																														
4	Modifications to lb Silt Excluder																														
5	Flank bund on LB																														
6	Grouting fo Anicut Fiundation																														
7	Anicut raising																														
8	Central Silt Excluder																														

Table 2: Plant Species Recorded in the project area

Abbreviations Used:

HA - Habit, **T** - Tree, **S** - Shrub, **H** - Herb, **C** - Climber or Creeper, **EP –** Epiphyte
TS - Taxonomic Status, **E** - Endemic, **N -** Native, **I -** Introduced or Exotic,
NCS - National Conservation Status, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, **LC** - Least Concern
US - Upstream Inundation Area, **DS** - Downstream Area, **CA** - Canal and Associated Vegetation, **WA** - Water Bodies and Associated Vegetation, **RV** - Rivers, Stream and Associated Vegetation, **HG** - Home Gardens, **AG** - Agriculture Lands, **WNP** - Inside of the Wasgamuwa National Park, **CV** - Canal Side Vegetation, **KT** - Kadurupitiya Tank

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Acanthaceae	*Barleria prionitis*	Katu Karandu	S	N	LC	+								
Acanthaceae	*Blepharis maderaspatensis*		H	N	LC	+								
Acanthaceae	*Crossandra infundibuliformis*		H	N	LC	+	+			+				
Acanthaceae	*Eranthemum capense*		H	N	LC	+				+				
Acanthaceae	*Justicia betonica*	Sudu Puruk	S	N	LC	+	+	+	+	+				
Acanthaceae	*Rhinacanthus flavovirens*		H	E	VU	+	+			+				
Acanthaceae	*Stenosiphonium cordifolium*	Bu Nelu	S	N	LC	+								
Alangiaceae	*Alangium salviifolium*	Ruk Anguna	S	N	NT	+								
Amaranthaceae	*Achyranthes aspera*	Gas Karal Heba	H	N	LC	+		+	+					
Amaranthaceae	*Aerva lanata*	Pol Pala	H	N	LC			+	+					
Amaryllidaceae	*Crinum defixum*	Heen Tolabo	H	N	LC	+	+	+	+	+				
Anacardiaceae	*Lannea coromandelica*	Hik	T	N	LC			+	+		+			
Anacardiaceae	*Mangifera indica*	Amba	T	I	LC						+			
Anacardiaceae	*Mangifera zeylanica*	Etamba	T	E	LC		+							
Anacardiaceae	*Nothopegia beddomei*	Bala	T	N	LC	+	+			+				
Anacardiaceae	*Semecarpus nigro-viridis*	Badulla	T	E	LC		+			+				
Annonaceae	*Miliusa indica*	Kekili Messa	T	N	LC	+	+							
Annonaceae	*Polyalthia korinti*	Ul Kenda	T	N	LC	+	+			+				

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Annonaceae	*Polyalthia longifolia*	Owila	T	N	LC	+	+				+			
Annonaceae	*Uvaria sphenocarpa*		C	E	LC	+	+							
Apocynaceae	*Alstonia scholaris*	Ruk Attana	T	N	LC		+	+	+		+			
Apocynaceae	*Anodendron paniculatum*	As Wel	C	N	VU		+							
Apocynaceae	*Plumeria obtusa*	Araliya	T	I	LC			+			+			
Apocynaceae	*Tabernaemontana divaricata*	Watu Sudda	S	I	LC						+			
Araceae	*Colocasia esculenta*	Gahala	H	N	LC	+	+	+	+					
Araceae	*Cryptocoryne beckettii*	Athiudayan	H	E	VU	+	+			+				
Araceae	*Cryptocoryne parva*		H	E	EN		+							
Araceae	*Lagenandra praetermissa*	Kethala	H	E	LC		+			+				
Araceae	*Lasia spinosa*	Kohila	H	N	LC			+	+					
Araceae	*Pothos scandens*	Pota Wel	C	N	LC	+	+			+				
Araceae	*Syngonium angustatum*	Wel Kohila	C	I	LC					+				
Arecaceae	*Areca catechu*	Puwak	T	N	LC			+			+			
Arecaceae	*Borassus flabellifer*	Tal	T	I	LC			+	+		+			
Arecaceae	*Caryota urens*	Kitul	T	N	LC			+			+			
Arecaceae	*Cocos nucifera*	Pol	T	N	LC						+			
Asclepiadaceae	*Calotropis gigantea*	Wara	S	N	LC			+						
Asteraceae	*Ageratum conyzoides*	Hulan Tala	H	I	LC	+	+							
Asteraceae	*Eupatorium odoratum*	Podisinnamaran	S	I	LC	+		+	+		+			
Asteraceae	*Mikania cordata*	Wathu Palu	C	I	LC	+	+	+	+	+				
Asteraceae	*Spilanthes iabadicensis*		H	N	LC		+							
Asteraceae	*Synedrella nodiflora*		H	I	LC	+			+					
Asteraceae	*Vernonia cinerea*	Monara Kudumbiya	H	N	LC	+	+	+	+					
Asteraceae	*Vernonia zeylanica*	Pupula	C	E	LC			+	+					
Asteraceae	*Xanthium indicum*	Uru Kossa	H	N	LC	+	+	+	+					
Bignoniaceae	*Stereospermum colais*	Dunu Madala	T	N	LC	+		+	+		+		+	
Bignoniaceae	*Tabebuia rosea*		T	I	LC			+						

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Bombacaceae	*Ceiba pentandra*	Pulun	T	I	LC			+			+			
Capparaceae	*Capparis zeylanica*	Sudu Welangiriya	S	N	LC								+	
Capparaceae	*Cleome viscosa*	Wal Aba	H	N	LC			+	+					
Clusiaceae	*Garcinia spicata*	Ela Gokatu	T	N	NT	+	+			+				
Clusiaceae	*Mesua ferrea*	Na	T	N	LC	+								
Combretaceae	*Combretum albidum*	Kaduru Ketiya Wel	C	N	NT	+	+			+				
Combretaceae	*Quisqualis indica*		C	I	LC			+						
Combretaceae	*Terminalia arjuna*	Kumbuk	T	N	LC	+	+	+	+	+				
Combretaceae	*Terminalia bellirica*	Bulu	T	N	LC			+						
Combretaceae	*Terminalia catappa*	Kottan	T	I	LC			+			+			
Commelinaceae	*Commelina diffusa*	Gira Pala	H	N	LC	+		+	+					
Connaraceae	*Connarus monocarpus*	Radaliya	C	N	LC	+								
Convolvulaceae	*Cuscuta chinensis*	Aga Mula Neti Wel	C	N	LC			+						
Convolvulaceae	*Ipomoea aquatica*	Kan Kun	C	N	LC			+	+					
Convolvulaceae	*Ipomoea carnea*		S	I	LC			+	+					
Convolvulaceae	*Ipomoea obscura*	Tel Kola	C	N	LC			+	+					
Convolvulaceae	*Merremia umbellata*	Kiri Madu	C	N	LC	+		+	+					
Cyperaceae	*Actinoscirpus grossus*		H	N	LC			+	+					+
Cyperaceae	*Cyperus aromaticus*		H	I	LC	+	+							
Cyperaceae	*Cyperus spp.*		H	N	LC	+	+	+	+					+
Cyperaceae	*Fimbristylis spp.*		H	N	LC	+	+	+	+					+
Datiscaceae	*Tetrameles nudiflora*	Niguna	T	N	LC			+						
Dilleniaceae	*Dillenia indica*	Hondapara	T	N	LC	+	+			+				
Dioscoreacea	*Dioscorea alata*		C	I	LC		+							
Dracaenaceae	*Sansevieria zeylanica*	Niyanda	H	N	NT	+								
Ebenaceae	*Diospyros ebenum*	Kaluwara	T	N	EN	+								
Ebenaceae	*Diospyros malabarica*	Timbiri	T	N	LC	+	+			+				
Ebenaceae	*Diospyros ovalifolia*	Kunumella	T	N	LC	+	+							

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Euphorbiaceae	*Breynia vitis-idaea*	Gas Kayila	S	N	LC			+						
Euphorbiaceae	*Bridelia retusa*	Ketakala	T	N	LC			+	+	+	+			
Euphorbiaceae	*Cleistanthus pallidus*		T	E	LC	+	+							
Euphorbiaceae	*Croton aromaticus*	Wel Keppetiya	S	N	LC	+	+	+	+					
Euphorbiaceae	*Croton hirtus*	Val Tippili	H	I	LC			+	+					
Euphorbiaceae	*Dimorphocalyx glabellus*	Weli Wenna	T	N	LC	+	+			+			+	
Euphorbiaceae	*Drypetes gardneri*	Gal Wira	T	E	NT								+	
Euphorbiaceae	*Drypetes sepiaria*	Weera	T	N	LC	+	+						+	
Euphorbiaceae	*Euphorbia heterophylla*		H	I	LC			+	+					
Euphorbiaceae	*Flueggea leucopyrus*	Heen Katu Pila	S	N	LC	+		+	+					
Euphorbiaceae	*Homonoia riparia*		S	N	NT					+				
Euphorbiaceae	*Macaranga peltata*	Kenda	T	N	LC	+		+			+			
Euphorbiaceae	*Mallotus repandus*		S	N	LC	+	+							
Euphorbiaceae	*Mallotus rhamnifolius*	Molabe	T	N	LC	+							+	
Euphorbiaceae	*Manihot esculenta*	Maiyokka	S	I	LC						+			
Euphorbiaceae	*Manihot glaziovii*	Gas Maiyokka	T	I	LC			+						
Euphorbiaceae	*Margaritaria indicus*	Karavu	T	N	VU	+	+	+	+	+				
Euphorbiaceae	*Phyllanthus myrtifolius*		S	E	VU	+	+							
Euphorbiaceae	*Phyllanthus polyphyllus*	Kuratiya	S	N	LC	+							+	
Euphorbiaceae	*Phyllanthus reticulatus*	Kaila	S	N	LC	+	+	+	+					
Euphorbiaceae	*Sapium indicum*	Kiri Makulu	T	N	VU			+						
Fabaceae	*Acacia caesia*	Hinguru Wel	C	N	LC	+	+	+	+	+			+	
Fabaceae	*Acacia melanoxylon*		T	I	LC			+			+			
Fabaceae	*Bauhinia racemosa*	Maila	T	N	LC	+		+	+				+	
Fabaceae	*Bauhinia tomentosa*	Kaha Petan	T	N	LC	+							+	
Fabaceae	*Cassia fistula*	Ehela	T	I	LC	+		+			+			
Fabaceae	*Cassia spectabilis*	Kaha Kona	T	I	LC	+	+							
Fabaceae	*Crotalaria pallida*		H	N	LC	+	+		+					

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Fabaceae	*Crotalaria verrucosa*	Nil Andana Hiriya	H	N	LC	+			+					
Fabaceae	*Cynometra zeylanica*		T	E	NT	+	+							
Fabaceae	*Delonix regia*	May Mara	T	I	LC			+						
Fabaceae	*Derris parviflora*	Kala Wel	C	E	LC	+	+	+	+				+	
Fabaceae	*Entada pusaetha*	Pus Wel	C	N	LC	+	+			+				
Fabaceae	*Erythrina fusca*	Yak Erabadu	T	N	NT			+	+					
Fabaceae	*Flemingia strobilifera*	Hampinna	S	N	LC	+		+		+				
Fabaceae	*Gliricidia sepium*	Weta Mara	T	I	LC			+	+		+			
Fabaceae	*Leucaena leucocephala*	Ipil Ipil	T	I	LC			+	+		+			
Fabaceae	*Mimosa invisa*		C	I	LC		+							
Fabaceae	*Mimosa pigra*	Yoda Nidikumba	S	I	LC		+							
Fabaceae	*Mimosa pudica*	Nidikumba	H	I	LC	+	+	+	+					
Fabaceae	*Peltophorum pterocarpum*		T	I	LC			+						
Fabaceae	*Pongamia pinnata*	Magul Karanda	T	N	LC	+	+	+	+	+				
Fabaceae	*Samanea saman*	Para Mara	T	I	LC	+	+	+	+	+				
Fabaceae	*Tamarindus indica*	Siyabala	T	I	LC			+			+			
Fabaceae	*Tephrosia purpurea*	Pila	H	N	LC			+	+					
Fabaceae	*Vigna radiata*	Mun Eta	H	I	LC							+		
Flacourtiaceae	*Hydnocarpus venenata*	Makulu	T	E	LC	+	+		+	+				
Hippocrateaceae	*Reissantia indica*		C	N	LC	+	+							
Hippocrateaceae	*Salacia reticulata*	Kotala Himbutu	C	N	EN	+								
Hydrocharitaceae	*Blyxa sp.*	Diya Hawari	H	N	LC			+	+					
Hydrocharitaceae	*Ottelia alismoides*		H	N	LC			+	+					
Lamiaceae	*Hyptis capitata*		H	I	LC		+							
Lamiaceae	*Hyptis suaveolens*	Madurutala	S	I	LC			+	+					
Lauraceae	*Alseodaphne semecarpifolia*	Wewarana	T	N	VU	+							+	
Lecythidaceae	*Careya arborea*	Kahata	T	N	LC			+						
Limnocharitaceae	*Limnocharis flava*		H	I	LC			+	+					+

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Linaceae	*Hugonia mystax*	Bu Getiya	C	N	LC	+								
Loganiaceae	*Strychnos minor*	Kaduru Wel	C	N	LC	+								
Loganiaceae	*Strychnos nux-vomica*	Godakaduru	T	N	VU								+	
Loganiaceae	*Strychnos potatorum*	Ingini	T	N	VU	+	+	+						
Loranthaceae	*Dendrophthoe falcata*		EP	N	LC			+	+					
Malpighiaceae	*Hiptage benghalensis*	Puwak Gediya Wel	C	N	LC	+		+	+					
Malvaceae	*Hibiscus tiliaceus*	Beli Patta	T	N	LC			+						
Malvaceae	*Hibiscus vitifolius*	Maha Epala	S	N	LC			+	+					
Malvaceae	*Sida acuta*	Gas Bebila	H	N	LC	+		+	+					
Malvaceae	*Sida rhombifolia*	Kotikan Bevila	H	N	LC	+	+							
Malvaceae	*Urena sinuata*	Patta Epala	H	N	LC			+	+					
Meliaceae	*Aglaia elaeagnoidea*		T	N	LC	+								
Meliaceae	*Azadirachta indica*	Kohomba	T	I	LC			+	+		+		+	
Meliaceae	*Cipadessa baccifera*	Hal Bebiya	T	N	LC	+	+	+	+					
Meliaceae	*Dysoxylum ficiforme*		T	N	NT					+				
Meliaceae	*Melia azedarach*	Lunu Midella	T	I	LC						+			
Meliaceae	*Swietenia macrophylla*	Mahogani	T	I	LC			+			+			
Menispermaceae	*Anamirta cocculus*	Titta Wel	C	N	LC	+	+	+	+	+				
Menyanthaceae	*Nympoides indica*	Kumudu	H	N	LC			+	+					
Moraceae	*Artocarpus heterophyllus*	Kos	T	I	LC						+			
Moraceae	*Artocarpus incisus*	Del	T	I	LC						+			
Moraceae	*Artocarpus nobilis*	Bedi Del	T	E	LC						+			
Moraceae	*Ficus benghalensis*	Maha Nuga	T	N	LC			+						
Moraceae	*Ficus hispida*	Kota Dimbula	T	N	LC	+	+	+	+	+				
Moraceae	*Ficus microcarpa*		T	N	LC	+		+						
Moraceae	*Ficus mollis*	Wal Aralu	T	N	LC	+								
Moraceae	*Ficus racemosa*	Attikka	T	N	LC	+	+	+	+	+				
Moraceae	*Ficus religiosa*	Bo	T	I	LC			+						

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Moraceae	*Ficus sp.*	Nuga	T	N	LC	+	+	+	+					
Moraceae	*Streblus asper*	Geta Netul	T	N	LC					+			+	
Moraceae	*Streblus taxoides*	Gon Gotu	T	N	LC	+	+						+	
Musaceae	*Musa x paradisiaca*	Kesel	H	I	LC			+			+			
Myristicaceae	*Horsfieldia iryaghedhi*	Ruk Gedhi	T	E	VU		+			+				
Myrsinaceae	*Ardisia missionis*		S	N	LC		+							
Myrtaceae	*Eucalyptus sp.*		T	I	LC			+			+			
Myrtaceae	*Syzygium cumini*	Madan	T	N	LC	+	+	+	+	+				
Myrtaceae	*Syzygium zeylanicum var. lineare*		S	N	VU	+	+							
Nelumbonaceae	*Nelumbo nucifera*	Nelum	H	N	LC				+					
Nyctaginaceae	*Pisonia aculeata*	Vavul Lairitiya	C	N	NT					+				
Nymphaeaceae	*Nymphaea pubescens*	Olu	H	N	LC			+	+					
Onagraceae	*Ludwigia decurrens*		H	I	LC	+	+							
Onagraceae	*Ludwigia perennis*	Piduruwella	H	N	LC	+	+	+	+					
Onagraceae	*Ludwigia peruviana*		H	I	LC	+	+	+	+					
Orchidaceae	*Vanda tessellata*		EP	N	VU			+	+					
Pandanaceae	*Pandanus amaryllifolius*	Rampa	S	I	LC			+						
Pandanaceae	*Pandanus ceylanicus*	Weta Keyiya	S	E	VU		+	+		+				
Pandanaceae	*Pandanus kaida*	Weta Keyiya	S	N	LC			+	+					
Passifloraceae	*Passiflora foetida*		C	I	LC			+	+					
Piperaceae	*Piper betle*	Bulath	C	I	LC						+			
Piperaceae	*Piper nigrum*	Gam Miris	C	I	LC						+			
Piperaceae	*Piper sylvestre*	Wal Gam Miris Wel	C	N	LC	+	+			+				
Plumbaginaceae	*Plumbago zeylanica*	Ela Netul	H	N	LC	+								
Poaceae	*Bambusa sp.*	Una	T	I	LC			+						
Poaceae	*Bambusa vulgaris*	Kaha Una	T	I	LC			+	+					
Poaceae	*Coix gigantea*	Heen Kirindi	H	N	NT		+	+						

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Poaceae	*Imperata cylindrica*	Illuk	H	N	LC	+		+	+					
Poaceae	*Oryza sativa*	Wi	H	N	LC							+		
Poaceae	*Panicum maximum*	Rata Tana	H	I	LC	+	+	+	+		+			
Poaceae	*Saccharum spontaneum*	Wal Uk	H	N	LC			+						
Poaceae	*Zea mays*	Bada Iringu	H	I	LC							+		
Polygonaceae	*Persicaria attenuata*	Sudu Kimbul Wenna	H	N	LC			+	+					
Polygonaceae	*Persicaria glabra*		H	N	LC		+	+	+					
Polypodiaceae	*Drynaria quercifolia*	Benduru	EP	N	LC					+				
Pontederiaceae	*Eichhornia crassipes*	Japan Jabara	H	I	LC			+	+					+
Potamogetonaceae	*Potamogeton nodosus*		H	N	LC			+						
Rhamnaceae	*Ventilago madraspatana*	Yakada Wel	C	N	LC	+	+	+	+				+	
Rhamnaceae	*Ziziphus oenoplia*	Heen Eraminiya	C	N	LC	+		+	+				+	
Rhizophoraceae	*Carallia brachiata*	Dawata	T	N	NT		+							
Rubiaceae	*Canthium coromandelicum*	Kara	S	N	LC	+	+							
Rubiaceae	*Catunaregam spinosa*	Kukuruman	S	N	LC	+							+	
Rubiaceae	*Discospermum sphaerocarpum*		T	N	LC	+	+							
Rubiaceae	*Haldina cordifolia*	Kolon	T	N	LC	+		+	+	+			+	
Rubiaceae	*Ixora coccinea*	Ratambala	S	N	LC	+	+							
Rubiaceae	*Ixora pavetta*	Maharatambala	T	N	LC	+	+							
Rubiaceae	*Mitragyna parvifolia*	Helamba	T	N	LC	+	+	+	+					
Rubiaceae	*Morinda coreia*	Ahu	T	N	LC			+	+					
Rubiaceae	*Mussaenda frondosa*	Mussenda	C	N	LC	+		+	+					
Rubiaceae	*Nauclea orientalis*	Bakmi	T	N	LC	+	+	+	+	+				
Rubiaceae	*Psydrax dicoccos*	Panduru	T	N	LC	+		+					+	
Rutaceae	*Atalantia ceylanica*	Yakinaran	S	N	LC	+								
Rutaceae	*Chloroxylon swietenia*	Buruta	T	N	VU	+	+	+	+		+		+	
Rutaceae	*Glycosmis pentaphylla*	Dodan Pana	S	N	LC					+				
Rutaceae	*Limonia acidissima*	Divul	T	N	LC			+			+			

Family	Scientific Name	Common Name	HA	TS	NCS	Minipe Anicut		Canal Path & Surroundings					WNP	
						US	DS	CA	WA	RV	HG	AG	CV	KT
Rutaceae	*Murraya paniculata*	Etteriya	T	N	LC	+	+			+				
Rutaceae	*Pleiospermium alatum*	Tumpat Kurundu	T	N	LC	+	+							
Salviniaceae	*Salvinia molesta*	Salvinia	H	I	LC			+	+					+
Sapindaceae	*Allophylus cobbe*	Kobbe	T	N	LC	+	+			+			+	
Sapindaceae	*Dimocarpus longan*	Mora	T	N	LC	+				+				
Sapindaceae	*Lepisanthes senegalensis*	Gal Kuma	T	N	LC	+	+							
Sapindaceae	*Lepisanthes tetraphylla*	Dambu	T	N	LC	+	+	+					+	
Sapindaceae	*Schleichera oleosa*	Koon	T	N	LC	+	+	+	+				+	
Sapotaceae	*Madhuca longifolia*	Mi	T	N	NT	+	+	+	+	+				
Scrophulariaceae	*Lindernia antipoda*	Wila	H	N	LC	+	+							
Scrophulariaceae	*Scoparia dulcis*		H	I	LC		+	+	+					
Sterculiaceae	*Helicteres isora*	Lihiniya	T	N	NT	+	+			+				
Sterculiaceae	*Pterospermum suberifolium*	Welan	T	N	LC	+	+	+	+	+			+	
Sterculiaceae	*Theobroma cacao*	Kokowa	T	I	LC						+			
Tiliaceae	*Berrya cordifolia*	Hal Milla	T	N	LC	+	+		+		+			
Tiliaceae	*Grewia damine*	Daminiya	T	N	LC	+		+						
Tiliaceae	*Grewia helicterifolia*	Bora Daminiya	T	N	LC	+	+							
Tiliaceae	*Grewia orientalis*	Wel Keliya	S	N	LC	+		+	+	+			+	
Ulmaceae	*Holoptelea integrifolia*	Goda Kirilla	T	N	NT	+	+	+	+					
Ulmaceae	*Trema orientalis*	Gadumba	T	N	LC			+	+		+			
Urticaceae	*Pilea microphylla*		H	I	LC		+							
Verbenaceae	*Lantana camara*	Gandapana	S	I	LC	+	+	+	+		+			
Verbenaceae	*Premna tomentosa*	Bu Seru	T	N	LC								+	
Verbenaceae	*Stachytarpheta jamaicensis*	Balu Nakuta	H	I	LC	+	+	+	+					
Verbenaceae	*Tectona grandis*	Thekka	T	I	LC			+			+			
Verbenaceae	*Vitex altissima*	Milla	T	N	NT	+	+	+	+					
Vitaceae	*Cissus quadrangularis*	Hiressa	C	N	LC	+								

Table 3. Animal species recorded in the habitats around the proposed project site.

Abbreviations Used: TS - Taxonomic Status, En - Endemic, Ex – Exotic, Na - Native, Mi -Migrant, CS - Conservation Status, En – Endangered, VU - Vulnerable, NT - Near Threatened, LC – Least Concern, NE – Not Evaluated

Family	Scientific Name	English Name	TS	NCS	GCS	Minipe Anicut		LB Canal and Surroundings				
						US	DS	LBC	CA	WB	HO	HW
Dragonflies												
Aeshnidae	*Anax immaculifrons*	Fiery Emperor	Na	VU	LC		+					
Aeshnidae	*Anax indicus*	Elephant Emperor	Na	LC	LC		+	+			+	
Cholorocyphidae	*Libellago adami*	Adam's Gem	En	VU	NE		+	+			+	
Coenagrionidae	*Pseudagrion rubriceps*	Red-headed Sprite	Na	LC	LC		+	+			+	
Gomphidae	*Ictinogomphus rapax*	Rapacious Flangetail	En	LC	LC	+	+					
Libellulidae	*Brachythmis contaminata*	Asian Groundling	Na	LC	NE							+
Libellulidae	*Bradinopyga geminata*	Indian Rockdweller	Na	LC	LC							+
Libellulidae	*Diplacodes trivialis*	Blue Percher	Na	LC	LC				+		+	
Libellulidae	*Neurothemis tullia*	Pied Parasol	Na	LC	LC					+		
Libellulidae	*Orthetrum pruinosum*	Pink Skimmer	Na	NT	LC		+					
Libellulidae	*Orthetrum sabina*	Green Skimmer	Na	LC	LC				+			+
Libellulidae	*Pantala flavescens*	Wandering Glider	Na	LC	LC				+			
Libellulidae	*Rhyothemis variegata*	Varigated Flutter	Na	LC	LC					+		
Libellulidae	*Trithemis aurora*	Crimson Dropwing	Na	LC	LC	+	+	+		+	+	
Libellulidae	*Trithemis festiva*	Indigo Dropwing	Na	VU	LC	+	+					
Libellulidae	*Urothemis signata*	Scarlet Basker	Na	LC	LC			+		+		
Platycnemididae	*Copera marginipes*	Yellow Featherleg	Na	LC	LC	+	+				+	+
Protoneuridae	*Elattoneura centralis*	Dark-glittering Threadtail	En	VU	NE	+	+	+		+		
Butterflies												
Hesperiidae	*Suastus gremius*	Indian Palm Bob	Na	LC	NE							+
Lycaenidae	*Castalius rosimon*	Common Pierrot	Na	LC	NE	+	+		+			

Family	Scientific Name	English Name	TS	NCS	GCS	Minipe Anicut		LB Canal and Surroundings				
						US	DS	LBC	CA	WB	HO	HW
Lycaenidae	*Jamides bochus*	Dark Cerulean	Na	LC	NE	+	+					
Lycaenidae	*Jamides celeno*	Common Cerulean	Na	LC	NE		+					+
Lycaenidae	*Lampides boeticus*	Pea Blue	Na	LC	NE	+	+		+			
Lycaenidae	*Prosotas nora*	Common Lineblue	Na	LC	NE	+	+		+			
Lycaenidae	*Zizina otis*	Lesser Grass Blue	Na	LC	NE		+		+		+	
Nymphalidae	*Danaus chrysippus*	Plain tiger	Na	LC	NE	+	+		+			
Nymphalidae	*Danaus genutia*	Common tiger	Na	LC	NE				+			
Nymphalidae	*Euploea core*	Common crow	Na	LC	LC	+	+		+		+	+
Nymphalidae	*Junonia almana*	Peacock pansy	Na	LC	LC				+		+	
Nymphalidae	*Junonia atlites*	Grey pansy	Na	LC	NE				+			
Nymphalidae	*Junonia iphita*	Chocolate soldier	Na	LC	NE		+		+			
Nymphalidae	*Melanitis leda*	Common evening brown	Na	LC	NE	+	+		+			
Nymphalidae	*Neptis hylas*	Common sailor	Na	LC	NE	+	+		+			
Nymphalidae	*Neptis jumbah*	Chestnut-streaked sailor	Na	LC	NE		+					
Nymphalidae	*Pantoporia hordonia*	Common lasker	Na	NT	NE	+	+					
Nymphalidae	*Parantica aglea*	Glassy tiger	Na	LC	NE	+	+		+		+	
Nymphalidae	*Tirumala limniace*	Blue tiger	Na	LC	NE				+			+
Nymphalidae	*Ypthima ceylonica*	White four-ring	Na	LC	NE	+	+					+
Papilionidae	*Graphium agamemnon*	Tailed jay	Na	LC	NE		+		+			
Papilionidae	*Pachliopta aristolochiae*	Common rose	Na	LC	NE		+		+		+	+
Papilionidae	*Pachliopta hector*	Crimson rose	Na	LC	NE	+	+		+		+	+
Papilionidae	*Papilio crino*	Banded peacock	Na	VU	NE				+			
Papilionidae	*Papilio demoleus*	Lime butterfly	Na	LC	NE	+	+		+			
Papilionidae	*Papilio polytes*	Common mormon	Na	LC	NE				+			+
Papilionidae	*Troides darsius*	Ceylon birdwing	En	LC	NE	+	+					
Pieridae	*Appias galane*	Lesser albatross	En	LC	NE				+			
Pieridae	*Catopsilia pomona*	Lemon emigrant	Na	LC	NE	+	+		+		+	+
Pieridae	*Catopsilia pyranthe*	Mottled emigrant	Na	LC	NE	+	+		+		+	

Family	Scientific Name	English Name	TS	NCS	GCS	Minipe Anicut		LB Canal and Surroundings				
						US	DS	LBC	CA	WB	HO	HW
Pieridae	*Cepora nerissa*	Common gull	Na	LC	NE		+					
Pieridae	*Delias eucharis*	Jezebel	Na	LC	NE		+		+			+
Pieridae	*Eurema hecabe*	Common grass yellow	Na	LC	NE	+	+		+		+	
Pieridae	*Hebomoia glaucippe*	Great orange tip	Na	LC	NE				+			
Pieridae	*Leptosia nina*	Psyche	Na	LC	NE	+	+		+		+	+
Freshwater Fish												
Belontiidae	*Belontia signata*	Combtail	En	NT	LR:cd		+					
Cichlidae	*Oreochromis niloticus*	Tilapia	Ex	NE	NE	+	+	+		+	+	+
Cobitidae	*Lepidocephalichthys thermalis*	Common spiny loach	Na	LC	LC		+					
Cyprinidae	*Devario malabaricus*	Giant Danio	Na	LC	LC	+	+				+	
Cyprinidae	*Garra ceylonensis*	Stone sucker	En	VU	NE	+	+				+	
Cyprinidae	*Puntius bimaculatus*	Redside barb	Na	LC	LC	+	+	+		+	+	+
Cyprinidae	*Rasbora dandia*	Striped rasbora	Na	LC	LC	+	+			+	+	
Cyprinidae	*Rasbora microcephalus*	Carverii Rasbora	Na	LC	LC	+	+			+	+	+
Cyprinidae	*Tor khudree*	Mahseer	Na	NT	EN	+	+					
Gobiidae	*Glossogobius giuris*	Bareye Goby	Na	LC	LC		+				+	
Amphibians												
Bufonidae	*Duttaphrynus melanostictus*	Common house toad	Na	LC	NE				+			+
Dicroglossidae	*Euphlyctis cyanophlyctis*	Skipper frog	Na	LC	NE	+	+			+		+
Dicroglossidae	*Fejervarya cf. syhadrensis*	Common paddy field frog	Na	LC	NE		+			+		+
Microhylidae	*Microhyla ornata*	Ornate narrow mouth frog	Na	LC	NE					+		
Microhylidae	*Microhyla rubra*	Red narrow mouth frog	Na	LC	NE					+		
Reptiles												
Agamidae	*Calotes versicolor*	Common garden lizard	Na	LC	NE	+	+		+			+
Gekkonidae	*Hemidactylus frenatus*	Common house-gecko	Na	LC	LC				+			+
Varanidae	*Varanus bengalensis*	Land monitor	Na	LC	LC				+			+

Family	Scientific Name	English Name	TS	NCS	GCS	Minipe Anicut		LB Canal and Surroundings				
						US	DS	LBC	CA	WB	HO	HW
Varanidae	*Varanus salvator*	Water monitor	Na	LC	LC			+			+	
Scincidae	*Eutropis macularia*	Bronzegreen little skink	Na	LC	NE		+		+			
Birds												
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Na	LC	LC	+	+					
Accipitridae	*Haliastur indus*	Brahminy Kite	Na	LC	LC				+			+
Accipitridae	*Spilornis cheela*	Crested Serpent Eagle	Na	LC	LC	+	+		+			
Accipitridae	*Spizaetus cirrhatus*	Changeable Hawk Eagle	Na	LC	NE							+
Aegithinidae	*Aegithina tiphia*	Common Iora	Na	LC	LC	+	+		+		+	+
Alcedinidae	*Alcedo atthis*	Common Kingfisher	Na	LC	LC	+	+		+		+	
Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher	Na	LC	LC	+	+	+	+	+		
Alcedinidae	*Pelargopsis capensis*	Stork-billed Kingfisher	Na	LC	LC				+	+		
Apodidae	*Apus affinis*	House Swift	Na	LC	LC				+		+	
Apodidae	*Cypsiurus balasiensis*	Asian Palm Swift	Na	LC	LC	+	+		+		+	
Ardeidae	*Ardea purpurea*	Purple Heron	Na	LC	LC					+		
Ardeidae	*Ardeola grayii*	Indian Pond Heron	Na	LC	LC				+	+		
Ardeidae	*Casmerodius albus*	Great Egret	Na	LC	LC			+				
Ardeidae	*Egretta garzetta*	Little Egret	Na	LC	LC			+				
Bucerotidae	*Anthracoceros coronatus*	Malabar Pied Hornbill	Na	LC	NT							+
Bucerotidae	*Ocyceros gingalensis*	Sri Lanka Grey Hornbill	En	LC	LC	+	+					
Campephagidae	*Tephrodornis pondicerianus*	Common Woodshrike	En	LC	LC	+	+		+			
Ciconiidae	*Anastomus oscitans*	Asian Openbill	Na	LC	LC			+		+		
Ciconiidae	*Ciconia episcopus*	Woolly-necked Stork	Na	NT	LC				+			
Cisticolidae	*Prinia hodgsonii*	Grey-breasted Prinia	Na	LC	LC	+	+		+			
Cisticolidae	*Prinia socialis*	Ashy Prinia	Na	LC	LC		+		+		+	
Columbidae	*Columba livia*	Rock Pigeon	Na	LC	LC				+		+	
Columbidae	*Ducula aenea*	Green Imperial Pigeon	Na	LC	LC				+		+	+
Columbidae	*Streptopelia chinensis*	Spotted Dove	Na	LC	LC	+	+		+		+	+

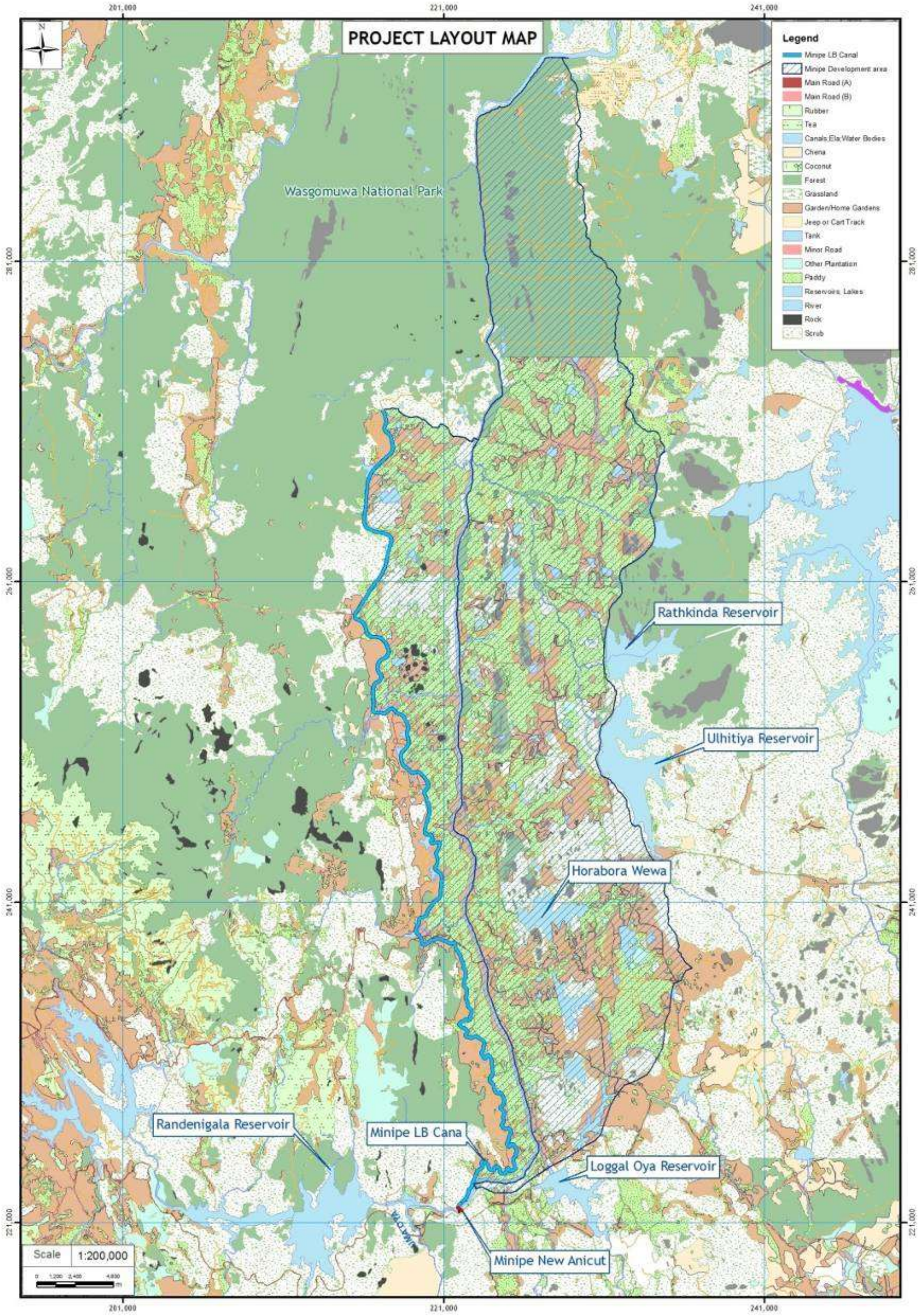
Family	Scientific Name	English Name	TS	NCS	GCS	Minipe Anicut		LB Canal and Surroundings				
						US	DS	LBC	CA	WB	HO	HW
Corvidae	*Corvus levaillantii*	Large-billed Crow	Na	LC	LC	+	+		+		+	
Cuculidae	*Centropus sinensis*	Greater Coucal	Na	LC	LC	+	+		+		+	
Cuculidae	*Clamator jacobinus*	Pied Cuckoo	Na	LC	LC		+					
Cuculidae	*Eudynamys scolopacea*	Asian Koel	Na	LC	LC							+
Cuculidae	*Phaenicophaeus viridirostris*	Blue-faced Malkoha	Na	LC	LC		+		+			
Dicaeidae	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	Na	LC	LC	+	+		+			
Dicruidae	*Dicrurus caerulescens*	White-bellied Drongo	Na	LC	LC	+	+		+	+	+	
Estrididae	*Lonchura punctulata*	Scaly-breasted Munia	Na	LC	LC				+			
Hemiprocnidae	*Hemiprocne coronata*	Crested Treeswift	Na	LC	LC	+	+		+			
Hirundinidae	*Hirundo daurica*	Red-rumped Swallow	En	LC	LC				+			
Laridae	*Sterna albifrons*	Little Tern	Na	LC	LC					+		
Meropidae	*Merops leschenaulti*	Chestnut-headed Bee-eater	Na	LC	LC	+	+					
Meropidae	*Merops orientalis*	Green Bee-eater	Na	LC	LC		+		+			
Monarchidae	*Terpsiphone paradisi*	Asian Paradise- flycathcher	Na	LC	LC	+	+		+		+	
Muscicapidae	*Copsychus malabaricus*	White-rumped Shama	Na	LC	LC	+	+					
Muscicapidae	*Copsychus saularis*	Oriental Magpie Robin	Na	LC	LC		+		+			
Muscicapidae	*Cyornis tickelliae*	Tickell's Blue Flycatcher	Na	LC	LC	+	+		+		+	
Muscicapidae	*Muscicapa daurica*	Asian Brown Flycatcher	Mi	NE	LC	+	+		+			
Muscicapidae	*Saxicoloides fulicata*	Indian Robin	Na	LC	LC		+		+			
Nectariniidae	*Nectarina zeylonica*	Purple-rumped Sunbird	Na	LC	LC	+	+		+			
Oriolidae	*Oriolus xanthornus*	Black-hooded Oriole	Na	LC	LC	+	+		+		+	
Passeridae	*Passer domesticus*	House Sparrow	Na	LC	LC				+			
Pelecanidae	*Pelecanus philippensis*	Spot-billed Pelican	Na	LC	NT					+		
Phalacrocoracidae	*Phalacrocorax fuscicollis*	Indian Cormorant	Na	LC	LC					+		
Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	Na	LC	LC			+				
Phasianidae	*Gallus lafayetii*	Sri Lanka Junglefowl	En	LC	LC	+	+		+		+	
Phasianidae	*Pavo cristatus*	Indian Peafowl	Na	LC	LC				+		+	

Family	Scientific Name	English Name	TS	NCS	GCS	Minipe Anicut		LB Canal and Surroundings				
						US	DS	LBC	CA	WB	HO	HW
Ploceidae	*Ploceus philippinus*	Baya Weaver	Na	LC	LC				+			
Psittacidae	*Loriculus beryllinus*	Sri Lanka Hanging Parakeet	En	LC	LC				+		+	
Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	Na	LC	LC	+	+					+
Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	Na	LC	LC	+	+		+		+	
Pycnonotidae	*Pycnonotus luteolus*	White-browed Bulbul	Na	LC	LC				+			
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	Na	LC	LC		+	+				
Ramphastidae	*Megalaima haemacephala*	Coppersmith Barbet	Na	LC	LC	+	+		+		+	+
Ramphastidae	*Megalaima zeylanica*	Brown-headed Barbet	Na	LC	LC	+	+		+		+	+
Sturnidae	*Acridotheres tristis*	Common Myna	Na	LC	LC				+		+	+
Sylviidae	*Orthotomus sutorius*	Common Tailorbird	Na	LC	LC	+	+		+		+	
Threskiornithidae	*Threskiornis melanocephalus*	Black-headed Ibis	Na	LC	NT				+	+		
Timalidae	*Pellorneum fuscocapillum*	Sri Lanka Brown-capped Babbler	En	LC	LC	+	+					
Timalidae	*Turdoides affinis*	Yellow-billed Babbler	Na	LC	LC	+	+		+		+	
Mammals												
Cercopithecidae	*Macaca sinica*	Sri Lanka toque monkey	En	LC	EN	+	+		+			
Cercopithecidae	*Semnopithecus priam*	Grey langur	Na	LC	NT	+	+					+
Elephantidae	*Elephas maximus*	Elephant	Na	EN	EN		+					+
Herpestidae	*Herpestes edwardsii*	Grey mongoose	Na	LC	LC				+		+	
Herpestidae	*Herpestes smithii*	Ruddy mongoose	Na	LC	LC				1		1	
Leporidae	*Lepus nigricollis*	Black-naped hare	Na	LC	LC	1	1		1			
Sciuridae	*Funambulus palmarum*	Palm squirrel	Na	LC	LC	1	1		1		1	1
Sciuridae	*Ratufa macroura*	Giant squirrel	Na	LC	NT	1	1		1		1	
Suidae	*Sus scrofa*	Wild boar	Na	LC	LC		1		1		1	
Viverridae	*Paradoxurus hermaphroditus*	Palm Civet	Na	LC	LC	1	1		1		1	1

Table 4. Recommended list of plants species for aforestation of the Minipe LB canal reserve

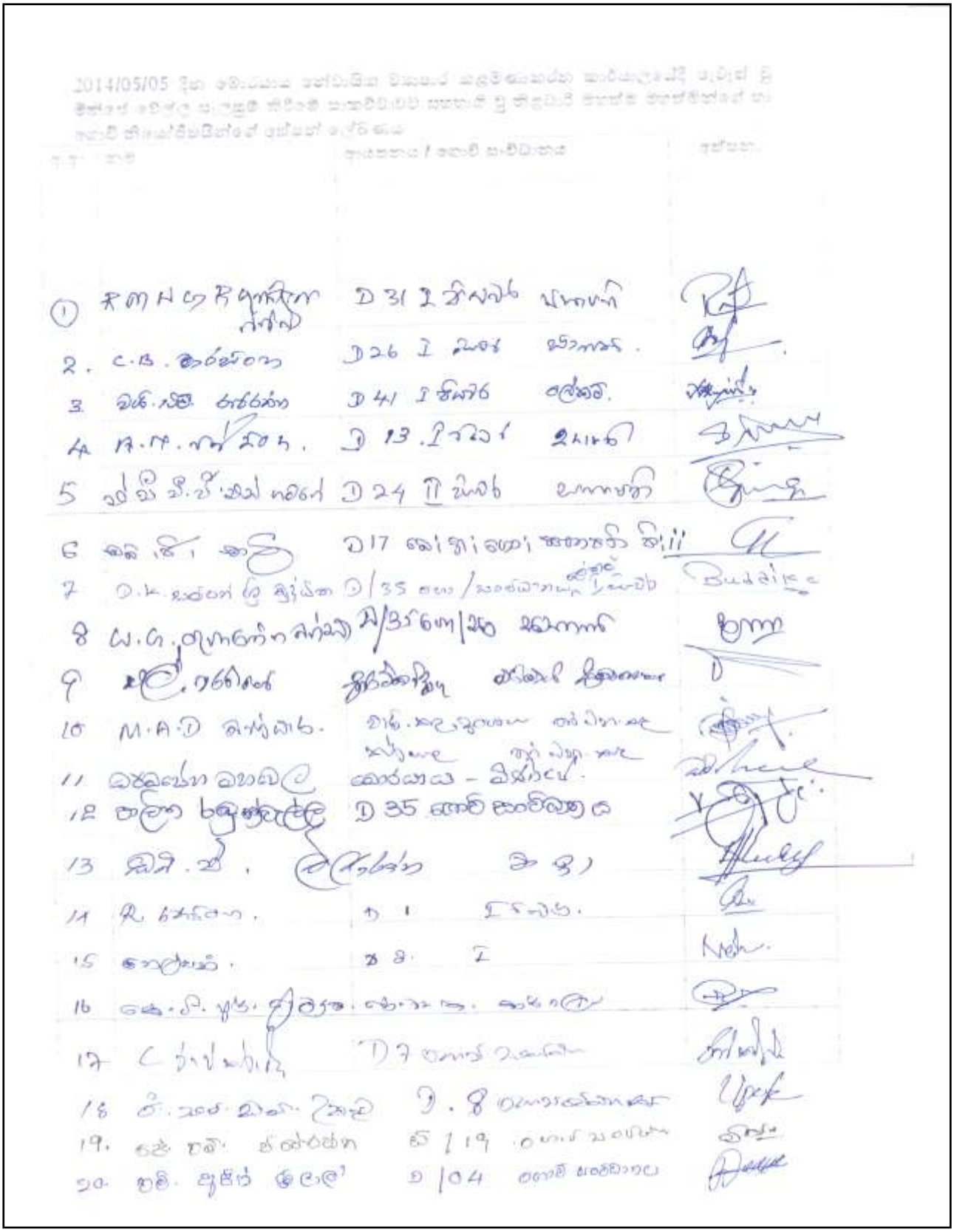
Family	Scientific Name	Common Name	Ha	TS	NCS
Acanthaceae	*Rhinacanthus flavovirens*		H	E	VU
Alangiaceae	*Alangium salviifolium*	Ruk Anguna	S	N	NT
Anacardiaceae	*Lannea coromandelica*	Hik	T	N	
Anacardiaceae	*Mangifera zeylanica*	Etamba	T	E	
Anacardiaceae	*Semecarpus nigro-viridis*	Badulla	T	E	
Annonaceae	*Uvaria sphenocarpa*		C	E	
Annonaceae	*Polyalthia longifolia*	Owila	T	N	
Apocynaceae	*Anodendron paniculatum*	As Wel	C	N	VU
Asteraceae	*Vernonia zeylanica*	Pupula	C	E	
Clusiaceae	*Garcinia spicata*	Ela Gokatu	T	N	NT
Combretaceae	*Combretum albidum*	Kaduru Ketiya Wel	C	N	NT
Combretaceae	*Terminalia arjuna*	Kumbuk	T	N	
Combretaceae	*Terminalia bellirica*	Bulu	T	N	
Dilleniaceae	*Dillenia indica*	Hondapara	T	N	
Dracaenaceae	*Sansevieria zeylanica*	Niyanda	H	N	NT
Ebenaceae	*Diospyros ebenum*	Kaluwara	T	N	EN
Ebenaceae	*Diospyros malabarica*	Timbiri	T	N	
Ebenaceae	*Diospyros ovalifolia*	Kunumella	T	N	
Euphorbiaceae	*Homonoia riparia*		S	N	NT
Euphorbiaceae	*Phyllanthus myrtifolius*		S	E	VU
Euphorbiaceae	*Phyllanthus polyphyllus*	Kuratiya	S	N	
Euphorbiaceae	*Phyllanthus reticulatus*	Kaila	S	N	
Euphorbiaceae	*Bridelia retusa*	Ketakala	T	N	
Euphorbiaceae	*Dimorphocalyx glabellus*	Weli Wenna	T	N	
Euphorbiaceae	*Drypetes gardneri*	Gal Wira	T	E	NT
Euphorbiaceae	*Drypetes sepiaria*	Weera	T	N	
Euphorbiaceae	*Macaranga peltata*	Kenda	T	N	
Euphorbiaceae	*Margaritaria indicus*	Karavu	T	N	VU
Euphorbiaceae	*Sapium indicum*	Kiri Makulu	T	N	VU
Fabaceae	*Acacia caesia*	Hinguru Wel	C	N	
Fabaceae	*Derris parviflora*	Kala Wel	C	E	
Fabaceae	*Entada pusaetha*	Pus Wel	C	N	
Fabaceae	*Bauhinia racemosa*	Maila	T	N	
Fabaceae	*Cynometra zeylanica*		T	E	NT
Fabaceae	*Erythrina fusca*	Yak Erabadu	T	N	NT
Fabaceae	*Pongamia pinnata*	Magul Karanda	T	N	
Flacourtiaceae	*Hydnocarpus venenata*	Makulu	T	E	
Hippocrateaceae	*Salacia reticulata*	Kotala Himbutu	C	N	EN
Lauraceae	*Alseodaphne semecarpifolia*	Wewarana	T	N	VU
Lecythidaceae	*Careya arborea*	Kahata	T	N	
Loganiaceae	*Strychnos nux-vomica*	Godakaduru	T	N	VU
Loganiaceae	*Strychnos potatorum*	Ingini	T	N	VU
Meliaceae	*Dysoxylum ficiforme*		T	N	NT

Family	Scientific Name	Common Name	Ha	TS	NCS
Moraceae	*Artocarpus nobilis*	Bedi Del	T	E	
Moraceae	*Ficus benghalensis*	Maha Nuga	T	N	
Moraceae	*Ficus hispida*	Kota Dimbula	T	N	
Moraceae	*Ficus microcarpa*		T	N	
Moraceae	*Ficus mollis*	Wal Aralu	T	N	
Moraceae	*Ficus racemosa*	Attikka	T	N	
Myristicaceae	*Horsfieldia iryaghedhi*	Ruk Gedhi	T	E	VU
Myrtaceae	*Syzygium zeylanicum*		S	N	VU
Myrtaceae	*Syzygium cumini*	Madan	T	N	
Nyctaginaceae	*Pisonia aculeata*	Vavul Lairitiya	C	N	NT
Orchidaceae	*Vanda tessellata*		EP	N	VU
Pandanaceae	*Pandanus ceylanicus*	Weta Keyiya	S	E	VU
Poaceae	*Coix gigantea*	Heen Kirindi	H	N	NT
Rhizophoraceae	*Carallia brachiata*	Dawata	T	N	NT
Rubiaceae	*Ixora coccinea*	Ratambala	S	N	
Rubiaceae	*Haldina cordifolia*	Kolon	T	N	
Rubiaceae	*Ixora pavetta*	Maharatambala	T	N	
Rubiaceae	*Nauclea orientalis*	Bakmi	T	N	
Rutaceae	*Chloroxylon swietenia*	Buruta	T	N	VU
Sapindaceae	*Dimocarpus longan*	Mora	T	N	
Sapotaceae	*Madhuca longifolia*	Mi	T	N	NT
Sterculiaceae	*Helicteres isora*	Lihiniya	T	N	NT
Tiliaceae	*Berrya cordifolia*	Hal Milla	T	N	
Tiliaceae	*Grewia damine*	Daminiya	T	N	
Tiliaceae	*Grewia helicterifolia*	Bora Daminiya	T	N	
Ulmaceae	*Holoptelea integrifolia*	Goda Kirilla	T	N	NT
Ulmaceae	*Trema orientalis*	Gadumba	T	N	
Verbenaceae	*Vitex altissima*	Milla	T	N	NT



igure 1. Map Sho wing the Project Layout and command area of minipe LB

Annexure VI. List of participants that have attended the public consultation meeting held on 5th may 2014 at Resident managers Office of the Morayaya Scheme.



Annexure VII. Report from the National Building Research Organization on Land Stability

LRRMD/SPI/WP/MNP/14/31/14216

Report on the Landslide Hazard Investigation for Proposed Raising of Minipe Anicut

1.0 Introduction

As per the request of the Additional Secretary of Ministry of Irrigation and Water Resources by his letter ref. IW/PL/WRD/04/28 dated 28/07/2014 Geologists of Kandy District Office of National Building Research Organization (NBRO) along with the geologist Mr. Jayathilake from the ministry of irrigation carried out a landslide hazard investigation to study the impact due to proposed raising of Minipe Anicut. This investigation was carried out on 26/08/2014. This report is based on the observations made in this inspection and information provided by the client.

2.0 Location and Accessibility

The Minipe Anicut is located on River Mahaweli at the boundary of Kandy and Badulla districts. The left bank at the anicut is at Bembiya GN division of Menipe Divisional Secretariat in Kandy District while right bank is at Mahakele GN division of Kandeketiya Divisional Secretariat in Badulla District.

This site can be reached from Kandy through Mahaweli Raja mawatha (B492) and located about 80km from Kandy.

The location map of the project (Part of Sheet No.62 Hanguranketha 1:50,000 topographic map) is given in Fig.1. The coordinate at the right bank end of the anicut is 7°11'51.80"N, 80°58'27.00"E.

3.0 Objectives

The evaluation of general aspects of in-situ ground conditions of the project area is the main objective of this investigation, to achieve this object the investigation has been carried out to;

i. Identify the existing engineering geological conditions of the selected site for proposed project.

ii. Determine the vulnerability of future mass movements within the soil mass and the rock fall threats at the project area, if any.

iii. Describe the subsurface geological conditions of the soil overburden and bed rock.

iv. Recommendations to avoid or minimize the expected slope failure problems by applying most suitable remedial measures to overcome destructive situations to the project itself and to the surrounding environment.

4.0 Project Features

The Minipe Anicut diverts water of River Mahaweli to both the right and left bank canals in order to fulfil the water requirments of Mahaweli Systems. Currently Left Bank (LB) irrigation system and right bank (RB) transbasin canal systems are getting water from Minipe pool from the power flow releace of Rantambe hydropower generation. The FSL of the Minipe Pool is 114m MSL. The only regulatory reservior for the LB area is this pool with a limited capacity which has caused difficuilties in providing irrigation water to that area. Therefore, it is proposed to increase the capacity by reising the Minipe anicut from the present level of 114m (MSL) to another 4m upto the 118m MSL which is feaseable without inundating the Ranrambe tailrace at the upstream.

In accordance with the information provided by the developer the proposed modifications to the anicut is as follows;

	Existing	after Completion
Length:	225.25m	225.25m
Max. Height	9m	13m
Crest Level	114m MSL	118m MSL
HFL	120m MSL	119.6m MSL

5.0 Limitations

Representative sampling and conducting laboratory testing for the determination of strength characteristic of soil overburden and rock layers beneath the proposed structures is beyond the scope of this investigation. Also detail geological/geotechnical mapping of the area is not included into the scope of this study. Design of the appropriate engineering structures and their foundations also not included into the scope of this study.

6.0 Field Observations

6.1 In the project area, the meandering River Mahaweli flows in a general direction of east in a broad shallow valley made up of bedrock and mainly its residual overburden. Minipe Anicut is located about 3km downstream of the Rantembe Dam.

6.2 Morphologically the project area is at the boundary of the lowest and the second peneplain of the island. Regional-wise the east part of the site area is showing more or less flat and low relief topography while the west side is dominated by high relieved steep slopes morphology which is typical to the second peneplain.

6.3 The north-south trending rocky ridges dissected by east-west discontinuities forming ridge and valley topographically which the valleys usually housed the mature stage rivers and their tributaries. Due to surround prolong erosions the present topography at the site is undulating domes with broad U shaped valleys.

6.4 The bedrock trending in the general direction of NS while dipping west in low to moderate dip angles. The measured attitude of the weathered rock at the road cut on right bank opposite to the entrance of the gates is N40°W/35°SW while at the left bank where the proposed bund located is N10°W/24°W. The rock can be identified as weathered garnet bearing charnockite gneiss. In addition to that, as per the geological map compiled by GSMB (Sheet No.14 shown in Fig.2), the project area also consisting of

quartozofeldspathic gneiss and quartzite in concordantly trending in N-S direction. The residual soils are predominant in the area while some alluvial deposits can be observed at the river bank especially at the inner curves of the meanders.

6.5 Upon the completion of the project where the anicut will be raised 4m from the present level, the water level as well as the high flood level will be raised. Therefore, either banks will be inundated. For the left bank it is proposed to construct an appropriate bund. However, the right bank especially close to the gate is a steep cut slope of about 6m high. The main road is also very close. When inundated usually the soil banks may become saturated and therefore, losing their strengths. The case may become worst if the water level fluctuate significantly as the tendency of slope failure increases. Therefore, about 100m from the gate the right bank should be protected. It is recommended to construct well engineered gabion structure covering at least the high flood level of the total slope. Furthermore, the bare soil slope should be protected against river erosion using boulder packing or with a suitable rip-rap.

6.6 As per the landslide zonation maps (1:50,000) prepared by NBRO (Fig.3) the entire project area is in no landslide zone or low hazards zone. Also our field inspection reveals no unstable slopes or landslide prone areas. Steep road cuts in the vicinity has a certain degree to become unstable if unfavorable conditions prevails, however there are no effect to this project and not affecting by the project.

6.7 No dwelling or other private structures are observed within the project area. There are several houses on the left bank close to the road and appeared well away from the high flood level and the proposed left bank bund.

7.0 Conclusion

According to the field observations and the information gathered, this project is feasible. However special attention is required while constructing associated with steep slopes not to provoke slope instabilities. Following recommendations are given to enhance the safety condition of the vicinity in land stability point of view. The developer may proceed with the project following these recommendations.

8.0 Recommendations

On appraisal of the data analysis, landslide hazard experience and conclusions made by field observations following recommendations are given to enhance and ensure the stability of the area.

1. All the construction work, especially the construction of the concrete anicut, earth bund and other civil works should be carried out under the supervision of qualified geotechnical/civil engineers.

2. As the earth slopes submerge it is recommended to lay suitable size boulders to protect the toe of the slope from erosion and instabilities due to the fluctuation of the water level. Therefore, about 100m from the gate at the right bank should be protected by well-engineered gabion structure covering at least the high flood level of the total slope height. Furthermore, the bare soil slope should be protected against river erosion using boulder packing or with a suitable rip-rap.

3. Disturbance to the steep slopes should be minimized. It is recommended to carry out construction works in dry period to minimize the heavy erosion. Necessary protective measures against soil erosion should be applied.

4. Blasting in steep slopes is not encourage. However, if rock excavation is required control blasting techniques should be used under the supervision of blasting experts.

5. The foundations of civil structures including retaining walls should be on solid ground by-passing the overburden. All design and constructions should be carried out under the supervision of qualified geotechnical and structural experts.

Site Investigation.

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Scientist/Geologist

Anurudda Marambe
Scientist/Geologist

Certified by;

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National Building Research Organisation (NBRO)

National Building Research Organisation
NBRO
Regional Office
Central Province
Kandy

Figures

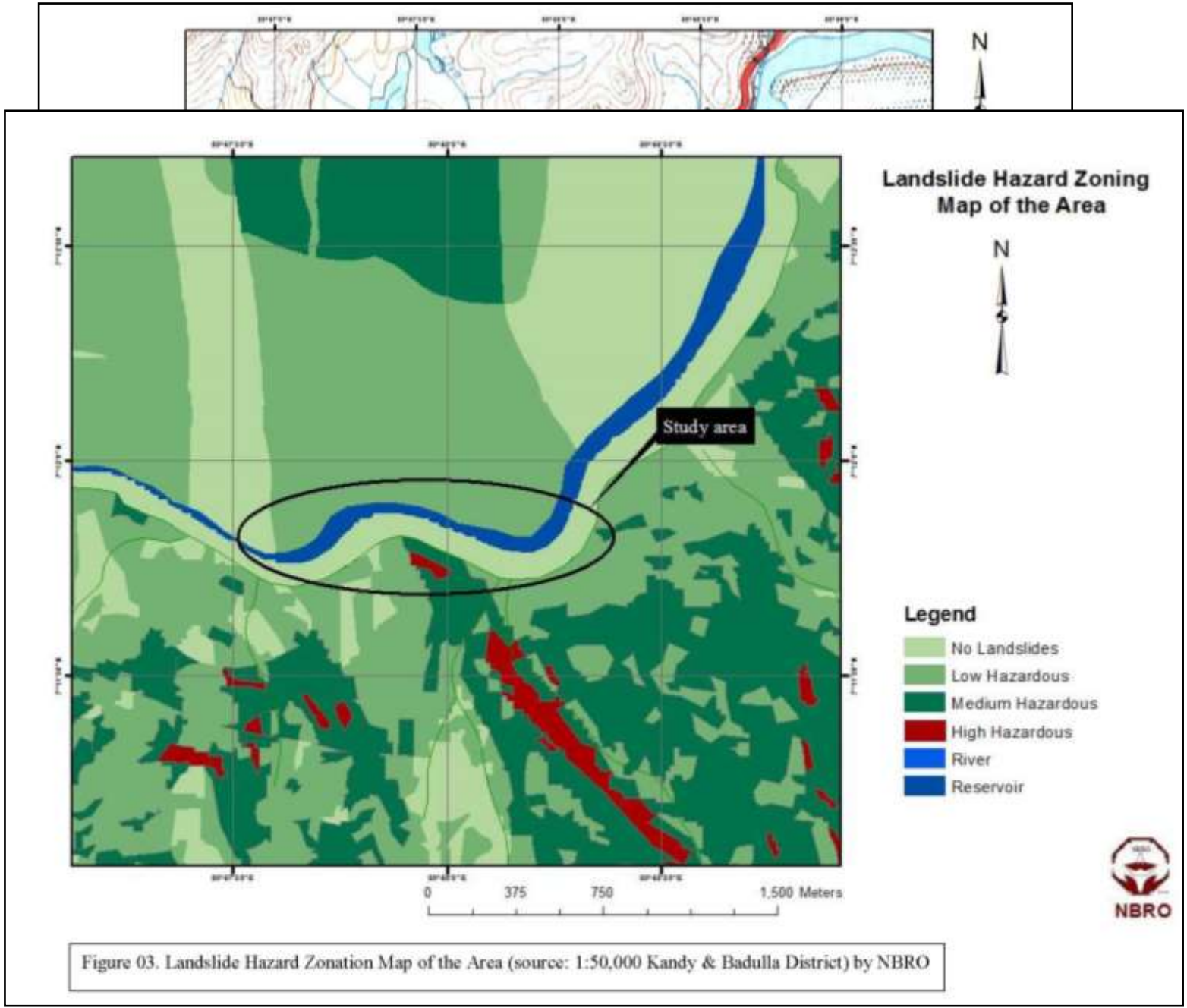

Figure 03. Landslide Hazard Zonation Map of the Area (source: 1:50,000 Kandy & Badulla District) by NBRO

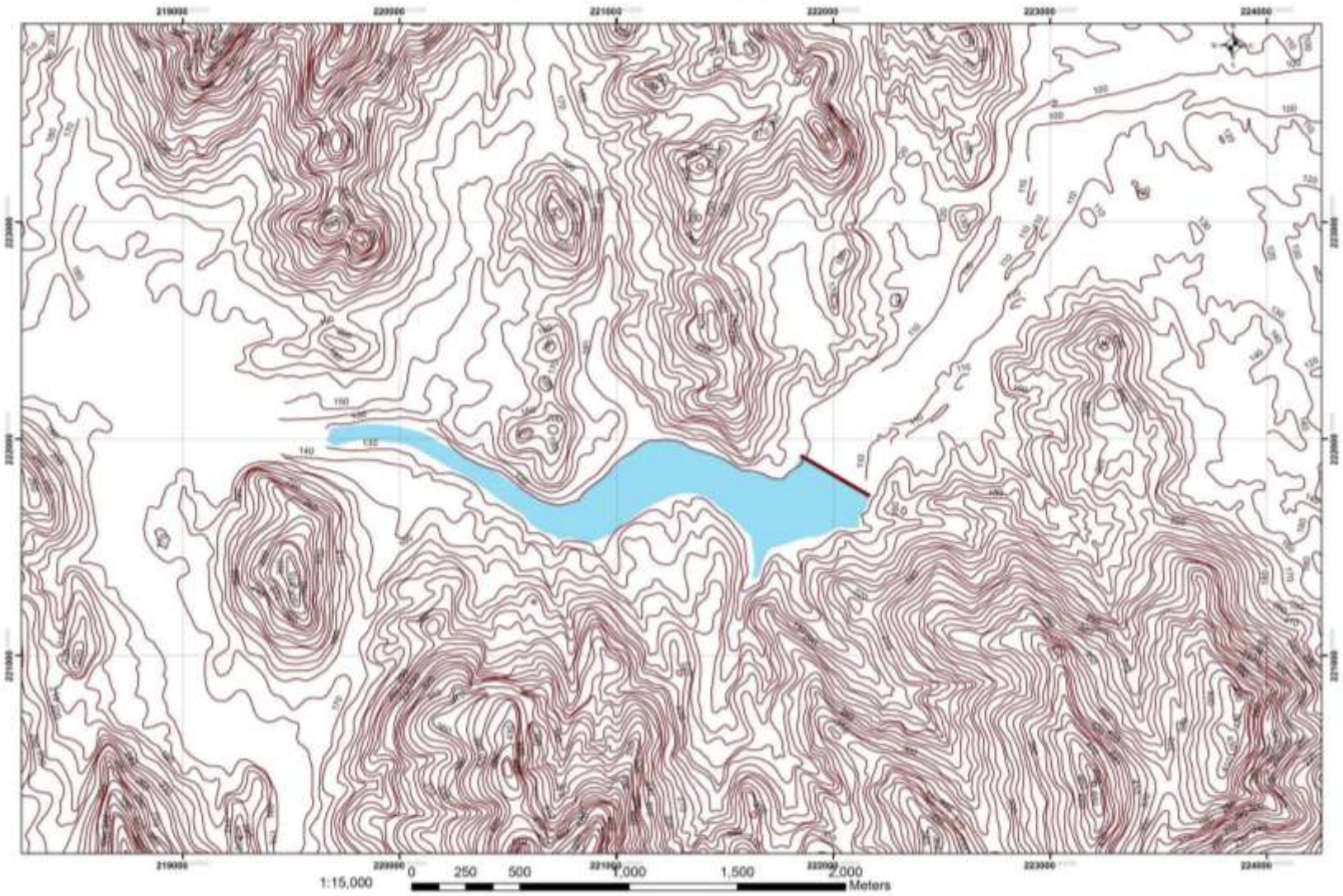

Figure 04. Contour Map of the Area (source: 1:50,000 topo Sheet No. 62 –Survey department)

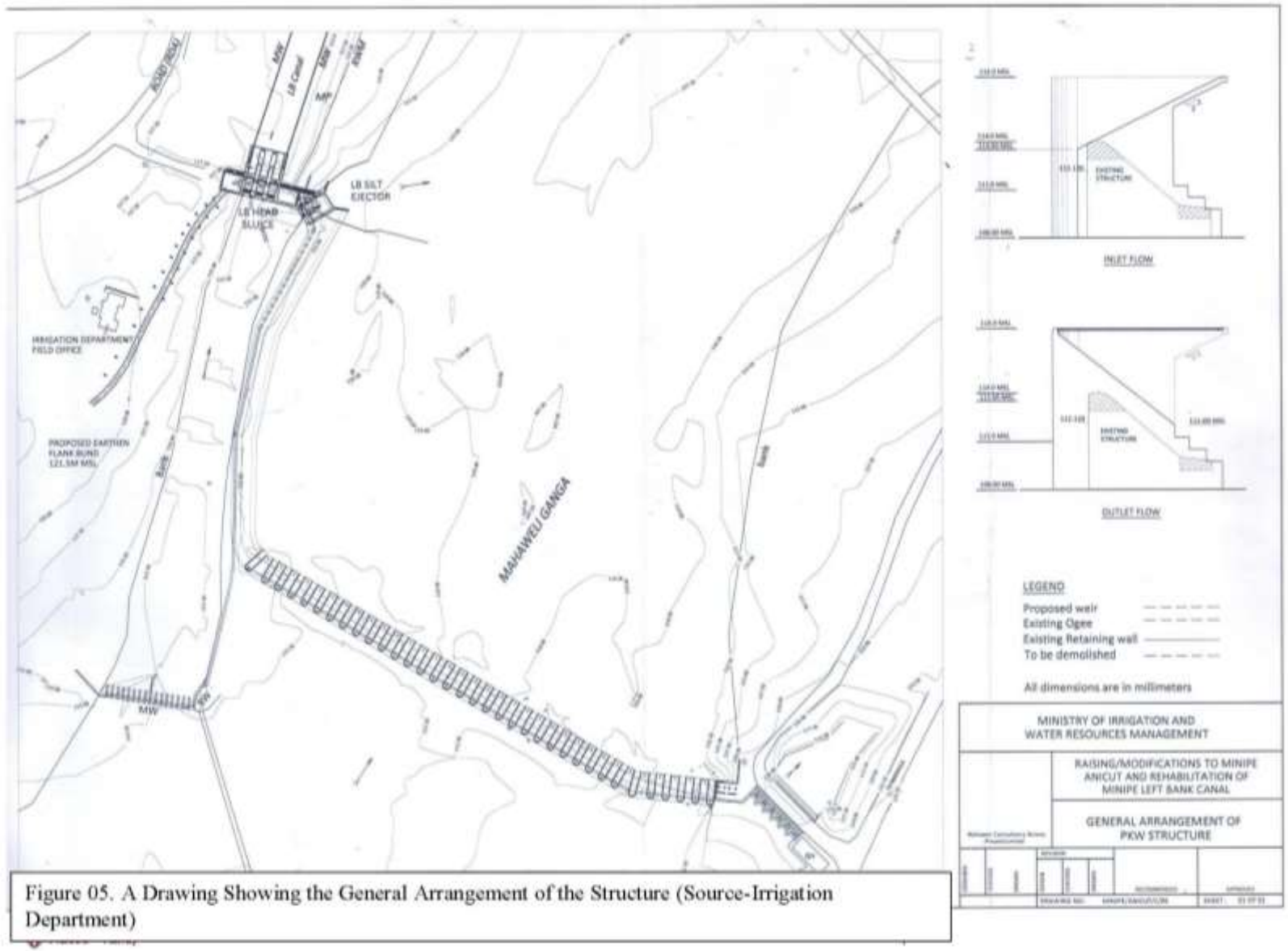

Figure 05. A Drawing Showing the General Arrangement of the Structure (Source-Irrigation Department)

Figure 08. Right Bank and Gate of the RB Canal with Road embankment which should be protected

Figure 09. Right Bank near the RB Canal Gate- Slopes to be protected

Figure 10. Left bank – New bund will be built as this area will be inundated

Figure 11. Anicut View from Left bank –this area will be inundated