

# Emergency Action Plan

## Kulur Barrage (Pazhassi)

KL07MH0031



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Prepared for:  
**Irrigation Department  
Kerala**

Prepared by:  
**State Project Management unit  
IDRB, Kerala  
July 2019**

## **FOREWORD**

The basic purpose of this plan is to provide a guide for emergency operations. The plan is intended to assist key officials and emergency organisations to carry out their responsibility for the protection of life and property under a wide range of emergency conditions.

When disasters threaten or strike a jurisdiction, people expect elected leaders to take immediate action to deal with the problem. Local government is expected to marshal its resources, channel the efforts of voluntary agencies and private enterprise in the community, and solicit assistance from outside the jurisdiction, if necessary.

This is the Emergency Action Plan for Pazhassi Barrage. It assigns responsibility to organizations and individuals for carrying out specific actions in emergencies exceeding to the capacity or routine responsibility of any agency. The plan sets forth lines of authority and organizational relationships and shows how coordination should be achieved. The Plan describes how people and property will be protected and identifies personnel and resources available within the districts involved, or by agreement with others, for use during response and recovery operations.

Although an organization may have the foresight to plan for anticipated situations, such planning is of little worth if the planning is not reduced to written form. Personnel familiar with unwritten plans may be unavailable at the time it becomes necessary to implement them. A written plan will furnish a documentary record, which can be referred to as needed. This documentary record will serve to refresh the knowledge of key individuals and can be used to inform persons who become replacements.

Primary goals of Emergency Action Plan are:

- Protect life and property and alleviate human distress.
- Ensure that the public safety and welfare is maintained by coordinating aid.
- Improve emergency response through planning and education.
- Define roles of Departments and agencies for large and small emergencies.
- Develop effective response and coordination among district agencies.
- Promote mobilization with less duplication of effort or gaps.
- Outline access to resources within corresponding districts.
- Encourage partnerships between government, private and volunteer sectors.
- Outline the recovery and restoration process (resilience).

We wish to place on record our heartfelt thanks to Dr.Vishwas Mehta IAS, Additional Chief Secretary, Home & Water Resources for his support and encouragement throughout. We also

wish to place our sincere gratitude to Dr. B. Ashok IAS, Secretary, Water Resources for his constant advice and inspiration. We personally thank all field Engineers including Superintending Engineer, Project Circle, Kannur, Executive Engineer, PyIP Division No.II, Kannur, Assistant Executive Engineer, PyIP Maintenance Sub Division No, Mattanur and Assistant Engineers, PyIP Section (M) No.1, Veliyambra for their efforts in drafting this document with all the inputs. We personally thank all the members of SPMU for their efforts in addressing the issues that was raised time to time and which required intellectual input and strategic thinking. Finally, we personally thank Sri. Rajesh S, Assistant Director, Dam Safety for his painstaking efforts to finalise the document on a time bound manner and without whose contribution this proposal would not have materialized.

Chief Engineer (I&D)  
IDRB, Vikas Bhavan  
Thiruvananthapuram

Chief Engineer  
Projects-I  
Kozhikode

**PREFACE**

Pazhassi Irrigation Project is the first Irrigation project in North Kerala, aiming overall development of agriculture in Kannur district of Kerala state. The project started in 1961 and fully commissioned in 1998. The project has a barrage across Valapattanamriver at Kuyiloor to impound water to a maximum capacity of 49.084Mm<sup>3</sup>. Though the project is initially envisaged as an irrigation project, it is now being converted as a multipurpose project to cater drinking water requirement of Iritty, Thalassery, Thaliparamba and Kannur Taluks and for power generation using the surplus in the rainy season. The Pazhassi Irrigation project has a canal network of 404km.

The barrage consist of a straight concrete masonry structure across Valapattanam river having a length of 245m and a height of 20.85m. The barrage having 16 spillways are made of concrete and non-overflow sections are made of masonry. The radial shutters are above spill way and over the radial shutters there is breast on all ogee portions. The concrete spillway has a total length of 155m. The left bank non overflow section is having a length of 54.5m. The gallery of the barrage is in this section only. The right bank non over flow section is having a length of 35.5m. The storage capacity of the reservoir is 49.084 Mm<sup>3</sup> with a design spillway capacity of 4200m<sup>3</sup>/s.

The EAP is prepared using the Inundation map developed by Central Project Management Unit (CPMU) for the following three causes of flooding : (1) A dam failure caused by overtopping from the inflow design flood leading to breaching and uncontrolled release of impounded water, (2) A non-flood dam failure caused by internal erosion (piping) with the reservoir at full supply level leading to breaching and uncontrolled releases of impounded waste and (3) A large controlled release flood without dam failure. The villages which can suffer a significant impact are Padiyoor, Vayathoor, Payam, Vilamana, Aralam, Keezhur, Chavassery, Muzhakkunnu andKolari in IrittyTaluk, Irikkur, Malappattam, Chengalayi, Anthoor, Kayaralam, Mayyil and Kolachery in TaliparambaTaluk, Kalliyasseri, Pappinisseri, Mattool, Narath, Puzhathi, Chirakkal, Valapattanam and Azhikode North in Kannur Taluk, Pattanur in TalasseryTaluk.

# **Kulur Barrage(Pazhassi)**

**KL07MH0031**

**Veliyambra**

Emergency Action Plan for Kulur Pazhassi Barrage was published in July 2019. This is the..... Revision in ..... as updated in .....

## **Disclaimer**

Every effort has been taken to estimate the severity of flooding and inundation areas likely to be affected by Pazhassi Barrage in an emergency condition. These estimates are based on available primary and secondary data. Every effort has been made to foresee varied emergency possibilities and develop appropriate notification procedures for timely rescue and relief operations. However, implementation of the Emergency Action Plan (EAP) involves many agencies, who are required to work in a coordinated manner to reduce the consequences of the emergency triggered by the dam site condition. Effectiveness of the rescue and relief operations depend on many factors including the adequacy and accuracy of the estimation of the severity of flooding, coordinated efforts of all the agencies involved in rescue and relief efforts and availability of facilities like power telephones, road communications, etc. EAP Developer may therefore, not be held responsible for the efficiency of the EAP.

Chief Engineer  
Projects - I,  
Kozhikode  
Mobile No: 9447332645  
Office No: 0495 2385595

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## Approval and Implementation

This Emergency Action Plan has been prepared by State Project Management Unit in collaboration with Pazhassi barrage Officials. This version of the document is hereby approved. This plan is effective immediately and supersedes all previous editions.

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[Secretary to Govt, Water Resources Department]

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Date

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I have received a copy of this Emergency Action Plan and concur with the notification procedures.

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[District Collector/ District Representatives]

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Date

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I have received a copy of this Emergency Action Plan and concur with the notification procedures.

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[State Disaster Management Authority]

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Date

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I have received a copy of this Emergency Action Plan and concur with the notification procedures.

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[State Dam Safety Organisation ]

---

Date



## EAP Distribution List

A copy of the EAP has been provided to the following people

Authority	Name, Title, Phone	Address	Acceptance Signature
Dam Owner(s) and Representatives	Chief Engineer Mobile No: 9447332645 Office No: 0495 2385595	Office of the Chief Engineer, Projects - I , Kozhikode	
	Superintending Engineer Mobile No: 9447303940 Office No: 0497 2700328 Email:sepcknr@yahoo.co.in	Project Circle Kannur	
District Collector, Kannur	District Collector Mobile No: 9447029015 Office No:0497-2700243	Office of the District Collector Civil Station Kannur	
State Dam Safety Organisation	Chief Engineer, IDRB Mobile No: 9447780159 Office No: 0471-2303972 <a href="mailto:idrvtm@gmail.com">idrvtm@gmail.com</a>  Director (Designs), IDRB Mobile No: 9446685757 Office No: 0471-2303972 <a href="mailto:idrvtm@gmail.com">idrvtm@gmail.com</a>	Office of the Chief Engineer (I&D), IDRB, Vikas Bhavan Thiruvananthapuram	
Central Dam Safety Organisation	Chief Engineer, CDSO Mobile No: 9717333808 Office No: 011-26106848  Director, DRIP Mobile No: 9958975928 Office No: 011-26192633	Sewa Bhavan, Sector 1, RK Puram, New Delhi, Delhi 110066  CWC Library Buildings, RK Puram, New Delhi, Delhi 110066	
State Emergency Operation Center, Kerala Disaster Management Authority	Member Secretary Email : keralasdma@gmail.com Mobile No:9400202927 Office No:0471-2331345	Observatory Hills Museum, Vikas Bhavan P O Thiruvananthapuram, Kerala 695033	
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	<p>Fire Station, Iritty Phone No: 0490 2493001</p> <p>Fire Station, Thaliparambu Phone No: 0460 2207101</p>	<p>Fire Station, Iritty, Kannur</p> <p>Fire Station, Thaliparambu, Kannur</p>	
The District Health Officers	<p><b>Contact: Kannur</b> Title: District Medical Officer (Health), Contact No: 0497 2700194</p>	Thavakkara, Kannur,-670002	
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11/01

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Village Office, **Azhikkode  
North**



## **Purpose**

The purpose of this Emergency Action Plan (EAP) is to identify emergency situations that could threaten Kulur Barrage (Pazhassi) and to plan for an expedited, effective response to prevent failure of the barrage and warn downstream residents of impending danger. This plan defines the notification procedures to be followed in the event of a potentially hazardous situation. The procedures are intended to protect lives and prevent property damage from an excessive release of water from the barrage spillways or an uncontrolled outflow of water from the breached portion of barrage.

### **1. Barrage Description**

#### **2.1. General**

2.1. Kulur Barrage (Pazhassi) is owned and operated by Irrigation Department, Kerala. The project is the first irrigation scheme taken up in North Malabar region of Kannur District. The barrage was constructed across Valapattanam River. Valapattanam river is one of the largest river in Kerala with its upper reaches located in Coorg at an elevation of 2500 ft above MSL. The dam is located at Kuyiloor across Valapattanam river about 37 km from Kannur Railway Station. Project consists of a masonry barrage having a water spread area of 6.50 Sq Km. The Project was started in 1961 and was partially commissioned in 1979 and fully commissioned on 1998. The project envisages irrigating an ayacut of 11525 Ha. Besides this the project also act as drinking water source of around 10 KWA Schemes. Moreover Government intended to generate 7.50 MW of electricity from this barrage for which KSEB has moved forward with this project.

A vicinity map showing the location of the dam is presented in Annexure 1. Inundation maps showing the areas subject to flooding as a result of a dam failure are provided in Annexure 2. The inundation area is described in further detail in the Inundation Area section of the report. Lastly, a description of the dam, its spillways, and other features are outlined in the Dam Description in Annexure 4.

#### **2.2. Reservoir Operations**

The scope of the Pazhassi barrage is to irrigate 11525 Ha. of agricultural land especially for second crop. It acts as a diversion structure and opened in rainy season. Since this project is a barrage there are no warning levels as in the case of Dam and all the shutters are kept fully opened during monsoon period.

This project has only one main canal starting on the left bank of river and it has 46.26 Km. Length. There are six branch canals namely Mahe, Edakkad, Azhikkal, Thaliparamba,

MWL	:	27.52 m
TBL	:	28.35 m
MDDL	:	13.72 m
Crest of Spillway	:	13.72 m
Dead storage Capacity	:	0.271 Mm <sup>3</sup>
Gross storage Capacity	:	49.084 Mm <sup>3</sup>
Revised Peak Flood	:	7136 Cumecs (SPF)
Type of Spillway	:	Ogee spillway
Type of Gate	:	Radial Gate
No of Bays	:	16 Gates of 5.18 m (H) X 6.1 m (W) each
Spillway Capacity	:	4200 m <sup>3</sup> /s
Regulation of Spillway Shutters	:	Both manually and electrically

Generally the shutters of barrage are closed during the mid of November and opened just before the onset of monsoon giving intimation to the district administration and to the public through Medias in time and are operated only in the presence of concerned Assistant Executive Engineer, Assistant Engineer, as per the order from Executive Engineer.

The Assistant Engineer in charge of the dam shall be responsible for the operation of the spillway shutters. All the water reaching the reservoir from the catchment shall be impounded until the level in the reservoirs reaches up to the full reservoir level. Daily readings of the reservoir level shall be taken at 7.00 am. All the data regarding the reservoir shall be sent to the Assistant Executive Engineer, Executive Engineer, Superintending Engineer, Chief Engineer and to Dam Safety Head Quarters from time to time.

There are sixteen radial shutters in the barrage and they are opened in the order as shown below.

The end shutters are opened first ( i.e. 1<sup>st</sup> and 16) to prevent cross- flows striking against the walls and junctions. After opening the end shutters, The shutters at the centre ( i.e. 8<sup>th</sup> and 9<sup>th</sup>) are opened and the other shutters are opened in symmetrical manner starting from the centre towards the end through gradual increase in the openings. While closing the shutters, the shutter that was opened last is closed first. The procedure to be followed for closing the shutters is generally reverse of the procedure for opening the shutters. Complete closure of the shutter should be accomplished by gradual lowering of the shutters by 0.2m to 0.3m in the proper sequence. In no time while operating the shutters it is ensured that the



The Dam Owner, Irrigation Department is responsible for all dam operation and maintenance. This EAP is not intended to designate a specific person for a specific responsibility but instead will designate the person's duties or job description for both, before and during an Emergency event (Table 1)

**Table – 1 : Dam Owner's Responsibilities**

Officer Designation	Responsibilities (During Preparedness and Emergency Events)
Executive Engineer (Emergency Planning Manager)	<p><b><u>Preparedness Responsibilities:</u></b></p> <ul style="list-style-type: none"> <li>• Coordinate routine inspections and Dam's Operations as per guidelines for safety inspection of dams.</li> <li>• Conduct pre and post monsoon inspection of dams.</li> <li>• Ensure effective transmission of hydro-metrological and stream flow data through different means.</li> <li>• Ensure proper accessibility to all vulnerable points for constant monitoring during emergency situations</li> <li>• Identify primary and secondary communication systems, both internal (between persons at the dam) and external (between dam personnel and outside entities).</li> <li>• Provide security measures at the dam (CCTV surveillance, security guards, fencing).</li> <li>• Ensure the availability of adequate staff at dam site during holidays, nights and round the clock in weekdays.</li> <li>• Ensure that the EAP is functional and staffs are familiar with their responsibilities.</li> <li>• Ensure that a sign board is installed and clearly visible in different locations at dam site and operation room, with the most common evidence of distress and corresponding levels of alert and remedial actions.</li> <li>• Ensure all the equipment/means at dam site in response to an emergency are easily accessible and well maintained (generators, vehicles, lanterns, radios, heavy equipment, etc)</li> </ul>

- Ensure the current approved version of the EAP is available to all relevant stakeholders (those who have a functional role in the emergency response)
- Ensure all necessary means to manage the emergency response are available and operative in the Emergency Operation Center.
- Participate in exercises for test/improvement of this EAP.
- In charge of organizing publicity at strategic points in Dam area limited for forewarning people on opening of gates.

**During Emergency Responsibilities:**

- Ensure a continuous and reliable communication with dam site officers
- Receive and assess any distress condition as notified by site engineers, observer on regular inspection.
- Classify the incident/distress condition reported by the observer into the different Emergency Levels (Blue, Orange, Red) based on the ANNEXURE 4 (Emergency Level Determination/Action Sheets) and ANNEXURE 2 (Inundation Maps).
- Initiate/implement the Emergency Action Plan and the Emergency Operation Centre if it is deemed necessary
- Identify the areas that would be potentially impacted by the emergency events.
- Provide updates of the situation to the District Disaster Management Authority to assist them in making timely and accurate decisions regarding warnings and evacuations.
- Propagate the emergency information to other relevant stakeholders.
- Support the communication needs of local emergency authority.

Dam Site Engineers  
(Assistant Executive  
Engineer, Assistant  
Engineers, Junior  
Engineers)

- inspection of dams and follow up on the events, if any noticed.
- Continuous monitor & surveillance of dam and appurtenant structures looking for evidence of distress as mentioned in **Annexure 4**
- Conduct Pre and Post monsoon Inspections along with the Emergency Planning Manager
- Inform the Emergency Planning Manager about any irregular/unusual condition at dam site and keep him/her posted about any progression/change
- Operate dam's gates/under sluices, under the express direction of Chief Engineer / Superintending Engineer / Executive Engineer
- Conduct routine dam maintenance
- Collect instrumentation measurements, evaluate and report if found necessary.
- Ensure that all the data are properly recorded.
- Ensure effective working conditions of the warning system (Sirens)
- Participate in exercises for test/improvement of this EAP

**During Emergency Responsibilities:**

- Monitor the emergency event at dam site and keep posted the Emergency Planning Manager about any change in development
- Contact the supplier / contractors
- Supervise the work of the labour contractors and machineries engaged in the site for rehabilitation / remedial works
- Conduct the remedial actions as per Action Data Sheets (**Annexure 4**)

Superintending  
Engineer

- Coordinate the annual / regulator testing events of the EAP, such as tabletop exercises, mock drills, and stakeholder's consultation.
- Coordinate training events in problem detection, evaluation and appropriate corrective measures
- Supervise the functioning of control room and ensure to be well equipped with all type of information to facilitate the rescue and relief operations.
- Ensure proper access to site at the earliest possible
- Ensure that all related machinery / equipment are in running conditions and can be deployed as per requirement at emergency site
- Formation of Purchase Committee / Committee in consultation with Chief Engineer for Procurement of Material from Appropriate Source through Spot purchase
- Ensure the correctness of Gauge Discharge sites under his control every year well before monsoon
- Have a constant liaison with Indian Meteorological Department (IMD) and other National / International agencies involved in forecasting.

**During Emergency Responsibilities:**

- Provide decision support and technical support to Emergency Planning Manager as appropriate
- Have a constant liaison with Indian Meteorological Department (IMD) during emergency periods related with flood events
- Advise the Emergency Planning Manager of the emergency level determination, if time permits
- Disseminate information and make contact to utilize media as appropriate at the time of emergency on behalf of Chief Engineer, Projects - II

**Preparedness Responsibilities:**

**Chief Engineer**

- Assist the Dam Owner's officers in preparation of Action

- Support and Monitor the remedial construction activities such as earth moving, special investigations, etc.
- Decide depending upon the quantum of repair/reconstruction work, whether the work is to be got executed through large construction firms or purely through the department or small contractors.
- Undertake an engineering assessment of the safety hazard at the dam in collaboration with the State Dam Safety Organization

#### **During Emergency Responsibilities:**

- Advise the dam's Emergency Planning Manager / Superintending Engineer with the emergency level determination, if time permits.
- Advise the dam's Emergency Planning Manager / Superintending Engineer with remedial actions to take if Blue / Orange events occurs, and if time permits.
- Direct specific and appropriate procedures to open/close the spillway's gates during the reservoir operation.
- Play the role of "Public Affairs Officer" in case external / public notifications should be released.
- Keep close watch on the different activities being carried out by different agencies at the time of emergency

### **3.2. Dam Safety Organization's Responsibilities**

The following are the basic emergency planning and response roles and responsibilities for the dam safety authorities (State and National level). The Dam Safety Organization (DSO) is the first point of contact for **BLUE** alert

- Is the responsibility of the Dam Safety Organizations undertaking an engineering assessment of the safety hazard at the dam.
- The DSO may inspect the Dam at its discretion and inform the Emergency Planning Manager if **Pazhassi barrage** is considered to be at **BLUE** alert.
- The DSO may advise the Dam Owner / Emergency Planning Manager of remedial actions to take if **BLUE** / **ORANGE** events occur.

- A DSO's officer may be called on to be the Subject Matter Expert at the Emergency Operation / Response Center.
- The DSO is responsible for reviewing and accepting the Emergency Action Plan, before its final publication.
- State Dam Safety Organization shall constitute a Dam Safety Review Panel consisting of engineers, geologist and hydrologist to analyse the distress conditions of Dam periodically.
- Support for the preparation of asset management plans, emergency preparedness plans, emergency warning systems, flood plain mapping, preparation of flood inundation maps in different areas for the river Basin and downstream impact mitigation measures
- Focus on legal, regulatory and technical frameworks for dam safety assurance
- Participate / Conduct a stake holders meeting before finalization of the Emergency Action Plan

### 3.3. Responsibilities for Notification

After an event level has been determined appropriate notifications should be made in accordance with the corresponding notification Flow Chart provided in this EAP (**See Notification Flowcharts Tab**). These Notification Flowcharts list the names and contact information and identifies who is to be notified of a dam safety incident, by whom, and in what order. Alternate contacts and their confirmed telephone number is also listed, in case primary contact is unavailable. Each official listed in the notification flowcharts should be familiar with it and immediately notify the Emergency Planning Manager in case of cessation of his / her functions within the organization.

**Table 2- Responsibilities for Notification**

Officer Designation	Responsibilities During Emergency Events
Executive Engineer (Emergency Planning Manager)	<ul style="list-style-type: none"> <li>• Notify the District Disaster Management Authorities (District Collector) in case of <b>Orange</b> / <b>Red</b> alert</li> <li>• Notify the District Authorities about any emergency response actions at dam site and their impacts in the downstream area (e.g. large releases)</li> </ul>

- Where the residences located immediately downstream of a dam that would be inundated within minutes of a dam failure, wherein the available warning time is very limited, in that cases, Emergency Planning Manager will arrange to notify the residences directly without waiting for the local administration to act upon before an emergency situation develops.

Dam Site Engineers  
(Assistant Executive Engineer, Assistant Engineers)

- Keep inform the Emergency Planning Manager about the progress of the situation at dam site

Superintending Engineer /  
Chief Engineer

- Notify Dam Safety Organization and request technical advice as required.
- Notify / inform higher authorities on the mishap as per notification flow chart of particular alert level as per situation at site.
- Notify / inform media representatives about the emergency situation.
- Define emergency situations for which each medium will be utilized and include an example of a news release that would be the most effective for each possible emergency, avoiding disseminate false / overstated messages among the population.

District Collector(s) /  
District Disaster Management Authority

- Implement the Notification Flow chart for regional and State Disaster Management Contacts
- Contact Local Law Enforcement Authorities and Relief Authorities under their jurisdiction
- Liaising and coordinating with Early Warning Agencies like IMD, CWC, INCOIS, etc. for disaster specific information and disseminating the information for coordinating with the State Government, and facilitating the deployment of NDRF in the disaster affected districts during disaster.

- Issue public announcements in coordination with Dam

Relief Authorities  
(Police Department,  
Civil Defense, Army  
Forces)

- Provide to the District Disaster Management Authority precise and accurate feedback information about the progress of relief actions and advise when the emergency can be terminated.
- Notify their corresponding command the necessity to deploy more resources to attend the rescue and relief actions.

Media  
Representatives

- Disseminate wide public awareness during emergency condition of Dam through Social Media Platform such as Facebook, Twitter, Whatsapp & Instagram.
- The news media, including radio, television and newspapers, should be utilized to the extent available and appropriate.
- Pre-plan in coordination with Chief Engineer / Superintending Engineer the most effective way to disseminate the most delicate and common emergency situations among the population. Pre-defined news shall be available in order to improve readiness of the decision-making process

### 3.4. Responsibilities for Evacuation

Evacuation and relief actions are exclusive responsibilities of Districts Authorities, and emergency relief forces at local and state level. As far as Pazhassi Barrage is concerned, 24 Panchayats and 27 villages in Kannur district would be directly affected by a potential failure / emergency event at the dam site, and therefore, District representative is responsible for evacuation / relief actions in their jurisdiction. District Collector acting as District's Disaster Management Authority is responsible to coordinate actions along with the following specialised teams / forces: Police and Fire Departments, National Disaster Management Authority (Response Force), Civil Defense, Army Forces.

Within their responsibilities are:

UNDER **NO EMERGENCY** (Preparedness)



before, during and after emergency events such as flash floods.

### UNDER **ORANGE** ALERT

- Prepare emergency response personnel for possible evacuations that may be needed if a **RED** alert is declared.
- Provide resources as necessary to the dam owners.
- Serve as the primary contact responsible for coordination of all emergency actions for potentially affected communities.
- Consider drafting a State of Local Emergency in preparation for **RED** alert.
- Maintain close liaison with the district and the State Governments as well as the nearest units of Armed Forces / Central Police Organizations and other relevant Central Government organizations like Ministries of Communications, Water Resources, Health, Drinking Water, Surface Transport, who could supplement the efforts of the district administration in the rescue and relief operations.
- Decide in coordination with the Emergency Planning Manager when to terminate the Emergency.

### UNDER **RED** ALERT

- Initiate warnings and order evacuation of people under vulnerable areas as per inundation maps (**Annexure 2**)
- Direct local emergency response services (may include local law enforcement) to carry out the evacuation of people and close roads/crossings within the evacuation area (see local Evacuation Plan, Annexure 2 and Annexure 3 tables).
- Declare a State of Local Emergency if required.
- Provide resources as necessary to the dam owners.
- Decide in coordination with the Emergency Planning Manager when to terminate the Emergency.

### **Police Department(s) Responsibilities**

- Warn the public under vulnerable areas in their jurisdiction as per inundation maps (**Annexure 2**).

- Assist in conducting rescue and recovery operation as required.
- Ensure proper access to the emergency services
- Prioritize the vehicle movement to the emergency site
- Control the traffic and divert through alternative routes.
- Ensure no unauthorized persons entering into the emergency site.
- Permit with minimum delay the entry of authorized personnel and recognized outside agencies, vehicles etc. involved in the emergency operations that come to help.
- Any other responsibility as entrusted by the high officers.

### **Fire Department(s), Army & Navy Forces Responsibilities**

- Assist in evacuation operations and initiate the evacuation of impact areas in cooperation with Emergency Management Agency and Police Department.
- Request mutual aid for boats and initiate rescue of trapped residents as needed.
- Supply special equipment/teams to support rescue operations (e.g. Helicopters, divers, off-road and amphibious vehicles)

### **3.5. Responsibilities for Termination and Follow-Up**

Once EAP operations have begun under **BLUE**, **ORANGE** or **RED** alerts levels, the EAP operations must eventually be terminated and follow-up procedures completed. EAP operations can only be terminated after completing operations under **RED** or **BLUE** alert levels. If **ORANGE** Event Level is declared, the operations must be designated **RED** Event Level or **BLUE** before terminating the EAP operations.

Please check the Action data Sheets (**Annexure 4**) for further details when to declare an emergency event terminated. **Table - 4** below shows the main responsibilities in the termination and follow-up process.

**Table 4– Termination and Follow-Up Responsibilities**

<b>Officer Designation</b>	<b>Responsibilities ( Termination and Follow Up )</b>
Executive Engineer (Emergency Planning Manager)	<ul style="list-style-type: none"> <li>• Declare the termination of the emergency operations in coordination with District Disaster Management Authority and Relief / Response Forces.</li> </ul>

- Identify EAP procedures that were followed effectively, as well as any ways that the EAP could be improved.
- Identify the causes that could have triggered the emergency event and propose actions to improve readiness and early detection. Support from the Dam Safety Organization may be requested in this regard
- For Major Emergencies, the Emergency Planning manager will maintain detailed records of cost expended and will prepare a detailed report in this regard.

Superintending Engineer /  
Chief Engineer

- Ensure that all parties that participated in the EAP activities are involved in the review process.
- Impose a time frame within which the EAP review is to be completed. Propose any ways that the EAP could be improved.
- Present the final results of the EAP evaluation in a documented report to Government
- Ensure that there is no danger of spread of any epidemics or water borne diseases after the floods.

Dam Safety Organisation  
(State / Central level)

- Identify in coordination with the Emergency Planning Manager the causes that could have triggered the emergency event and propose actions to improve readiness and early detection. A report should be presented to the dam owner's authorities in this regard.

District(s) - All districts -  
and National Disaster  
Management Authority

- Declare the termination of the emergency operations in coordination with Emergency Planning Manager and Relief / Response Forces.
- Identify EAP procedures that were followed effectively, as well as any ways that the EAP could be improved.

otherwise via cell phones or emergency personnel (in person or using their radios). The various networks for emergency use include the networks of the following:

- District Collector / District Disaster Management Authority
- Indian Meteorological Department
- Central Water Commission
- All affected Districts Police and Fire Departments (See **Table 3**)
- State Disaster Management Authority
- Army / Navy Forces
- Kerala State Electricity Board
- Kerala Public Works Department

Sample public announcements appear in **Annexure 6** and internal suggested phone messages are also available in each notification flow chart. Verification or authentication of the situation can be made by contacting the Emergency Planning Manager and the corresponding District Disaster Management Officials (**See District-wise Notification Flow Charts Tab**). Television, Radio and bulk SMS facilities of the local Mobile Network Operators can be used as much as possible to notify area residents of the possible dangers.

As per notification responsibilities (Section 3.3) public announcements are to be issued by the concerned District Disaster Management officials and the Chief Engineer in coordination with media representatives.

## **5. EMERGENCY DETECTION, EVALUATION, AND CLASSIFICATION**

### **5.1. Emergency Detection**

#### **5.1.1. Situations**

Many dam conditions can lead to emergency situations, not all of which will require the implementation of the EAP. However, if any of them occur, the appropriate actions must be taken. **Annexure 4** of this EAP shows the most common emergency situations that may emerge in Pazhassi Barrage and appurtenances, along with the corresponding specific actions to be done by each of the dam's officials. Some of these emergency situations are summarized as follows:

- Severe Storms / Inclement Weather : Although generally not in themselves a threat to

- Tropical cyclones : Tropical cyclones do occur in the area, with the potential for structural damage to the dam, possibly resulting in its failure. If a tropical cyclone has struck in the area, an inspection of the dam for any signs of damage will be appropriate.
- Earthquakes: Pazhassi Barrage is located in the Seismic Zone Number III. This zone is classified as Moderate Damage Risk Zone which is liable to MSK VII and also 7.8. The IS code assigns zone factor of 0.16 for Zone III. Therefore, an earthquake is a possibility, and appropriate post-earthquake inspections should be performed.
- Sabotage: If a threat to damage the dam has been made appropriate actions must be taken to protect the dam.

### 5.1.2. Signs of Failure

Site engineers in coordination with the **Executive Engineer, Pazhassi Irrigation Project Division No. II** are responsible for conducting routine inspections and identifying conditions that could indicate the onset of problems leading to a dam failure. The early identification of potentially dangerous conditions can allow time for the implementation of the EAP. The following sections describe some of the different types of failure which could lead to a dam failure.

- Structural Failure: The structural failure or collapse of any non-overflow portion of the dam, spillway or spillway gates could result in loss of the reservoir.

### 5.2. Emergency Evaluation and Classification

This section lists the conditions and actions which may be used to classify the level of emergency response, as a guide for the **Emergency Planning Manager (Executive Engineer, Pazhassi Irrigation Project Division No.II, Kannur)**. Specific dam observations and corresponding emergency classification levels can be found in Annexure 4, along with appropriate and recommended actions to follow in each case.

Internal Alert Condition **BLUE** — A "watch" condition. A problem has been detected at the dam that requires constant monitoring. At this time, the distress condition is manageable by dam personnel. The **Emergency Planning Manager (Executive Engineer, Pazhassi Irrigation Project Division No.II, Kannur)** along with the support of site engineers will be

- High intensity rainfall in the catchment area of reservoir ; Forecast of heavy rain by IMD; large inflow to reservoir ; in the summer season ( pre monsoon period ) when the shutters are in closed position and the water level reaches one metre below FRL and rapid increase in the water level may need to open gates in an emergency'
- Cracking or movement of any concrete structure.
- Instrumentation readings are beyond predetermined / threshold values
- Malfunction of Spillway / Sluice Gate (s). Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gate(s). no leakage or uncontrolled discharge is detected. Flood can be routed without damaged / non-operational gate(s)

**External Alert Condition ORANGE** - This is indicative of a dam condition that is progressively getting worse; and there is a high probability of dam failure. Although there is no immediate danger, the dam could fail if conditions continue to deteriorate. The **Emergency Planning Manager (Executive Engineer, Pazhassi Irrigation Project Division No.II, Kannur)** will be responsible for initiating immediate repairs, including lowering the reservoir if appropriate and implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate this condition:

- High intensity rainfall in the catchment area of reservoir ; Forecast of heavy rain by IMD; large inflow to reservoir ; in the summer season ( pre monsoon period ) when the shutters are in closed position and the water level reaches 0.50 metre below FRL and rapid increase in the water level, Controlled release through the spillway.
- Large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam
- Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gates(s). Considerable leakage or uncontrolled discharge is detected. Flood cannot be routed without damaged / non-operational gate(s)
- Near to 'Design Flood' inflow forecast

**External Alert Conditions RED** - These are "failure" conditions. Either the dam is in immediate danger of failing or has already failed. No time remains to implement measures to prevent failure. Evacuate immediately. Evacuation efforts will continue until the situation is

- Any spillway's release matching with a **RED** alert in accordance with **Annexure 4**
- High intensity rainfall in the catchment area of reservoir ; Forecast of heavy rain by IMD; large inflow to reservoir ; in the summer season ( pre monsoon period ) when the shutters are in closed position and the water level reaches FRL, open gates and large release through spillway
- Dam unexpectedly and without warning begins to fail
- Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gates(s). Unexpected high discharge is occurring. Flood cannot be routed without damaged / non-operational gate(s)
- Earthquake resulting in uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage
- Cracks that extend to the reservoir level
- Significant movement or failure of any structure that forms an integral part of the dam
- Overtopping of the dam
- Uncontrollable release of the reservoir

### **5.3. Previously / Existing Known Problems**

**Over topping failure:** Due to heavy rain and landslides experienced in August 2012 flash flood was occurred resulting in flood havoc to Pazhassi barrage and nearby areas. The banks of Valapattanam river was over flown causing damages to the barrage, canal system, houses, commercial buildings, agriculture lands, roads etc. The reservoir level was rose and the flood water over flown the barrage. All people in and around the barrage were evacuated. One of the major reasons for flooding was the non-functioning of 7 shutters out of the total number of 16 shutters. Heavy damages occurred to the barrage and main canal was breached at two locations viz. near Ch.0/300km and at Ch.1/300km. All the major damages of barrage are rectified in “DRIP” work, but the breaches aforementioned are yet to be attended for which rectification works are arranged under action plan 2018-19. Since these works are not completed, water distribution through this project could not be resumed so far.

**Seepage** - Even though the rectification works of barrage both civil and mechanical works are attended properly leakages are noticed at crest level of shutters due to the damages of

Damages to electric system:- During the last year monsoon, the transformer of the barrage failed to function and the electric system of the barrage partially damaged. All steps were taken to re-instate the system immediately after the occurrence of damages. Now the KSEB authorities are doing the needful in this regard.

## **6. PREPAREDNESS**

Preparedness actions are to be taken both before and following the development of emergency conditions and should identify ways of preparing for an emergency, increasing response readiness in a uniform and coordinated manner, and helping to reduce the effects of a dam failure. The following are some steps that could prevent or delay failure after an emergency is first discovered.

### **6.1. Surveillance**

Round the clock surveillance at the dam and its appurtenant (on the rim of reservoir (left & right)) will be carried out by site engineers during emergency situations. For this, the posting of special observer of high experience and keen observation is an important requirement of EAP during high flood period. To ensure that the whole system (including civil structures & mechanical installations) is being maintained well upto satisfactory level, the repair maintenance must be carried out as per requirement of O & M manual of Pazhassi barrage. In addition, it must be ensured that maintenance and upkeep of different components are carried out and will be only possible through deployment of well procedure conversant and trained staff. The list of such persons should be displayed on a photo frame mounting at convenient safe places at dam site and list of local telephone numbers inside the dam & outside the dam area. It will be updated from time to time for any change.

### **6.2 Response on forecast of excessive inflow**

**Dam Engineers** as well as **Emergency Planning Managers** will respond to the situation of excessive inflow forecast in close co-ordination with IMD especially during monsoons for their forecast by way of controlled spillway releases as per the warning levels as per warning levels in Clause 2.2 of Reservoir Operations. Warnings will be intimated to the affected downstream authorities and 24 x 7 monitoring will be initiated.

### **6.3 Response during weekends and holidays**

The Standard Operating Procedure with Reservoir Operation & Maintenance Manual and Gate Operation Manual are strictly followed throughout the year whether it is weekends/holidays/night. **Executive Engineer, Pazhassi Irrigation Project Division No.II, Kannur** will be available for emergency response during weekends and holidays and can be present at the dam site within 15 minutes of detection of an emergency condition. In case of



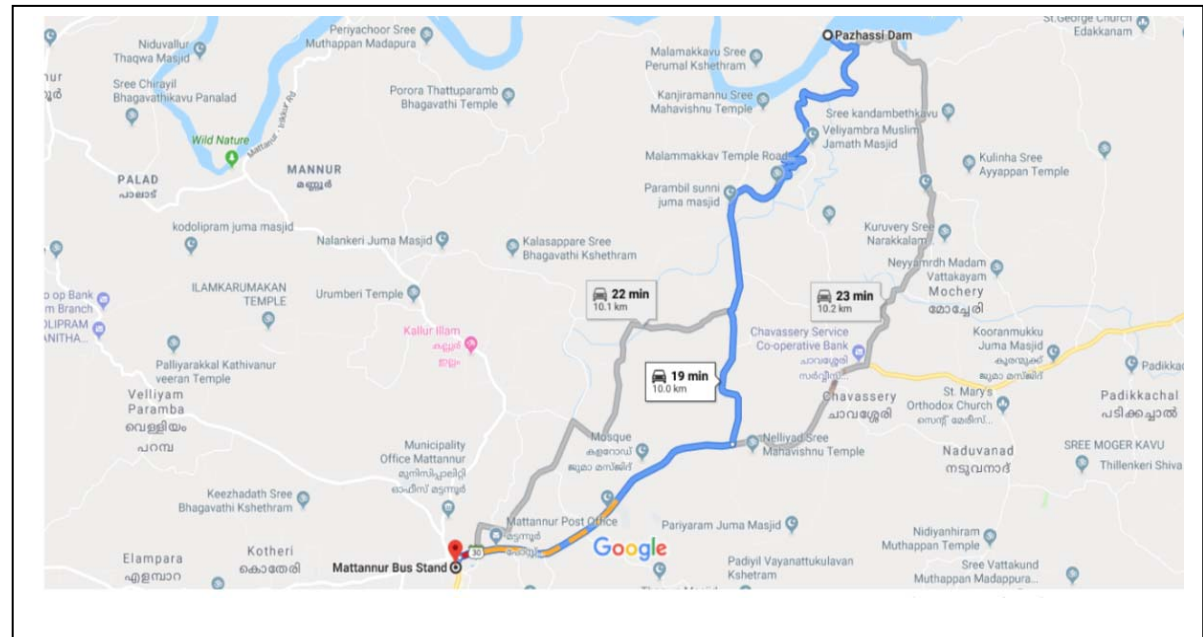
## 6.4 Response during periods of darkness and adverse weather

The **Executive Engineer, Pazhassi Irrigation Project Division No.II,Kannur** and **Site Engineers** will arrange for access to generators and lights to adequately monitor the situation. **Site Engineers** will ensure the generators and emergency light are well maintained and available under any circumstances. **Executive Engineer, Pazhassi Irrigation Project Division No.II,Kannur** will be able to access the site during adverse weather conditions by off road vehicle.

## 6.5. Access to the site

The following accesses to the dam are available, and depending on the emergency situation some of them should be used with caution or totally avoided

### Accesses to Pazhassi Barrage under Emergency Conditions



## 6.6. Remedial Actions

Preparedness and remedial actions can be taken in an emergency to prevent the catastrophic failure of the dam, but such repairs should be undertaken with extreme caution. The repairs are only temporary, and a permanent repair should be designed by an engineer as soon as possible.

the State Dam Safety Organization be notified.

Consider the following remedial actions if the dam's integrity is threatened by:

### **Structural Failure**

- Implement temporary measures to protect the damaged structure, such as placing rock riprap in the damaged area.
- Lower the water level to a safe elevation through the low flow outlet.

## **7. SUPPLIES AND RESOURCES**

### **7.1 Contracts**

If Dam Project's personnel and resources prove to be inadequate during an emergency, requests will be made for assistance from other local jurisdictions, other agencies, and industry, as needed. Such assistance may include equipment, supplies, or personnel. All agreements will be entered into by the following authorized officials, as deemed necessary to prevent the failure of the dam:

- Emergency Planning Manager (Executive Engineer, Pazhassi Irrigation Project Division No.II,Kannur)
- Superintending Engineer, Project Circle, Kannur.
- Chief Engineer, Projects – I,Kozhikode

### **7.2 Equipment and Supplies**

Equipment that is available for use and local contractors that can be contacted to provide equipment during an emergency event are listed in **Annexure 5**.

### **7.3 Reports**

Pre-monsoon and post-monsoon inspections of the dam are made every year during the month of **May and December** respectively by the Site Engineers in coordination with the **Emergency Planning Manager (Executive Engineer, Pazhassi Irrigation Project Division No.II, Kannur)** to evaluate its structural safety, stability, and operational adequacy. In the event of an abnormal occurrence, reference to these reports, particularly the photographs, can be beneficial in the evaluation of a potential problem.

Technical records such as drawings and inspection reports are stored and carefully

## **8. EMERGENCY OPERATIONS CENTRE**

### **8.1. Activity log**

Any unusual or emergency condition should be documented, including the following:

- Activation or deactivation of emergency facilities
- Emergency notifications to other local governments and to state and central government agencies
- Significant changes in the emergency
- Major commitments of resources or requests for additional resources from external sources
- Telephone calls will be recorded in chronological order
- Issuance of protective action recommendations to the public
- Evacuations and casualties
- Termination of the incident

### **8.2. Costs of the Emergency Operations Centre**

For major emergencies, the emergency operations centre will maintain detailed records of costs expended. These records may be used to recover costs from the responsible party or insurers, or as a basis for requesting financial assistance for certain allowable response and recovery costs from the state or central government. Documented costs should include:

- Personnel costs, especially overtime
- Equipment operation
- Equipment leasing and rental
- Contract services to support emergency operations
- Specialized supplies expended in emergency operations

## **9. INUNDATION AREA**

expected, as well as an estimation of the time from the beginning of the breach to the moment the location start to be inundated. More hazard reference values such as depth, velocity, vulnerability, and water surface elevation are included in **Annexure 2** in both, tabular and map format for each of the affected locations

**Table – 5 Scenarios included in the Emergency Action Plan**

<b>Annexure Index</b>	<b>Scenario</b>	<b>Hazard Parameters</b>	<b>No. of Tiles</b>
2 A	Large Controlled Release	Depth, Velocity, Water Surface Elevation, Vulnerability	16
2 B	Over Topping	Depth, Velocity, Water Surface Elevation, Arrival Time, Vulnerability	20
2 C	Non-Flood Failure	Depth, Velocity, Water Surface Elevation, Arrival Time, Vulnerability	20

After examining the results of the breach analysis of Pazhassi Barrage, it has been determined that there were a significant number of structures that could be affected due to a design flood or sunny-day dam breach. These structures are located along the Valapattanam River. Irikkur, Koodali, and Malapattam Grama Panchayats and Mattannur municipality can suffer a significant impact from a breach of the dam. In addition, water results from a breach, and associated damages, can, under certain circumstances, travel down the Valapattanam River affecting Mayyil, Kuttiyattoor, Kolacheri, and Narath Grama Panchayats. Hazard reference values (water surface elevation, depth, velocity, arrival time and Vulnerability) for each of these locations are summarized in the **Annexure 3** tables and the inundation maps in **Annexure 2** for each case.

The potential consequences either due to a hypothetical breach scenario of Pazhassi Barrage or due to a large controlled release from the spillways involve all the nearby villages located on either banks of Valapattanam river downstream of the Pazhassi Barrages. The Villages which can suffer a significant impact are listed in the Table 6 below.

**Table -6 : Affected Taluk and Villages**

State	District	Taluk	Villages
Kerala	Kannur	Iritty	Padiyoor
			Vayathoor
			Payam
			Vilamana
			Aralam
			Keezhur
			Chavassery
			Muzhakkunnu
			Kolari
		Thaliparamba	Irikkur
			Malappattam
			Chengalayi
			Anthoor
			Kayaralam
			Maniyoor
			Mayyil
			Kolachery
		Kannur	Kalliasseri
			Pappinisseri
			Mattool
			Narath
			Puzhathi
			Chirakkal
Valapattanam			
Azhikode North			
Thalasery	Pattanur		

It is also determined that there are significant numbers of buildings/roads, located on the banks and adjoining areas of stream and banks of Valapattanam River could be affected due to a large control discharge from the spillways or flood wave resulting from dam breach scenario. Figures in the breach analysis include information on the estimated impact of flooding on the bridges along the Valapattanam River. The most important crossing structures and parts of roads, likely to be submerged due to various scenarios, are summarized in the Table 7

**Table 7 List of Main Crossing Structures likely to be submerged**

<b>Sl. No.</b>	<b>Name of Bridge / Location</b>	<b>Title Id in Inundation Map</b>
1	Irikkur-Mannur Bridge	(1/2)
2	Irikkur Bridge	(1/2)
3	Pavanur Bridge	(1/2)
4	Malappattam Bridge	(2/2)
5	Therlayi Bridge	(2/2)
6	Nanicheri-Mullakkodi Bridge	(2/2)
7	Parassinikadav Aqueduct cum Bridge	(2/2)
8.	Pamburuthi Bridge	(2/2)
9.	Kattampalli Regulator cum Bridge	(2/2)
10.	Valapattanam Bridge	(2/2)

The breach analysis contains profiles of the peak flood levels expected, as well as an estimation of the time from the beginning of the breach to the peak flood elevations. A comparison of the areas that are likely to be flooded with the plots showing the times from the start of the breach to the flooding shows the areas of evacuation and the time constraints involved. These structures may suffer such impacts before the peak elevation of the flood wave.

### **9.1. Local Evacuation Plan**

If imminent failure of Pazhassi Barrage with uncontrolled downstream flooding is anticipated, local disaster management and law enforcement personnel should notify those downstream (**Table 6**), for evacuation in the most expedient manner possible following the procedure given in the notification flow charts of this document (**Notification Flow Chart Tab**). Local law enforcement officials, along with local mobile network operators, radio and media representatives can best spread the notice for evacuation (**See Responsibilities Sections, 3.3 and 3.4**)

- Police Departments will barricade all bridges and roads that could possibly be flooded to prevent access to the affected area. These bridges include all crossings and its tributaries as well as those affected roads shown in the **Annexure 2 (Inundation Maps)**. Inundation Maps along with Flood Hazard Reference Values in crossings locations included in this annexure indicate the appropriate barricade locations under the responsibility of local law-enforcement authorities.
- The Districts Disaster Management Authorities (Districts Collectors) will assist with the notification of all persons and agencies involved (relief authorities), with the possibility of additional support—including contacting others not accessible by radio or telephone.
- Relief Authorities (Police, Fire, Army) are generally familiar with developed areas in their jurisdiction. Such knowledge, coupled with the requirements of state law that they respond to disasters, make them the logical officials to be notified and to spread the warning message to all areas subject to flooding.

Based on the specific results of the dam breach analysis (wave arrival time) a local evacuation plan has been developed to assist disaster management authorities in the relief actions. The local evacuation plan can be found in the **Annexure 2** of this EAP, and Hazard reference values and complete list of relief camps (shelters) is included in **Annexure 3**

## **10. IMPLEMENTATION**

### **10.1 Development**

This EAP version has been prepared by State Project Management Unit in collaboration with Dam Officials. The document has been sent to the State Dam Safety Organization and Disaster Management Authority for review, and agency their comments will be incorporated into this document for final publication.

### **10.2 Updating**

Copies of the EAP have been provided to all authorities/officials included in the distribution list and the document has been approved and signed by the Additional Chief Secretary of Kerala Water Resources Department, District Disaster Management Authority and the Dam Safety Organization.

This plan will be reviewed and updated annually before the **1<sup>st</sup> of June** of every year by the

**The Superintending Engineer** will organize every year prior to monsoon an orientation meeting to introduce the revised EAP to local officials, emergency responders. This meeting will give an opportunity to all the stakeholders to review and comment on EAP document and their respective roles.

**The Emergency Planning Manager (Executive Engineer, Pazhassi Irrigation Project Division No.II, Kannur)** will review and complete all items on the Annual EAP Evaluation Checklist in **Annexure 8**. After the annual update is complete, a new Approval and Implementation sheet will be attached and the annual update will be documented on the Plan Review and Update sheet in **Annexure 9**.

If revisions to the EAP are made as a result of the annual update, such changes will be recorded on the Log Sheet of Changes form at the front of the report. A copy of the updated portions of the EAP will be sent to the SDSO and all other concerned as per the EAP Distribution List. If the EAP was reviewed and revisions were not required, the **Emergency Planning Manager** will submit written notification to all concerned that no updates to the EAP have been adopted or implemented.

### **10.3. Testing**

**The Superintending Engineer** shall organize the following exercises as specified below:

- **Orientation (Stakeholders' Consultation):** The Superintending Engineer will organize an orientation meeting every year with local responders and stakeholders to solicit input, established roles during emergency situation and facilitate reliable responses to the emergencies. In orientation meeting, the Emergency Planning Manager will introduce the revised EAP to local officials and emergency responders and provide those entities the opportunity to review and comment on the documents and on their roles and responsibilities, described in EAP.
- **Tabletop exercises-** Superintending Engineer and Emergency Planning Manager will organize a table-top drill once in 2 years to discuss and review the simulated or imaginary emergency situation. The tabletop drill involves a meeting of **Emergency Planning Manager** with local and state **Disaster Management Officials** in a conference room. The drill begins with a description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures, and to resolve concerns regarding coordination and responsibilities. Any problems identified during a drill should be included in revisions to the EAP.

Before the tabletop exercise begins, meeting participants will visit the dam to familiarize with the dam site. **Emergency Planning Manager** will present a scenario of an unusual or



procedures and resolve the questions throughout the exercise. It will also clarify roles and responsibilities and will identify additional threat mitigation and preparedness actions.

Records and reporting of the main conclusions/findings of both meetings will be maintained in **Annexure 10** and following the deadline given in **Table 8**.

**Table 8 : EAP Exercise / Testing Techniques**

<b>Exercise</b>	<b>Schedule</b>	<b>Reporting Deadlines</b>
Orientation (Stakeholder's Consultation)	Annual	<ul style="list-style-type: none"><li>▪ <u>Pre-Event</u> : Submit Agenda to Stakeholders 30 days before meeting</li><li>▪ <u>Post-Event</u> : Update Form 2 (Annexure 10), within 30 days after meeting</li></ul>
Tabletop Exercise	Once every 2 years (before monsoon season)	<ul style="list-style-type: none"><li>• <u>Pre-Event</u> : Submit Exercise Plan and Schedule to participants 90 days before meeting</li><li>• <u>Post-Event</u> : Update Form 2 (Annexure 10), and submit Evaluation Report within 60 days after exercise</li></ul>

#### **10.4. Training**

**The Superintending Engineer** will ensure all people involved in the EAP be trained to guarantee that they are thoroughly familiar with its elements, the availability of equipment, and their responsibilities and duties under the plan. Personnel will be trained in problem detection, evaluation, and appropriate corrective measures. This training is essential for proper evaluation of developing situations at all levels of responsibility. Training records will be maintained also in **Annexure 10**.