KONAR DAM

Tier I - Emergency Action Plan
Revision - 1

DAMODAR VALLEY CORPORATION

May - 2024

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KONAR DAM

Project ID Code: JH05HH0005
Hazaribagh, Jharkhand

This is the first publication of Emergency Action Plan for Konar Dam.

Disclaimer

Every effort has been taken to estimate the severity of flooding and inundation areas likely to be affected by Konar Dam 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 efficacy of the EAP.

For any information, please contact:

Shri Anjani Kumar Dubey

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Emergency Action Plan
Konar Dam
Damodar Valley Corporation

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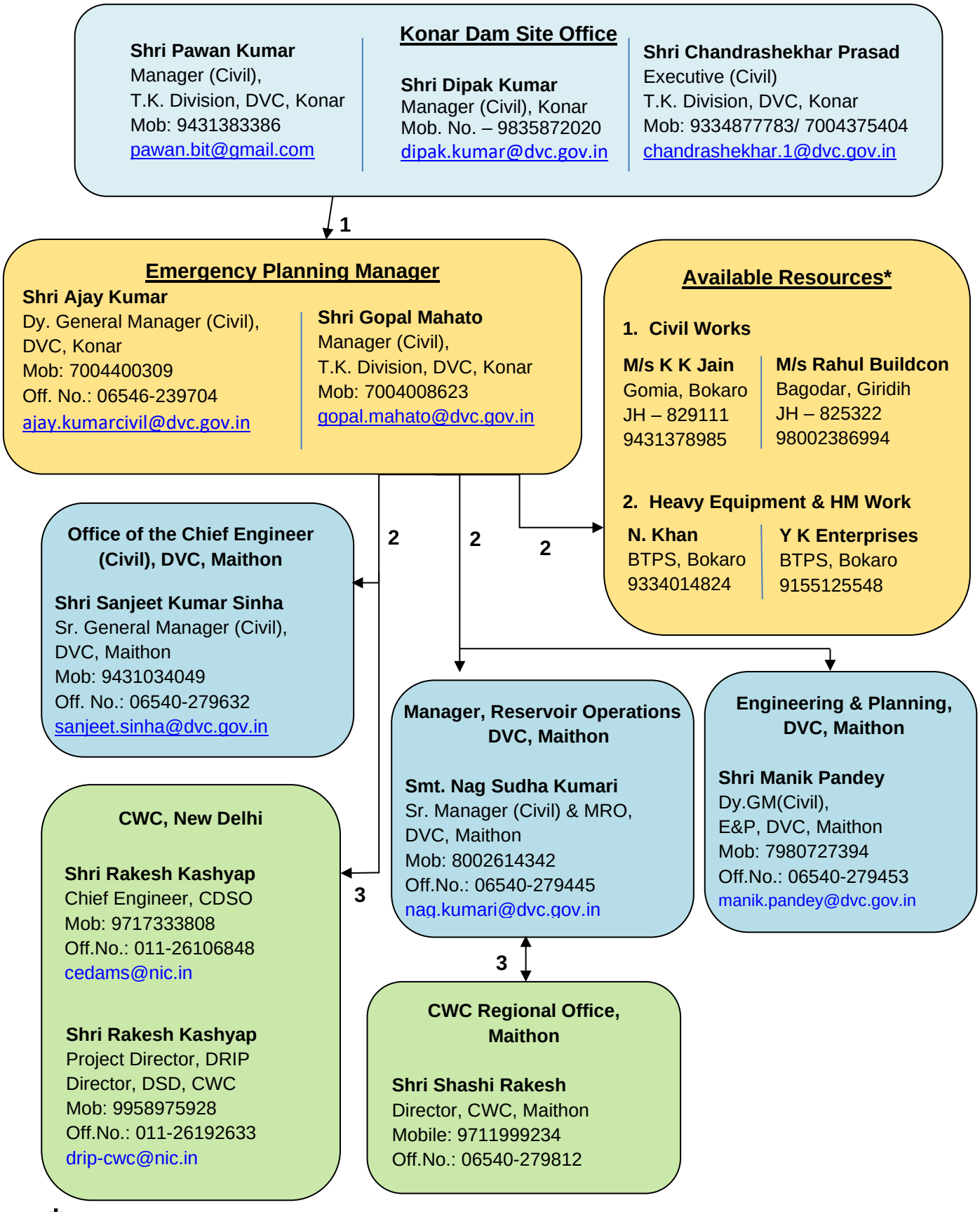
Annexures

ANNEXURE - 1

KONAR DAM – WATCH CONDITION NOTIFICATION FLOWCHART



* ***The detail list is appended in Annexure - 10.***

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ANNEXURE - 2

KONAR DAM – FAILURE CONDITION NOTIFICATION FLOWCHART

Konar Dam Site Office

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Manager (Civil), Konar
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1

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Shri Gopal Mahato
Manager (Civil),
T.K. Division, DVC, Konar
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gopal.mahato@dvc.gov.in

2

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M/s K K Jain
Gomia, Bokaro
JH – 829111
9431378985

M/s Rahul Buildcon
Bagodar, Giridih
JH – 825322
98002386994

2. Heavy Equipment & HM Work

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BTPS, Bokaro
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Y K Enterprises
BTPS, Bokaro
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Shri S N Panday
Superintending Engineer, Tenughat Dam, Water

Divisional Railway Manager, Dhanbad

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2

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2

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Shri Avinash Kumar, IAS
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Deputy Commissioner, Bokaro

Smt. **Jadhav Vijaya Narayan Rao**, IAS, Deputy Commissioner, Bokaro
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dc-bok@nic.in, dc_bokaro @rediffmail.com

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**** The detail list is appended in Annexure - 10.***

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ANNEXURE-3

KONAR DAM
Project ID Code: JH05HH0005
EAP Distribution List

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

Authority	Name, Title, Phone	Address
Dam Owner(s)	Shri Anjani Kumar Dubey Executive Director (Civil) Mob: 9431122635 e-mail; anjani.dubey@dvc.gov.in	Office of the Executive Director (Civil), DVC, Maithon.06540-279402
	Shri Sanjeet Kumar Sinha Sr. General Manager (Civil) Mob: 9431034049 sanjeet.sinha@dvc.gov.in	Office of the Chief Engineer (Civil), DVC, Maithon. 06540-27949632
	Shri Ajay Kumar Dy. GM (Civil) Mob: 7004400309 ajaykumar.civil@dvc.gov.in	Office of the Dy. General Manager (Civil), DVC, Konar.
	Shri Gopal Mahato Manager (Civil) Mob: 7004008623 gopal.mahato@dvc.gov.in	In-charge - T.K. Division, DVC, Konar
	Shri Pawan Kumar Manager (Civil) Mob: 9431383386 E-mail: pawan.550434@dvc.gov.in	Office of the T.K. Division, DVC, Konar
	Shri Chandrashekhar prasad Executive (Civil) Mob: 9334877783/7004375404 chandrashekhar.1@dvc.gov.in	
Dam Owner(s) Representatives	Shri Manik Pandey Dy. GM (C), Water Resources & E&P Mob: 7980727394 manik.panday@dvc.gov.in	Office of the Chief Engineer (Civil), DVC, Maithon.
	Name: Smt. Nag Sudha Kumari Sr. Manager (Civil) & MRO Mob: 8002614342 nag.kumari@dvc.ggov.in	
Dam Safety Organization	Shri Sanjeet Kumar Sinha Sr General Manager (C), Water Management Mob: 9431034049 / 8877499956 sanjeet.sinha@dvc.gov.in	Office of the Sr. General Manager (Civil), DVC, Maithon
	Shri Ram Krishna Sr. Manager (C), Dam Safety Mob: 9430511155 ram.krishn@dvc.gov.in	

	Shri. Abhishek Shukla Manager (C), Dam Safety Mob: 8986663966 Email: abhishek.shukla@dvc.gov.in	
	Shri Aloke Banerjee Dy. Manager (C), Dam Safety Mob:9002533400 aloke.banerjee@dvc.gov.in	
	Shri Dipak Kumar, Manager (Civil), Konar Dam Safety, DVC, Konar Mob. No. – 9835872020 E-mail -dipak.kumar@dvc.gov.in	
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Downstream Projects	Shri Anand Mohan Prasad, Sr. GM & HOP, BTPS Mob: 9431126686 anandmohan.prasad@dvc.gov.in	Office of the Chief Engineer & HOP, DVC, BTPS 06549266704
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	Shri Nasim Ansari Sr. Manager (Civil), Circle-I Mob: 9661159506 nasin.ansari@dvc .gov.in	Office of the Dy. General Manager (Civil), Circle-I, DVC, Panchet. 06540287203
	Shri S N Panday Superintending Engineer, Tenughat Dam Mob: 9471117390/ 06549230602	Office of the Superintending Engineer, Tenughat Dam, Water Resources Dept., GOJ
Central Water Commission	Shri Rakesh Kashyap Chief Engineer, CDSO Contact: 8826612840 drip-cwc@nic.in	Room No.-313 S, Sewa Bhawan, R. K. Puram, New Delhi - 110 066
	Shri Rakesh Kashyap Director,DRIP, Contact: 8826612840 dir-drip-cwc@nic.in	Sewa Bhawan, R. K. Puram, New Delhi - 110 066
	Shri Shashi Rakesh Director, CWC, Maithon Contact: 9711999234 sehocmaithon-cwc@nic.in	CWC Office Maithon, Dhanbad – 828207 06540-279812
National Disaster Management Authority	Shri Kamal Kishore Member & HOD Contact: 011-26701751 / 53 secretary@ndma.gov.in,	NDMA Bhawan, A-1, Safdarjung Enclave, New Delhi - 110 029
	Control Room: - 9868891801/ 9868101885, 011-26701728, 011-1078	

	controlroom@ndma.gov.in, ndmacontrolroom@gmail.com,	
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	Sh. Avinash Kumar, IAS Principal Secy Relief & DM Contact: 7070190807, 0651-2400220 sec-home-jhr@nic.in	
	Shri Umashankar Pal, US Contact: 878960225, 0651-2400218 dmjharkhand@gmail.com	
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Office of the Deputy Commissioner, Bokaro	Smt. **Jadhav Vijaya Narayan Rao**, IAS Deputy Commissioner, Bokaro Contact: 06542-249944/9431115667 dc-bok@nic.in	Bokaro Steel City Off. No.: 06542-249944/ 232701
Office of Divisional Railway Manager, Dhanbad	Shri K K Sinha, D.R.M, Dhanbad Contact: 9771426000 0326-2220338 / 0326-2220700 drmdhnecr@gmail.com	Dhanbad Railway Station
Office of the Superintendent of Police, Bokaro	Shri Priyadarshi Alok , I.P.S Superintendent of Police, Bokaro Contact: 9431706418, 06542-242266/06542-242299 sp-bokaro@jhpolice.gov.in	Bokaro Steel City
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ANNEXURE-4

KONAR DAM
Project ID Code: JH05HH0005
Log Sheet of Changes

The following changes have been made to the EAP and revisions have been provided to the people shown on the EAP distribution list:

Date	Change made	Signature
22-05-2024	Updation of distribution list, notification flowchart. Corrected contact addresses mentioned in the emergency action plan	

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ANNEXURE - 5

KONAR DAM
Project ID Code: JH05HH0005
Approval and Implementation

This Emergency Action Plan is hereby approved. This plan is effective immediately.

Signature

Satyabrata Banerjee, General Manager (Civil), DVC

_____ _____

[Name and Title of Appropriate Manager for Owner] Date

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

Signature

_____ _____

[Name and Title of Person(s) in charge of Emergency Response] Date

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Emergency Action Plan
KONAR DAM
Project ID Code: JH05HH0005

1. Purpose

The purpose of this Emergency Action Plan (EAP) is to identify emergency situations that could threaten Konar Dam and to plan for an effective response to prevent failure of the dam 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 dam spillways or an uncontrolled outflow of water from the breached portion of dam.

2. Dam Description

2.1. General

Konar Dam is owned and operated by Damodar Valley Corporation (DVC). It is located across the river Konar, a tributary of river Damodar in Hazaribagh District of Jharkhand State, approximately 16.1 kms from Gomia Railway Station and 38.6 kms from Hazaribagh town. The nearest railhead is at Gomia and the nearest airport is about 136.8 kms at Ranchi. The dam was completed in the year 1955. The reservoir was constructed to serve as multiple-purpose.

A vicinity map showing the location of the dam is presented in **Annexure - 6**. A description of the dam, its spillways, and other features are outlined in the Dam Description in **Annexure - 7**. Flood Hazard Reference Values indicating flood wave arrival time etc. are provided in **Annexure - 14**. Inundation maps showing the areas subject to flooding during dam failure conditions are provided in **Annexure - 15**.

2.2. Reservoir Operations

Reservoir Features:

Conservation level	=	R.L. 425.81 m (1397.00 ft.)
Full Reservoir Level	=	R.L. 427.94 m (1404.00 ft.)
Maximum Water Level	=	R.L. 429.16 m (1408.00 ft.)
Revised Flood peak (PMF)	=	9551 cumec (3.37 lac cusec)

2.3. Flood Management Operations

a) When the reservoir level rises to or shows a tendency to rise above RL 425.81 m (1397 ft.) flood control operations shall commence and they shall cease as soon as the reservoir level comes down to RL 425.81 m (1397 ft.).

b) While releasing water through the undersluices and crest gates, necessary flood warnings shall be given to the concerned by the Emergency Planning Manager or Dam Site Engineers.

c) During flood operations, the extent of releases is to be obtained from Dy. General Manager (Civil), Water Resources, DVC, Maithon. **If and when the reservoir level reaches RL 427.03m (1401 ft.), further rise in the water level should be prevented by opening crest gates to the extent required to match outflow with inflow and fact reported to the Dy. General Manager (Civil), Water Resources, DVC, Maithon.**

d) The reservoir level should be allowed to rise above RL 427.03m (1401 ft.) only in case of an emergency in the downstream conditions subject to the provision that it shall not exceed RL 427.94m (1404 ft.) and that it shall not be kept above RL 427.03m (1401 ft.) for more than 48 hours. The reservoir level ordinarily shall not be kept higher than RL 425.81m (1397 ft.) for more than one week. **Strict monitoring of the downstream face of the dam along with reading of Instruments shall be kept from the time the level crosses RL 425.81m (1397 ft.) mark such that the flood operations at any stage may be modified according to the behavior of the downstream of the dam.**

e) Towards the end of the rainy season i.e. after 15th October, if no storm is forecast, it is desirable to raise and maintain the reservoir level at RL 427.03m (1401 ft.) as long as possible to enable observations on the behavior of the dam. **During this period, a close watch must be kept by the Dam Site Engineers on the downstream face and the readings of the piezometers.**

f) In case of a storm warning, the reservoir should be brought down to RL 425.81m (1397 ft.) as quickly as possible.

3. Responsibilities

The dam owner, Damodar Valley Corporation, is responsible for all dam operation and maintenance. The responsibilities during emergency conditions are mentioned in the following section designating the person's roles & duties. However, this in no way restricts / limits other roles, responsibilities & duties of the concerned personnel.

3.1 Responsibilities for Remedial Measures & Notification

Sl.No.	Dam / Emergency Personnel	Responsibility (During Normal & Emergency conditions)
1.	**Dam Site Engineers** **Shri Pawan Kumar** EE (Civil), DVC, Konar **Shri Chandrashekhar prasad** Executive (Civil), DVC, Konar	• Routine dam maintenance work. • Monitoring & surveillance of dam and appurtenant structures including instruments & looking for evidence of distress as mentioned under **Annexure - 9.** • Notifying Dam Emergency Managers during any potential emergency situations. • As per advice, will operate dam gates / undersluices as well as contact the suppliers / resources available for executing actions during emergencies.
2.	**Emergency Planning Managers** **Shri Ajay Kumar** DGM(C), DVC, Konar **Shri Gopal Mahto** Manager (Civil), T.K.Division, DVC, Konar	• Examine the distress conditions / emergency as notified by site engineers and ensure to address the issue immediately. • Discuss the issue with Dy. General Manager (Civil), Water Resources, DVC, Maithon & Dy. General Manager (Civil), E&P and other experts and follow up the advice. • Will contact the suppliers / resources available for executing actions during emergencies and inform dam site engineers to carry out the required action. • Will establish Emergency Control Centre. • Will classify the events into type of Emergency alerts and direct specific, incident appropriate actions during an emergency. • Will notify the Disaster Management Authority and others as per the notification flow Chart. • Will coordinate with the emergency team / personnel for initiating & implementing EAP.

3.	**Shri Manik Panday** DGM (Civil), Water Resources, DVC, Maithon	• To issue release advices which shall be strictly adhered to by the Dam Emergency Manager & Dam Site Engineers. • To contact with the Regional CWC offices for integrated reservoir operation in Damodar Valley Area citing the emergency of Konar Dam.
4.	**Shri Manik Panday** Dy. General Manager (Civil), Engineering & Planning, DVC, Maithon	• To check for safety of the dam from design aspects and advise/visit the dam site for any needful actions regarding structural stability.

3.2 Emergency Operations Center

In the event of an emergency condition, Emergency Planning Managers will activate the Emergency Operations Center established at the dam site to serve as the main distribution center for warning and evacuation activities.

3.3 Responsibilities for Evacuation

The Hazaribagh & Bokaro District Disaster Management Authorities are responsible for initiating evacuations. The Flood Hazard Reference Values suggesting Flood wave arrival time, evacuation route, shelter points etc. **(Annexure –14)** and the Inundation cum Evacuation Map **(Annexure – 15)** as well as shall be utilized for evacuation during specific conditions. As the maps, settlements, routes, shelter points etc. shown in the map has been finalized with the help of Satellite imagery, there may be chances of some left over settlements, which also needs to be evacuated. The Disaster Management Authorities / evacuation team shall utilize the information of Maximum Water Surface Elevation (against each settlement) as given in the Flood Hazard Reference Values cum Evacuation Table **(Annexure – 14)** for evacuating the the marked settlements as well as left over portions. The same information will also help them to identify / modify the shelter points. The information in respect of Settlement wise Responsibilities of Evacuation along with the contact details as well as any modification with respect to routes or shelter points etc. shall be shared with Dam Site Engineers, Emergency Planning Managers or the office of General Manager (Civil), DVC, Maithon for updating this document.

3.4 Responsibilities for Duration, Security, Termination and Follow-up

The Emergency Planning Managers are responsible for monitoring of emergency situations at the dam and keeping authorities informed based on the Notification Flowcharts. They are responsible for declaring that an emergency at the dam is terminated. Concerned authorities will be notified based on the Notification Flowcharts.

Emergency Planning Managers will ensure that a follow-up evaluation is completed by all participants after the emergency. The results of the evaluation should be documented in a written report and filed with the EAP.

3.5 Communications

Local officials and downstream residents will be notified by landline telephone, if available; 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:

- ✓ Deputy Commissioner, Bokaro / Hazaribagh.
- ✓ Superintendent of Police, Bokaro / Hazaribagh.
- ✓ Divisional Railway Manager, Dhanbad.
- ✓ District Fire Officer, Bokaro /Hazaribagh.
- ✓ District Health Officer, Bokaro /Hazaribagh.
- ✓ India Meteorological Dept., Ranchi.

Sample Public Announcements appear in **Annexure - 8**. Verification or authentication of the situation can be made by contacting any of the Emergency Planning Managers and the Hazaribagh & Bokaro District Disaster Management officials. 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.

Public announcements are to be issued by the concerned District Disaster Management officials or the State Disaster Management officials.

4. Emergency Detection, Evaluation, and Classification

4.1. Emergency Detection

4.1.1. Situations

Many dam conditions can lead to emergency situations, not all of which will necessitate the implementation of the EAP. However, if any of them occurs, the appropriate actions must be taken.

- **Severe Storms/Inclement Weather:** Although generally not in themselves, a threat to the dam, severe storms and other inclement weather conditions can contribute to an existing problem and hinder any remedial efforts. Severe storms also cause the uncontrolled release of floodwater, and increase of flow in already rain-swollen areas. Hence, judicious reservoir operations shall be done as per the release advice of the ***Dy. General Manager (Civil), Water Resources, DVC, Maithon*** to minimize the risk of making dangerously higher releases than what it was originally planned.
- **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:** Konar Dam is located in the Seismic Zone-III. An earthquake is a possibility, and appropriate post-earthquake inspections should be performed.
- **Sabotage:** If a threat has been made to damage the dam, appropriate actions must be taken to protect the dam.

4.1.2. Signs of Failure

Dam Site Engineers are responsible for conducting routine inspections. **Dam Emergency Planning Managers** shall analyze the 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 EAPs. It is important to understand how distress can develop into failure. With appropriate action, distress may not lead to a catastrophic failure of the dam. The following sections describe some of the different types of failure, which could lead to a dam failure.

- **Seepage Failure:** Although all earthen embankments allow minor seepage through the dam or the foundation, excessive, uncontrolled seepage can result in piping (the movement of embankment material in the seepage flow) and lead to failure. Piping can occur for years at a slow rate. If the piping has progressed to a dangerous level, it will be evident by increased flow or the discharge of muddy water (or both). At that stage, immediate action to stop the piping is needed. Fully developed piping is difficult to control and is very likely to result in failure.

  A whirlpool in the reservoir is a sign of uncontrollable piping and necessitates immediate emergency action.

- **Embankment or Foundation Sliding:** Sliding is usually first apparent when cracks or bulges in the embankment appear. Slides with progressive movement can cause failure of the embankment.
- **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. A structural failure of a portion of the spillway could cause piping and possibly embankment failure.
- **Overtopping Failure:** Overtopping of the embankment results in erosion of the dam crest. Once erosion begins, it is very difficult to stop.

4.2. Emergency Evaluation and Classification

This section lists the conditions and actions that may be used to classify the level of emergency response, as a guide for the ***Emergency Planning Managers***. Specific dam observations and corresponding emergency classification levels can be found in the Evidence of Distress table in **Annexure - 9.**

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 ***Dam Site Engineers*** will be responsible for monitoring and repairing as soon as possible and notify ***Dam Emergency Planning Managers*** for implementing the appropriate Notification Flowchart as shown in ***Annexure - 1.*** The following is a list of conditions that would initiate this condition:

- Cloudy or dirty seepage or seepage with an increase in flow, boils, piping, or bogs.
- Seepage around conduits.
- Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.
- Cracking or movement of any concrete structure.
- Any slide that degrades the crest of the embankment or that is progressively increasing in size.
- An increase in the reservoir level leading to engagement of the emergency spillway.
- Exceptionally heavy rainfall in the catchment of the dam reservoir.

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 ***Dam Site Engineers*** will be responsible for initiating immediate repairs; the **Dam Emergency Planning Managers** shall monitor the overall situation and take necessary actions. Water level may be reduced, if needed, as per the advice of the ***Dy. General Manager (Civil), Water Resources, DVC, Maithon.*** The Dam Emergency Planning Managers shall also implement the appropriate Notification Flowchart as shown in ***Annexure - 2***. The following is a list of conditions (not exhaustive) that would initiate this condition:

- Large boils, increasing in size and flow rate, especially if there is flowing muddy water.
- Significantly increasing seepage, especially flowing muddy water.
- Slides involving a large mass of material that impairs the crest of the dam and is continuing to move.
- Sinkholes with seepage flowing muddy water.
- Large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam.
- An increase in the reservoir level to near the top of the dam.
- Overtopping of a dam that is not designed for overtopping.
- 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 stabilized. The Dam Emergency Planning Managers is responsible for implementing the appropriate Notification Flowchart as shown in ***Annexure-2***. The following is a list of conditions that would initiate “Imminent Dam Failure” or “Dam Failure” conditions:

- Rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones.
- Rapidly increasing seepage, especially flowing muddy water.
- Slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area.
- Settlement that is predicted to degrade to the reservoir level.
- Cracks that extend to the reservoir level.
- Significant movement or failure of any structure that forms an integral part of the dam.
- Overtopping of an earthen dam.
- Uncontrollable release of the reservoir.

4.3. Previously Known Problems

Sl. No.	Observations	Remedial actions taken by DVC
1.	**Cracks in the galleries and outside of dam body.**	The work of grouting of the cracks and its continuous monitoring is being undertaken under DRIP.
2.	**Problem in Day-to-day operation of Under sluices**	This work is also being undertaken under DRIP.
3.	**Gantry Crane**	Repaired under DRIP.
4.	**Emergency gate**	Repaired under DRIP.
5.	**Non-functionality of Piezometers**	Procurement of new Piezometers is taken up under Instrumentation package of DRIP. In addition, several other instruments are being procured for monitoring of the dam.
6.	**Design Flood**	After review of Design Flood, it was found that the PMF would be 9551 cumec as against 6796 cumec. However, Flood routing studies confirmed that the same could be successfully moderated.

5. 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.

A. **Surveillance: Dam Site Engineers** will monitor the dam during emergency situations such as a severe storm event etc. They will immediately appraise any situation to the **Emergency Planning Managers.**

B. **Response on Forecast of Excessive Inflow:** ***Dam Sate Engineers as well as Emergency Planning Managers*** will respond to situation of excessive inflow forecast by way of controlled spillway releases as advised by the ***Dy. General Manager (Civil), Water Resources, DVC, Maithon.*** They will warn the affected downstream authorities and initiate 24 hours monitoring.

C. **Response during Weekends and Holidays:** At least one of the Dam Site Engineers shall be available for emergency response during weekends and holidays and shall be present at the dam site within 10 minutes of detection of an emergency condition.

D. **Response during Periods of Darkness and Adverse Weather:** if required**, the Dam Site Engineers** will arrange for the generators and lights. Dam Emergency Planning Managers shall ensure ready availability of the generators / torches during darkness and adverse weather conditions to adequately monitor the situation. They shall arrange to access the site during adverse weather conditions by foot or utility vehicle.

E. **Access to the Site:** After going through the inundation cum evacuation map **(Annexure - 15)**; site can be accessed through Hazaribagh – Bisnugarh side in all failure conditions. However, the accessibility from Gomia Side can only be made within within 40 minutes of breach only in case of overtopping failure, 1 hour 20 minutes in case of Piping failure and 2 hours for Large Controlled Release.

Preventive measures 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.

In all cases, the appropriate Notification Flowchart must be implemented and all the concerned emergency personnel must be notified. The following actions should only be undertaken by the Site Engineers under the direction of Emergency Planning Managers.

Seepage Failure

- Plug the flow with whatever material is available (hay, bentonite, or plastic) if the entrance is in the reservoir.
- Lower the water level in the reservoir by using the low flow outlet and pumping if necessary, until the flow decreases to a non-erosive velocity or until it stops. Place an inverted filter (a protective layer of sand and gravel) on the exit area to hold the material in place.

- Continue operating at a lower level until a repair is made.

Embankment or Foundation Sliding

- Lower the water level in the reservoir by using the low flow outlet and pumping if necessary at a rate and to an elevation considered safe, given the slide condition.
- Stabilize the slide, if on the downstream slope, by weighting the toe area below the slide with soil, rock, or gravel.
- Continue operating at a lower level until a repair is made.

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 and by pumping if necessary.

6. Supplies and Resources

6.1 Contracts

Should Damodar Valley Corporation 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 authorized officials and should be in writing whenever possible. ***Emergency Planning Managers*** shall have the authority to enter into agreements as deemed necessary to prevent the failure of the dam.

6.2 Equipment and Supplies

Equipment that are available for use and local contractors who can be contacted to provide equipment during an emergency event are listed in **Annexure-10.**

6.3 Reports

A. Technical Data

Pre-monsoon and post-monsoon inspections of the dam is being made during the months of April & Dec respectively by the Dam Site Engineers 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 should be stored and carefully maintained both both at Konar Dam Site office and Emergency Operations Center at Dam site. All Emergency personnel of DVC, Konar Dam shall be familiar with the location of the documents in the event of an emergency.

B. Emergency Operations Center Activity Log

Emergency Planning Managers shall ensure that 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 should be recorded in chronological order.
- Issuance of protective action &recommendations to the public.
- Evacuations.
- Casualties.
- Termination of the incident.

C. Costs of the Emergency Operations Center

For major emergencies, the Emergency Operations Center will maintain detail records of costs expenses. 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

7. Inundation Area

The inundation cum evacuation maps at **Annexure - 15** illustrate the areas subject to flooding caused by **(i)** Dam failure caused by overtopping from the inflow design flood leading to breaching and uncontrolled release of impounded water **(ii)** A non-flood dam failure caused by internal erosion (piping) with the reservoir at full supply level (often called a “Fair-Weather Failure”) leading to breaching and uncontrolled release of impounded water and **(iii)** A large controlled-release flood without dam failure.

After examining the results of the breach analysis of the Dam, it is observed that several locations could be affected due to above flooding. These are located along the Konar River

stream, the maximum being 52 kms downstream from Dam measured along stream centre-line. The settlements, evacuation routes and probable shelter points are also shown in the maps. As the maps, settlements, routes, shelter points etc. shown in the map has been finalized with the help of Satellite imagery, there may be chances of some left over settlements, which also needs to be evacuated. The Disaster Management Authorities / evacuation team shall utilize the information of Maximum Water Surface Elevation (against each settlement) as given in the Flood Hazard Reference Values cum Evacuation Table **(Annexure – 14)** for evacuating the the marked settlements as well as left over portions. The same information will also help them to identify / modify the shelter points. The information in respect of Settlement wise Responsibilities of Evacuation along with the contact details as well as any modification with respect to routes or shelter points etc. shall be shared with Dam Site Engineers, Emergency Planning Managers or the office of General Manager (Civil), DVC, Maithon for updating this document.

7.1 Local Evacuation Plan

If imminent failure of the dam with uncontrolled downstream flooding is anticipated, local disaster management and law enforcement personnel should notify those downstream authorities, for evacuation in the most expedient manner possible. The organizations and personnel on the Notification Flowchart should be contacted immediately. Local law enforcement officials, along with local mobile network operators, radio and television stations can best spread the notice for evacuation. The immediate impact will be to areas along Konar River downstream of the dam. For design flood breaches, the following actions should be taken:

- Barricading all bridges that could possibly be flooded to prevent access to the affected area. The locations are tabulated in Flood Hazard Reference Values cum Evacuation Table **(Annexure – 14)** and shown in Inundation Maps **(Annexure – 15)**.
- The District Disaster Management office can assist with the notification to all persons and agencies involved, with the possibility of additional support including contacting others not accessible by radio or telephone.
- District officials 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. Section 7 shall be referred to for better utilization of **Annexure – 14** & **Annexure – 15.**

8. Implementation

8.1 Development

The EAP shall be sent to all concerned as per **Annexure – 3** for review & updating.

8.2 Updating

Copies of the this EAP incorporating the comments shall be provided to the appropriate persons as per the **Distribution List** at **Annexure - 3** and the EAP will be approved and signed by the owner and the person(s) in charge of emergency response, as shown in **Approval and Implementation sheet** at **Annexure - 5**. This plan will be reviewed and updated annually by **Emergency Planning Managers** and personnel from Local Disaster Management Agencies in conjunction with annual inspection & maintenance of the dam by the **Konar Dam Site Engineers**. Tabletop drills with all the Emergency personnel concerned shall be carried out by **Emergency Planning Managers**. The reviews made are to be documented as shown in **Annexure - 4. Emergency Planning Managers** shall complete all items on the **Annual EAP Evaluation Checklist** as shown in **Annexure-11**. 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 - 12**.

If revisions to the EAP are made because of the annual update, such changes will be recorded on the **Log Sheet of Changes** as shown in **Annexure - 4**. A copy of the updated portions of the EAP will be sent to all concerned as per the EAP Distribution List. If the EAP is reviewed and revisions are not required, the **Emergency Planning Managers** will submit written notification to all concerned that no updates to the EAP have been adopted or implemented.

8.3 Testing

A tabletop drill will be conducted at least once every five years. The tabletop drill involves a meeting of **Emergency Planning Managers** 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. Records of training and drills will be maintained in **Annexure - 13**.

8.4 Training

All people involved in the EAP will be trained to ensure 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 in **Annexure-13** as stated earlier.

9. References

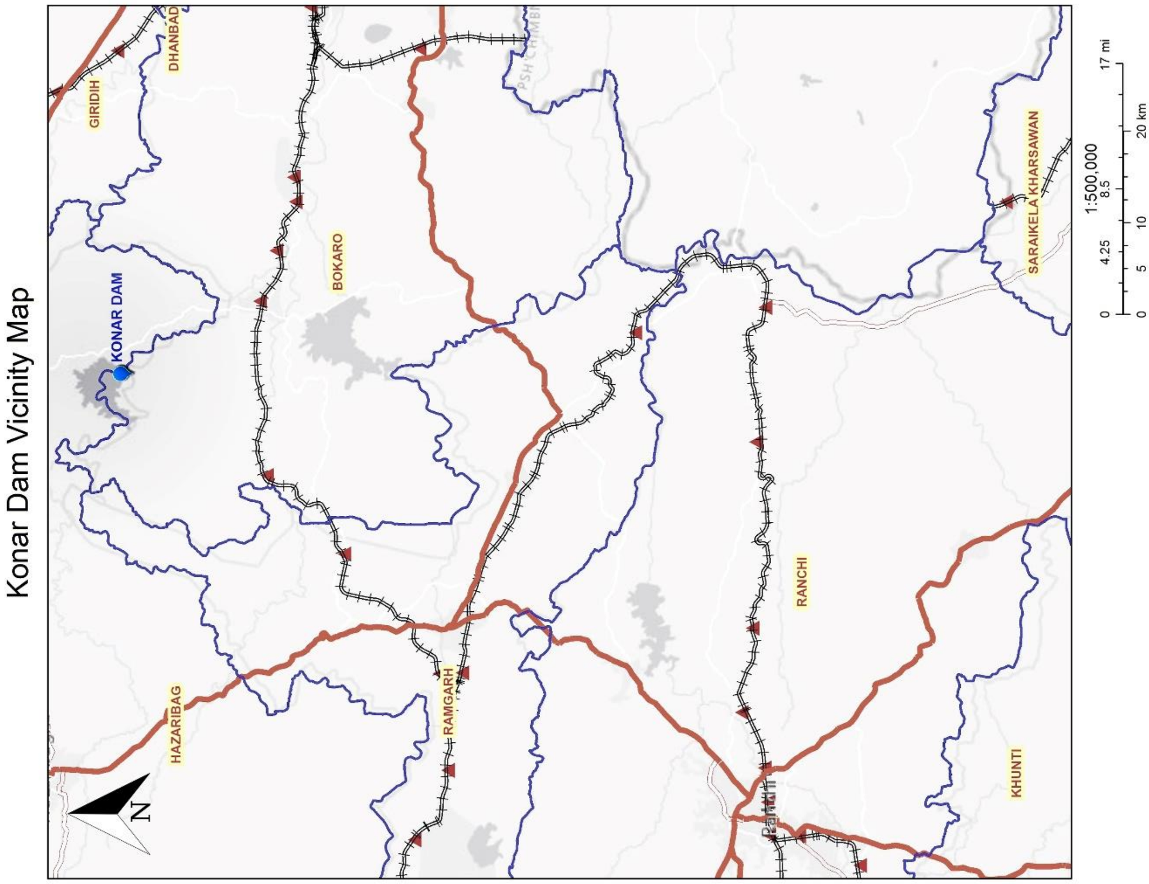
1. *Flood Inundation Maps for Konar Dam, Jharkhand,* CWC, MoWR, RD&GR, GoI, New Delhi 110066, Sept' 2016.
2. *Guidelines for Developing Emergency Action Plans for Dams,* CWC, MoWR,RD&GR, GoI, New Delhi 110066, Feb' 2016.

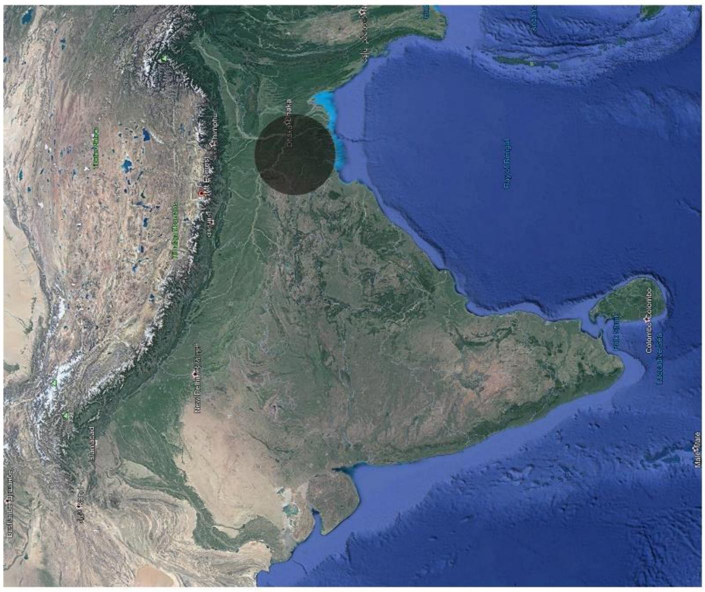
3. *Guidelines for Mapping Flood Risks Associated with Dams,* CWC, MoWR, RD&GR, GoI, New Delhi 110066, Jan' 2018.

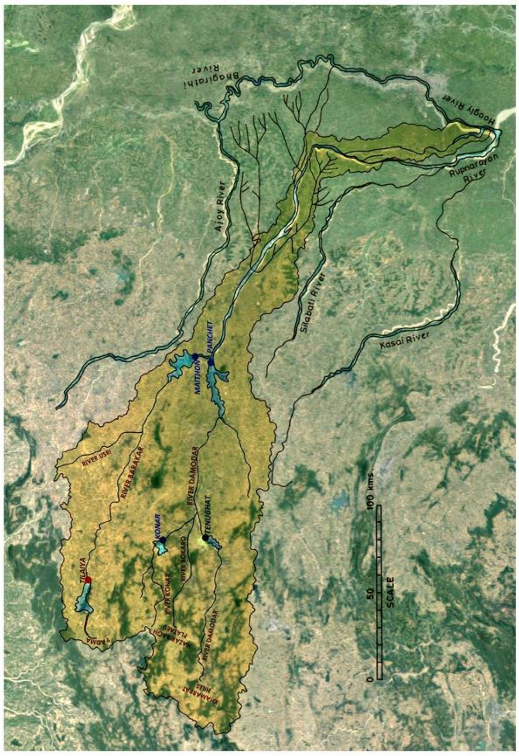
10 Softwares & Applications used

1. *Hec-RAS 2D*
2. *ArcGIS*
3. *Google Earth Pro*
4. *Jharkhand Space Application Centre*

ANNEXURE - 6


Konar Dam Vicinity Map
KONAR DAM
GIRIDIH
DHANBAD
BOKARO
HAZARIBAG
RAMGARH
RANCHI
SARAIKELA KHARSAWAN
KHUNTI
N
1:500,000
0 4.25 8.5 17 mi
0 5 10 20 km




Bhagirathi River
Hoogly River
Rupnarayan River
Ajoy River
Silabati River
Kasai River
SCALE

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ANNEXURE - 7

Dam Description

- Official Dam Name : Konar Dam
- Name of stream : Konar
- Dam location from : 16.1 km from Gomia Railway Station and 38.6 km. Hazaribagh town in Hazaribagh district of Jharkhand State.
- Latitude/Longitude : 23˚ 56´ / 85˚ 46´
- Seismic Zone : III
- Year of Starting of Dam Construction : 1950
- Year of Commissioning of Dam Project : 1955
- Year of first impoundment : 1956
- Name of immediate: upstream Dam : No Dam is available in upstream.
- Name of immediate downstream Dam : Panchet Dam
- Dam Owner : Damodar Valley Corporation (DVC)
- Dam Owner's Address : Damodar Valley Corporation, Kolkata, West Bengal.

Dam	
Type	Composite (Earth & Concrete)
Year constructed	1955
Overall Length (Earth & Concrete)	3682.03 m (12080 ft.)
Maximum Height of Dam above river bed	57.6 m (189 ft.)
Top of Dam (Road elevation)	R.L. 431.3 m (1415 ft.)
Width of roadway	5.79 m (19 ft.)
Drainage Area	997.1 sq. km. (385 sq. miles)
Main spillway	
Type	Ogee
Location	On main river channel
Crest length (gross)	107.9 m (354 ft.)
Crest length (effective)	93.27 m (306 ft.)
Crest elevation	R.L. 418.34 m (1372.5 ft.)
Capacity	6796 cumec (24000 cusec)
Emergency spillway	Does not exist
Inlet-Outlet works	
Type	Type
Number of under sluices	Number of under sluices
Size	Size
Location	Location
Upstream Centre line	Upstream Centre line
Maximum discharging capacity per undersluice	Maximum discharging capacity per undersluice
Reservoir	
MDDL	
(i) Elevation	R.L. 410.57 m (1347 ft.)
(ii) Dead storage Capacity	3440 Ha.m. (27888 acre feet)
(iii) Surface area	749 Ha (1850 acre)
Conservation Pool	
(i) Elevation	R.L. 425.81 m (1397 ft.)
(ii) Live storage Capacity	17552 Ha.m. (1.42 lac acre feet)
(iii) Surface area	2315 Ha (5720 acre)
Maximum Flood Management Pool	
(i) Elevation	R.L. 427.94 m (1404 ft.)
(ii) Flood management storage	3804 Ha.m. (30839 lac acre feet)
(iii) Surface area	2590 Ha (6400 acre)

ANNEXURE - 8

Sample Public Announcements

Note: These messages are communicated to downstream residents to alert the public of impending danger. Damodar Valley Corporation should coordinate with the India Meteorological Department, the Hazaribagh, Dhanbad, Bokaro Disaster Management Authority, and the District Magistrates/Collectors for Hazaribagh, Dhanbad, Bokaro Districts prior to release. Messages can be communicated via radio, television, bulk SMSs of local mobile networks, and other media outlets.

Name of Local Media persons is appended below:

Electronic Media	1. Name: Shri Murari, Reporter, Aajtak News, Hazaribagh, Mob: 9431155458 2. Name: Shri Rakesh Kumar, Reporter, ETV News, Hazaribagh, Mob: 9431336174
Print Media	1. Name: Shri Arvind Rana, Dainik Jagran, Hazaribagh, Mob: 9470185808 2. Name: Shri Shankar Prasad, Prabhat Khabar, Hazaribagh, Mob: 9471355937. 3. Name: Shri Bishbendu, The Telegraph, Hazaribagh, Mob: 9431153828 4. Name: Shri Binay Kumar Patak, Prabhat Khabar, Bishnugarh, Mob: 9934158104 5. Name: Shri Mithilesh Burman, Hindustan, Bishnugarh, Mob: 9955443788 6. Name : Lalit Kumar Mishra, Dainik jagran, Bishnugarh, Mob: 9431559112. 7. Name: Sanjay Kumar Mishra, Prabhat Khabar, Bokaro Thermal, Mob: 9431438194. 8. Name: Sanjay Giri, Dainik jagran, Bokaro Thermal, Mob: 7903829289. 9. Name : Ram Chandra Mahato, Hindustan, Mob: 9430374977.

Announcement for a Slowly Developing "Watch" Condition (BLUE Emergency Level)

Damodar Valley Corporation has declared a BLUE Level "Watch" condition for Konar Dam, Project Identification Code JH05HH0005 as of *[time and date]*. *[Briefly describe the problem or condition.]* Although there is no immediate danger of the dam failing, *[Describe what actions are being taken to monitor and control the situation.] [State the quantity of any releases from the reservoir.]*

Announcement for a Worsening "Watch" Condition (BLUE Emergency Level)

Damodar Valley Corporation has declared a BLUE Level "Watch" condition for Konar Dam, Project Identification Code JH05HH0005 as of [time and date]. [Briefly describe the problem or condition.] Although there is no immediate danger of the dam failing a possibility now exists that the dam will fail if correction efforts are unsuccessful. [Describe what actions are being

taken to monitor and correct the situation.] [State the quantity of any releases from the reservoir]. Additional news will be made available as soon as it is received.

Announcement for a Probable "Failure" Condition (ORANGE Emergency Level)

Urgent! This is an emergency message. Damodar Valley Corporation has announced that Konar Dam, Project Identification Code JH05HH0005 is probably going to fail. [Describe what actions are being taken to monitor and control the situation.] It is possible that the dam will fail in [##] hours. Residents in low lying areas along the Konar River, as well as the town of Hazaribagh, should prepare for immediate evacuation. Additional news will be made available as soon as it is received.

Announcement of an Impending "Failure" Condition (RED Emergency Level)

Emergency! This is an emergency message. Konar Dam, Project Identification Code JH05HH0005 is going to fail at any moment. Residents who have not yet done so should immediately evacuate the city of Hazaribagh and low-lying areas along the Konar River. The floodwaters have already reached [Highway] and [Road]. Additional news will be made available as soon as it is received.

Announcement of an Ongoing "Failure" Condition (RED Emergency Level)

Emergency! This is an emergency message. Konar Dam, Project Identification Code JH05HH0005 failed at [time and date]. Residents who have not yet done so should immediately evacuate the [city] and low-lying areas along the Konar River. The floodwaters have already reached [Highway] and [Road]. Additional news will be made available as soon as it is received.

ANNEXURE - 9

Evidence of Distress

Dam Site Engineers shall observe the situation and immediately take necessary action or inform the Emergency Planning Managers for further needful.

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment Material & Supplies	Data to Record
Boils	Small boils, no increase of water flow, flowing clear water	**BLUE**	Closely check all of downstream toe, especially in the vicinity of boil for additional boils, wet spots, sink holes or seepage. Closely monitor entire area for changes or flow rate increases.	None	Site & location, approximate flow
	Large or additional boils near previously identified ones, without increasing flow rate, but carrying small amount of soil particles.	**BLUE**	Invite 24-hr. surveillance. Monitor as described above. Construct sandbag ring dikes around boils, to cover them with water to retard the movement of soil particles. Filter cloth may be used to retard soil movement, but do not retard the flow of water.	Sandbags filter cloth.	Site & location, approximate flow
	Large or additional boils near previously identified ones, increasing flow rate, carrying soil particles.	**ORANGE**	Continue 24-hr. surveillance. Continue monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Issue a warning to downstream residents.	Sandbags Pump.	Site & location, approximate flow
	Rapidly increasing size of boils and flow increasing and muddy water.	**RED**	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the boil area.	Dozer, shovels, source of Earth Fill.	Site & location, approximate flow

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment Material & Supplies	Data to Record
Seepage	Minor seepage of clear water at toe, on slope of embankment, or at the abutments.	BLUE	Closely check entire embankment for other seepage areas. Use wooden stakes or flagging to delineate seepage area. Try to channel and measure flow. Look for upstream whirlpools.	Wooden stakes, flagging.	Site & location, approximate flow
	Additional seepage areas observed flowing clear water and/or increasing flow rate.	BLUE	Invite 24-hr. surveillance. Monitor as described above. Construct measuring weir and channel all seepage through weir. Attempt to determine the source of seepage.	Dozer, shovels.	Site & location, approximate flow
	Seriously or rapidly increasing seepage, Under – seepage, or drain flow.	ORANGE	Continue 24-hr. monitoring and remedial action as described above, initiate emergency lowering of the reservoir. Construct a large ring dike around the seepage area.	Dozer, shovels, source of fill material.	Site & location, approximate flow
	Additional seepage areas with rapid increase in flow and muddy water	RED	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the seepage area.	Dozer, shovels, source of fill material.	Site location, approximate flow.

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment, Material & Supplies	Data to Record
Slides of Severe Erosion	Skin slide or slough on slope of embankment. No further movement of slide and embankment crest not degraded.	**BLUE**	Examine rest of embankment for other slides. Place stakes in slide material and adjacent to it for determining if further movement is taking place.	Stakes, tape measure.	Distance between stakes.
	Slide or erosion involving large mass of material, crest of embankment is degraded, no movement or very slow continuing movement.	**BLUE**	Initiate 24-hour surveillance. Mobilize all available re-sources and equipment for repair operations to increase freeboard and to protect the exposed embankment material. Start filling sandbags and stockpile near slide area.	Dozer, shovels, sources of fill material, sandbags.	Distance between stakes.
	Slide or erosion involving large mass of material, crest of embankment is degraded, progressively increasing in size.	**ORANGE**	Continue monitoring and remedial actions as described above. Place additional material at the toe of the slope to stop the slide.	Dozer, shovels, source of fill material, pump.	Distance between stakes.
	Slide or erosion involving large mass of material, crest of embankment is severely degraded; movement of slide is continuing and may reach pool level.	**RED**	Downstream evacuation. Utilize all available equipment and personnel to sandbag the degraded slide area to prevent it from overtopping.	Dozer, shovels, sandbags pump.	Distance between stakes.

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment, Material & Supplies	Data to Record
Sinkhole	Sinkholes anywhere on the embankment or within 150 metres downstream from the toe.	BLUE	Carefully walk the entire embankment and downstream area looking for additional sinkholes, movement, or seepage.	Stakes, flagging.	Size, location.
	Sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	BLUE	Initiate 24-hour surveillance. Monitor as above. Construct sandbag dike around the seepage exit point to reduce the flow rate. Start filling sandbags and stockpile near sinkhole.	Dozer , shovels, pump.	Size, location.
	Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	ORANGE	Continue monitoring and remedial action as described above, utilize sandbags to increase the freeboard on the dam if necessary.	Sandbags, dozer, pump.	Size, location.
	Sinkholes rapidly getting worse, seepage flowing muddy water and increasing flow.	RED	Downstream evacuation. Utilize all available equipment and personnel to attempt to construct a large ring dike around the area.	Dozer, shovels, pump.	Size, location.

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment, Material & Supplies	Data to Record
Settlement	Obvious settlement of the crest of the embankment, especially adjacent to concrete structures.	BLUE	Look for bulges on slope or changes in crest alignment.	None	Size, location.
	Settlement of crest of embankment that is progressing, especially adjacent to concrete structures or if any corresponding seepage is present.	BLUE	Initiate 24-hour surveillance. Mobilize all available resources for repair operations to increase freeboard. Fill and stockpile sandbags. Identity any boils near settlement points for flowing material and pursue action for boils.	Sandbags, dozer, shovels, sources of fill material.	Size, location.
	Settlement of crest of embankment that is rapidly progressing especially adjacent to concrete structures or if any corresponding seepages is flowing muddy water or increasing flow.	ORANGE	Continue monitoring and remedial actions as described above. Use sandbags to increase the freeboard on the dam if necessary.	Sandbags, shovels, dozer, source of fill material.	Size, location.
	Progressing settlement that is expected to degrade the embankment to reservoir level.	RED	Downstream evacuation. Utilize all available equipment and personnel to build – up the crest in the area that is settling. Identify any boils near settlement points for flowing material and pursue action for boils.	Sandbags.	Size, location.

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment, Material & Supplies	Data to Record
Cracking	Cracks in the embankment crest or on slopes.	BLUE	Walk on entire crest and slope and check for additional cracking.	Stakes, tape measure	Size, location.
	Numerous cracks in the crest that are rapidly enlarging, especially, those perpendicular to the centreline of the dam.	BLUE	Initiate 24-hr. surveillance. Carefully monitor and measure cracking to determine the speed and extent of the problem. Mobilize to fill cracks. Cracks parallel to the centreline indicate a slide. Follow remedial action for slides.	Stakes, tape measure, Dozer, shovels, source of fill material.	
	Large cracks in the crest that are rapidly enlarging, especially, those perpendicular to the centreline of the dam.	ORANGE	Continue monitoring and remedial action as described above.	Dozer, shovels, source of fill material.	Size, location.
	Cracking that extends to pool elevation.	RED	Downstream evacuation. Continue remedial actions as described above.	Dozer, shovels, source of fill material.	Size, location.

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment, Material & Supplies	Data to Record
Cracking or movement of cracking structure	Minor cracking and/ or movement.	**BLUE**	Immediately install measuring device to monitor movement.	Crack monitors, stakes, tape measures.	Size, location.
	Significant cracking and/ or movement.	**BLUE**	Initiate 24-hour surveillance. Lower burlap on upstream face of crack to reduce flow of soil particles. Dump large rock on downstream of moving concrete structure monolith to resist the movement.	Burlap, rock, dozer, shovels.	Size, location, flow rate.
	Serious cracking and / or movement	**ORANGE**	Prepare for evacuation. Continue monitoring and remedial action as described above.	Dozer, rock, burlap, crack monitors	Size, movement, flow rate.
	Major cracking and / or movement	**RED**	Downstream evacuation. Dam failure is imminent. Continue monitoring and remedial actions as described above.	Dozer, shovels, rock.	Size, location, flow rate.

Evidence of Distress

General Observation	Specific Observation	Emergency Condition Level	Emergency Action	Equipment, Material & Supplies	Data to Record
Upstream Whirlpool	Whirlpool in the lake in the vicinity of the embankment	**RED**	Downstream evacuation. Attempt to plug the entrance of the whirlpool with riprap from the slope of the embankment. Search downstream for an exit point and construct a ring dike to retard the flow of soil particles.	Dozer, fill material, sandbags, filter cloth, straw, rocks.	Size, location, flow rate.
Malfunction of Gate	Structural member of a gate or gate operator broken or severely damaged so as to prevent operation of the gate.	**ORANGE**	Initiate 24- hour surveillance. Immediately place stop logs in front of gate and initiate necessary actions to get gate repaired.	Crane and welder	Type of problem location.
Rapidly Rising Lake	Lake level rising and rain continuing.	**BLUE**	Initiate 24- hour surveillance of lake level and rainfall. Generate inflow forecasts every 12 hours.		Lake level, rainfall.
Overtopping	Water flowing over the dam and lake continuing to rise. No significant erosion of downstream embankment.	**ORANGE**	Prepare for evacuation. Continue monitoring. Generate inflow forecasts every 3 hours.	Dozer, fill material, sandbags, filter cloth, rocks	Lake level, rainfall.
	Water flowing over the dam and lake continuing to rise and significant erosion of downstream embankment with development of head- cuts encroaching on the dam crest, or significant movement of sections of concrete portions of the dam.	**RED**	Immediate evacuation. Dam failure is imminent or ongoing.	Cameras.	Status of breach formation. Width of breach as it enlarges.

ANNEXURE-10

Supplies and Resources

The following equipment and supplies may be necessary for use during a dam emergency. Contact information for local contractors who can provide the following items during an emergency is listed below. For supplies owned by the dam owner, the dam owner's name and the specific location of the supplies have been denoted.

Equipment/Supplies	Location
Civil Contractors	Name: Shri Jainandan Saw Address: Konar Dam, Hazaribag, Mob: 9534127730
	Name: Shri Tukan Mahto Address: Konar Dam, Hazaribag, Mob: 9534049197
	Name: Shri Ramjee Rai Address: Konar Dam, Hazaribag, Mob: 8051258703
	Rameshwar Mahto, Jamnijara, Konar Dam, Mob: 8709952626
	Thanu Mahto, Chano, Hazaribagh, Mob: 9031535679
	Bhola Mahto, Jarkunda, Konar Dam, Dist. Bokaro, Mob: 9934504301
	Jainarayan Mahto, Cheliatand, Konar Dam, Dist. Bokaro, Mob: 8709720469
	Ganesh Ram, Konar Dam, Hazaribagh, Mob: 9955415073
	Koleshwar Saw, Chidri, P.O. Konar Dam, Dist. Bokaro, Mob: 7631192442
	Baijnath Kumar, Konar Dam, Hazaribagh, Mob: 8340213057
	Aman Enterprises, Jarkunda, P.O. Konar Dam, Dist. Bokaro, Mob: 8340284651
	Promod Kumar Singh, Konar Dam, Hazaribagh, Mob: 8877164372
	Sohan Saw, Chidri, P.O. Konar Dam, Dist. Bokaro, Mob: 9534076561
	Dhaneshwar Mahto, Chilgo, Chatrachatti, Bokaro, Mob: 8825287002

Backhoes, Dump trucks, Portable welding equipment, Generators, Bulldozers, Excavators, Loaders, Motor graders	N Khan Bokaro Thermal, Bokaro, Mob: 9334014824/9006972721
	B. K. Construction Bokaro Themal, Bokaro, Mob: 8521620665
Crane	N Khan Address: Bokaro Thermal, Bokaro Mob: 9334014824, 9006972721
Generator	Rohit Saw Mob: 9304257143, 7870949513
	Md. Mustaq, Star Electrical Mob: 9431534159, 7258052570
Structural & Hydro mechanical Work	Omprakash, M/s Technotrade, Mob: 9800897706
	Y K Enterprises BTPS, Bokaro, Mob: 9155125548
	Jha Engineering Works Madhubani, Bihar, Mob: 9449224837, 9862189547

ANNEXURE-11

Annual EAP Evaluation Checklist

Was the Annual Dam Inspection conducted?	□ Yes □ No	If yes, has the EAP been revised to include any signs of failures observed during the inspection?
Was weed clearing, animal burrow removal, or other maintenance required?	□ Yes □ No	If yes, describe actions taken and date.
Was the outlet gate operable?	□ Yes □ No	If no, describe actions taken and date.
Does the Notification Flow Charts require revision? (Note that revision of the contact information will not require EAP approval; however, the revised contact information pages will need to be distributed as replacement pages)	□ Yes □ No	If yes, list the dates of the contact information revision and redistribution.
Was annual training or a tabletop drill conducted?	□ Yes □ No	Circle : training drill Date conducted:
Are inspection and training records included in the EAP?	□ Yes □ No	
Was the EAP reviewed?	□ Yes □ No	If yes, review date:
Were changes required to the EAP?	□ Yes □ No	If yes, date of revised EAP approval:

_____ _____

[Name and title of appropriate manager for Owner] **Date:**

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ANNEXURE-12

Plan Review and Update

This plan will be reviewed and updated annually and tabletop drills will be carried out at least once every five years. Document these reviews below.

Date of Review: _____ Participants:

Date of Review: _____ Participants:

Date of Review: _____ Participants:

Date of Review: _____ Participants:

Date of Tabletop Drill: _____ Participants:

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ANNEXURE-13

Training Record

Use this form to record training sessions. File the completed form in the appropriate Annexure of the EAP. All items in the EAP should be thoroughly reviewed during training. Appropriate Damodar Valley Corporation employees and EAP team members should attend a training session annually (or participate in a simulated drill).

Training Location:	
Date : Time: Instructor:	
Class Sign-in:	
Type of simulation conducted:	Circle Emergency type: Emergency Water Release Watch Condition Possible Dam failure Imminent Dam failure Actual Dam failure
Comments, Results of Drill:	
Revision needed to EAP based on results of Drill? Yes ☐ No ☐ If yes, list revisions required:	

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ANNEXURE - 14

Flood Hazard Reference Values cum Evacuation Table

Flood hazard reference values, for each of the three failure conditions, consisting of Maximum Water Surface Elevation and Flood Wave Arrival Time at various locations downstream from Konar Dam along probable evacuation routes, shelter points etc. are presented in this Annexure. The locations were marked from Google Earth Pro and the village name has been taken from Jharkhand Space Application Centre. The chart shown here shall be used in conjunction with the Inundation cum Evacuation Maps as enclosed in **Annexure – 15.**

As the maps, settlements, routes, shelter points etc. shown in the map has been finalized with the help of Satellite imagery, there may be chances of some left-over settlements, which also needs to be evacuated. The Disaster Management Authorities / evacuation team shall utilize the information of Maximum Water Surface Elevation (against each settlement) as given in this annexure for evacuating the the marked settlements as well as left over portions. The same information will also help them to identify / modify the shelter points. The information in respect of Settlement wise Responsibilities of Evacuation along with the contact details as well as any modification with respect to routes or shelter points etc. shall be shared with Dam Site Engineers, Emergency Planning Managers, or the office of General Manager (Civil), DVC, Maithon for updating this document.

Note: Because of the method, procedures and assumptions used to determine the flooded areas; the limits of flooding shown, and flood wave arrival times are approximate and should be used only as a guideline for establishing evacuation zones. Areas inundated in an actual event will depend on actual failure conditions and may differ from areas shown on the maps.

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ANNEXURE - 15

Inundation cum Evacuation Maps

Inundation cum Evacuation maps have been prepared 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 (often called a “Fair-Weather Failure”) leading to breaching and uncontrolled release of impounded water.
3. A large controlled-release flood without dam failure.

The maps, enclosed in the following pages, show

1) The area Inundated
2) Arrival time of Flood water
3) Settlements
4) Evacuation Route to follow against each settlement.
5) Shelter Points
6) Bridges, Railway Lines & Roads

Please refer Section 3.3 and Section 7.

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