

# LEVEES Working Group Newsletter



Photograph from the Environment Agency – Storm Desmond levee breach on a rural flood defence. Erosion and riverward migration on the landward side of the levee caused by overtopping from river levels significantly above design criteria.



## Note from the Chairman

It is my pleasure to welcome you to this inaugural issue of our newsletter, whether you are a member of our Working Group or not. In addition to our web site, this newsletter will be an important medium to communicate information on our working group activities along with issues of interest to the levees and flood defences community of practice. We want YOU to send us information for future newsletters and the website and will welcome any contributions.

Our Working Group was officially created in June 2015 under the auspices of the European Club of ICOLD at its congress in Stavanger. The Working Group aims to gain the interest of the dam community through its activities and reports, in order for levees and other flood defence structures to be included in the scope of ICOLD. Many national large dams committees already include these "other" hydraulic structures in their regular activities, which is a definite sign that they are worth considering.

So far, we are pleased to note important Indicators of success:

- The number of member countries: thirteen already official members, two tentative members, not to forget a close association with the USA (the levee committee of USSD and the Levee Safety Coalition);
- The attendance at our second meeting in Lyon: 29 people from 10 different countries;
- The inclusion of a question related to levees as well as small dams in the program of ICOLD 2018 Vienna congress.

In terms of working group production, our first report on the situation in our different member countries regarding levees, flood defences and flood risk in general is already well advanced, and a first draft will be available for the Prague 2017 ICOLD meeting. Our second report, a comparison between dams and levees, highlighting both similarities and differences, is on its way too; a workshop for its scoping was held in Lelystad (NL) at the end of January, the actual writing will begin before long and we look forward to your contributions. We hope to present a summary at the Prague meeting, and a draft will be available at the Vienna ICOLD congress.

Finally, I want to thank all our members for the work we are doing together, which has been a pleasure for me. Gratitude must be extended to the national Committees of our members, the European Club of ICOLD and the President of ICOLD for their interest along with our USA partners in USSD, ASDSO and the Levee Safety Coalition for an excellent collaboration. I encourage everyone who shares our interest and passion on the topics of levees, flood defences, dams, and hydraulic structures to keep in touch by the way of this newsletter and our web site.

Rémy Tourment

## BY THE NUMBERS

50 Million

European people at risk from flooding, many of these are protected by levees

13

Member countries in the Levees and Flood Defences Working Group

€200 Billion

Economic value protected by flood defence levees in Europe

12 500

Properties protected by levees in the UK during the record rainfall event of Storm Desmond – December 2015

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# LYON WORKING GROUP MEETING – OCTOBER 2017

## SUMMARY OF TOPICS PRESENTED

The 2nd plenary meeting of the EURCOLD Working Group on Levees and Flood Defences was held on the 17th of October 2016, as a side event to the FLOODrisk 2016 conference.

The meeting included 29 attendees from 10 countries. During the morning session, technical and scientific presentations were conducted. During the afternoon session, participants worked on defining Working Group (WG) activities, analysing on-going actions and progress on the draft version of the Inventory report, which will include characteristics, risks and governance of levees and flood

Future actions for developing a WG Dam-Levee-Intercomparison Report were established, along with communication and dissemination activities for 2017 and 2018, including potential participation of WG members in 2018 ICOLD Congress, to be held in Vienna.

*Jessica Castillo Rodríguez, Universitat Politècnica de València  
Spain*

The working group presentations from the morning session of the Lyon meeting follow below. The presentations have been summarised by the editor, *Justin Watts*. For further detail the presentations are available in the members section of the website. The five key themes consist of:

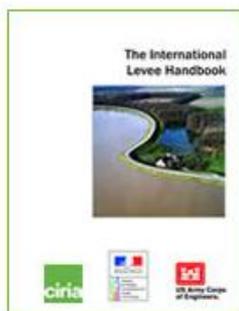
1. **Levee Fundamentals, International Levees Community of Practice**
2. **Flood Events and Flood Protection**
3. **Levee Failure**
4. **Risk Analysis and Assessment**
5. **Monitoring**

### 1. LEVEE FUNDAMENTALS, INTERNATIONAL LEVEES COMMUNITY OF PRACTICE

#### The International Levee Handbook

*Jonathan Simm, HR Wallingford  
United Kingdom*

An interesting introduction and overview to the International Levee Handbook was presented by Mr Simm. The levees working community has greatly advanced through this international development. The Handbook along with further detail can be found on the website link provided below.



*The International Levee Handbook (C731)  
Image credit: The ILH website*

Link to website:

[http://www.ciria.org/ciria/Resources/Free\\_publications/I\\_L\\_H/ILH\\_resources.aspx](http://www.ciria.org/ciria/Resources/Free_publications/I_L_H/ILH_resources.aspx)

### 2. FLOOD EVENTS AND FLOOD PROTECTION

#### 2.1 City of Cedar Rapids, Iowa, USA Flood Protection System

*Bob Beduhn, HDR Engineering  
United States*

On the 13<sup>th</sup> of June 2008, the City of Cedar Rapids experienced the 6<sup>th</sup> largest FEMA disaster (\$848 million U.S). According to the report an estimated 18 623 people lived in the flood impacted area with the event causing no flood-related fatalities. The Cedar River peaked at 9.5m, surpassing the previous record by more than 3.4m.

Six goals were highlighted:

1. Improve flood protection to better protect homes and businesses
2. Rebuild high-quality and affordable workforce neighbourhoods
3. Restore full business vitality
4. Preserve the arts and cultural assets
5. Maintain the historic heritage
6. Assure that the city can retain and attract the next generation workforce

Four elements planned for:

1. Economic recovery: Housing and business investment
2. Flood management and protection strategies
3. Public facilities replacement
4. Health and human service needs

Solution to the complex flood system:

- 30% of proposed flood protection is demountable closure systems
- 20 closure structures
- 2.2 km of demountable structures
- 4.2 km of levees and flood walls
- 11 pump stations
- 4 m high wall/levee system
- 36-50 hours of warning time to fully deploy the system



*Cedar Rapids in full flood during the 2008 event.  
Photo credit: The Main Street District website*

#### 2.2 France spring 2016 floods and damage to hydraulic structures

*Rémy Tourment, IRSTEA  
France*

Intense rainfall was experienced in the northern half of France in May 2016. The rainfall average was 1.5 to 3 times the norms of 1981 – 2010. The highest intensities were experienced on 28-31 May, which was the equivalent of 3 months rainfall.

An outline of the impacts are listed below:

- Limited damage to levees on the Cher river downstream from Tours
- Breach on the right bank of Canal de Briare
- Damage on small dams in the East of the Morvan
- Overflowing on the Sarreaux small dam
- Breaching cascade of small dams in the Argentelet valley
- Breach in the Alériot small dam



Breach on the right bank of Canal de Briare  
Photo credit IRSTEA

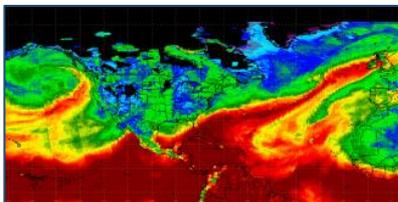
Important conclusions that were drawn are highlighted below in terms of hydraulic structural damage:

- No major levee loading => no damage
- Sand boils are a common issue in many levees, but the exact scenario needs research
- Safety management of the population behind levees after a first assessment/risk analysis, including a lot of uncertainties not clearly expressed
- Small dams are a safety concern, however the new regulations are excluding many of them - cascading effects increase the risk
- Canals are another type of structure with specific failure scenarios
- "Small" hydraulic works should not be neglected by their owners or safety managers
- Concerns expressed over the effects of a major flood on the Loire in the future

### 2.3 Levee failures in the UK during the 2015 – 16 winter floods

Jonathan Simm, HR Wallingford  
United Kingdom

An overview was presented on the performance of the levees in the UK during the 2015/16 Storm Desmond event. The few breaches that did occur mainly concerned low consequence defences.



Storm Desmond – map of air temperature in 'atmospheric river'.  
Image credit: HR Wallingford

A study was conducted which evaluated 3 fluvial breaches caused by overtopping, 3 fluvial breaches which occurred at a lower water level and 2 coastal failures that occurred due to low beach levels increasing exposure of the hard defences causing structural failure.

Key factors affecting the fluvial breaches included local irregularities, extremely steep side slopes, low crests, poor quality vegetation, lack of erosion protection and poor condition due to reduced maintenance of low consequence assets.



Severe levee erosion along the River Tyne – Dilston Haughs.  
Image credit: HR Wallingford

## 3. LEVELLE FAILURE

### 3.1 The SAFELevee Project

Myron Vandamme, TU Delft  
Netherlands

The objectives of the SAFElevee project were discussed in detail and the key points presented are highlighted below:

- Improve the understanding of (geotechnical) failure mechanisms and breaching of flood defence systems.
- Enhance failure models, reliability analyses and designs of flood defences.
- Provide systematically collected datasets for future scientific research.

The approach of SAFELevee is to improve the reliability of flood defence systems by providing a better understanding of their failure mechanisms. Three areas of research were discussed and are outlined below.

1. Understanding levee failure patterns.
2. Hindcasting of individual level failures and performance observations.
3. Breach patterns and breach growth modelling of historical failures.



Physical breach modelling - the effects of wave overtopping on the landside slope of levees.  
Photo credit: TUDelft

## 4. RISK ANALYSIS AND ASSESSMENT

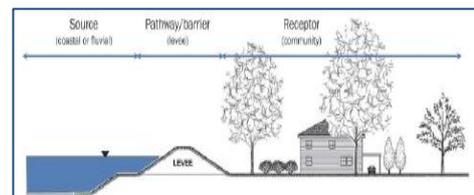
### 4.1 Levee risk analysis framework

Bruno Beullac, IRSTEA  
France

French regulations require regular risk analysis on protective levees. The analysis framework incorporates a range of source pathway receptor models. The method has been used on levee systems on the Loire River and is currently tested on sea and estuarine environments

The main objectives of the method:

- To structure the risk identification step of the risk analysis framework.
- Divide the levee system up into main functions and constrained functions.



The conceptual method has been applied to flood risk through the FOODsite project and the International Levee Handbook.  
Image credit: International Levee Handbook

The main interests of the method:

- Structure the identification and the functional analysis of the levee systems components at two levels, namely hydraulic sub-systems and structural components.
- Analyse hydraulic and structural failures.
- Identify the detailed hydraulic and structural failure scenarios of levee systems, namely hydraulic and structural failure scenarios.

#### 4.2 Probability of failure of an embankment by internal erosion using the Hole Erosion Test

Thibaut Mallet, SYMADREM  
France

Infiltration and progression were highlighted in this presentation as two conditions in concentrated leak erosion or pipe flow with erosion.

Initiation - there must be an existing hole

Progression - the hole must "hold"

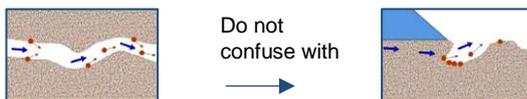


Image on the left depicting the mechanism of concentrated leak erosion.  
Image credit: SYMADREM

A risk assessment study area was implemented with six different levee types, ranging from new reinforced to 19<sup>th</sup> century levees. The noteworthy conclusions from the investigation are highlighted below.

- Annual probability of breach for old levees without trafficable crest was five times the annual probability of breach for old levees with trafficable crest.
- The increase in risk of a breach with absence of levee monitoring during floods is more important (X 32) for recently designed levees than older 19<sup>th</sup> century built levees (X 1.5)

## 5. MONITORING

### 5.1 USSD white paper on instrumentation and monitoring of levees

Scott Raschke, Schnabel Engineering  
United States

Levees were categorised generally according to two distinguishing characteristics. Namely the resources they protect – rural or urban and their geomorphic setting typically coastal, river and estuarine. Key comparisons were made between levees and dams which are highlighted below.

#### Similarities

- Use of potential failure mode analysis (PFMAs): To understand the risks and define the monitoring programs.
- Infrequently Wetted: For some flood control.
- Ownership and level of Regulation: For flood control dams, irrigation and many other types of levees, may not have a revenue stream tied to levee operations and regulatory agency resources are limited.

#### Differences

- Aerial Extent: Differences in structural footprint
- Reliance and flood fighting
- Additional Potential Failure Modes: associated with parallel flow and potential for erosion vs impounded flow.
- Complicated consequence evaluations: Failure of levee 'components of the system may be more complex than for a dam.
- Heterogeneous system components: levee systems often made up of various components including earthen levees, floodwalls, closure structures and their transitions.
- Subsurface penetration: while dams and levees typically both have penetrations, levees frequently have a greater number and variety of them.
- Magnitude of water pressure loads: higher in dams
- Transitory loading conditions: Infrequent loading of levees.
- Length of seepage path: shorter for levees. Therefore defects (roots of vegetation, animal borrows etc.) have more potential impact for levees.

Further topics relating to the consideration for monitoring levees that were presented included the potential failure modes for levees, risk considerations for levees, types of "conventional" instrumentation for use at levees, drawbacks to reliance on instrumentation, data collection, reduction and storage and finally types of monitoring activities.

### 5.2 Monitoring of seepage in levees by optical fibres

Jean Robert Courvaud, EDF Hydro Engineering Centre  
France

The levees that were monitored protect the residential and industrialised area, north of Strasbourg, against flooding from the Rhine. The levees are characteristically up to 8 metres high with a silty core, gravely fill and a drainage channel. The surveillance technique included:

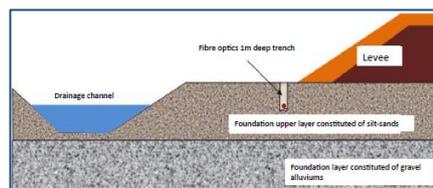
- Maintenance of the monitoring system.
- Periodic interpretation of the monitoring data (twice a year).
- Real time monitoring when the Rhine flow in Strasbourg is equal or larger than 2100m<sup>3</sup>/s.
- Detailed visual inspection by an expert every 2 years.
- Monitoring and surveillance reports

The monitoring system of the VNF levees includes 3 components:

1. Fibre optics temperature measurements for leakage detection.
2. Piezometric measurements
3. Rhine river water level measurements.

The Rhine river flood May 2016 (return period of less than 10 years) was monitored with surveillance records sent every 8 hours. The conclusions from the investigation are outlined below.

- Good feed-back from the fibre optics installation performance.
- Good feed-back from the real-time monitoring human organisation.
- 2100m<sup>3</sup>/s flow criteria defined to start real-time monitoring is too low. Needs to be increased to 3000 m<sup>3</sup>/s



The monitoring system used in the Rhine.  
Image credit: EDF Hydro Engineering Centre

## Upcoming WG Meetings

- The next meeting of our WG will be held during the ICOLD Prague meeting in July. We invite all our members to join us on this occasion.
- We plan to have a second WG meeting in the second half of the year. We would like your suggestions for a date and place, possibly link to another levee related event.
- The launch meeting/workshop of the writing phase of the dams-levees comparison report will be held in Aix en Provence in April 2017 (date to be confirmed, between 18 and 20) more details will be sent soon by email regarding this report and workshop.

## CALL FOR CONTRIBUTIONS

Please email the newsletter team at [lfd-eurcold@irstea.fr](mailto:lfd-eurcold@irstea.fr) to contribute articles, photos, future events, research topics and current news items on levees and flood defences. We would like to make the newsletter a collaborative effort!

## OUR COMMUNITY IN ACTION - SHARING INTERNATIONAL PRACTICE

BY JACKIE BANKS

In the UK Badgers (*Meles, meles*) are a protected species under the Protection of Badgers Act 1992. They need to dig to create their homes (known as setts) and to get their preferred food of earthworms. On the floodplains of England often the only high ground nearby is the levees, leading to badgers digging in them causing varying degrees of damage.



Photograph showing badger damage to a levee – courtesy of Environment Agency

Badger damage to levees affects most areas of the country to a greater or lesser extent. As part of its regular inspection and assessment of levees the Environment Agency calculates the impact of badgers on flood risk and where this is significant carries out badger exclusion work and repairs the levees under licence agreements with Natural England, the body responsible for licencing under the Act.

At our Levee Community of Practice (CoP) meeting in Lyon in October several people gave presentations which referred to animal damage to levees in their countries and what work and studies were underway to address the issues.

On returning to the UK I was able to use the information gained at the levee CoP meeting and use the CoP network to make contact with the individual members concerned and gain more in depth knowledge of practices in different countries. Whilst legislation is different in each country and the burrowing animals involved vary, the information provided helped us in developing guidance for our practitioners and to prepare briefings for Government Ministers and others. My thanks go to Thibaut Mallet, Silvia Berson,

Henk van Hemert and Dolf Moerkens for their contributions.



Photograph showing the protected UK Badgers – courtesy of the RSPCA website

A Community of Practice (CoP) has been defined as 'a group of people who share a concern, a set of problems or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis' (Wenger, McDermott & Snider 2002). It works by members sharing and explaining, listening to each other, improving knowledge and capitalising on a wider base of good practice. This requires willingness, commitment and an open mind from participants and results in general improvement and fulfilment of needs, plus ultimately recognition of their contributions.

The help and advice freely given on the burrowing animal issue clearly demonstrates that our CoP can work well together and extend the knowledge of individuals, organisations and countries. I recommend the use of this network for other levee issues you may face.

## FLOODrisk - SHORT REPORT FROM THE 2016 CONFERENCE

BY MARCEL BOTTEMA

From 18-20 October the 3<sup>rd</sup> European Conference on Flood Risk Management took place in Lyon, together with some side events, see FLOODrisk 2016, [www.floodrisk2016.net](http://www.floodrisk2016.net). Over 200 papers were presented covering a wide range of Flood Risk Management issues. The number of participants was over 500, covering research institutes as well as consultants, government and NGO's, and covering not only many European Countries, but people outside Europe, notably the US. Some highlights of relevance to both the dam and levee world are given below. But first and

foremost, it should be mentioned that FLOODrisk is as much a Community of Practice gathering as a conference.

Although the FLOODrisk conference only takes place every four years, FLOODrisk can still be considered to be an event that facilitates communities of practice within Flood Risk Management (FRM). This is partly due to the history of the FLOODrisk conferences, linked to the EU-FLOODsite and FloodProBE projects and the International Levee Handbook. But it is equally linked to the special character of the Conference, which is not just a set of lectures, but also includes some side events and planned as well as spontaneous workshops. In fact FLOODrisk serves not only to support individual Communities of Practice, but acts rather like an overarching FRM-community gathering, connecting various topic-specific Communities as well as different types of actors.

The FLOODrisk conference included a range of special sessions in workshop format. These sessions covered topics like the EU Floods Directive Implementation, Governance of FRM Programs, Natural and Nature-based FRM-solutions, Levee breach and failure mechanisms, Risk model validation and Communities of practice. More details can be found [www.floodrisk2016.net](http://www.floodrisk2016.net) and at <https://lfd-eurcold.irstea.fr/index.php/floodrisk-2016-as-an-interactive-conference-workshops/>

The side events included:

- A meeting of our EURCOLD Working group on Levees and Flood Defences, see <https://lfd-eurcold.irstea.fr>
- The French PREVIRISQ events on integrated French FRM projects, see <http://floodrisk2016.net/programme/special-sessions/previrisq-selected-french-projects-in-frm/>
- Side event on emergency management, co-hosted by FLOODrisk 2016, DG HOME.B4 from the European Commission, and the Disaster Risk Management Knowledge Centre (DRMKC) represented by JRC.

Besides this, informal meetings besides the official program took place, for example a meeting of the levee breaching community.

The term 'parallel conference sessions' may not seem inspiring. Yet it contains as many as 6 overarching topics and 24 sub-topics, each covering a set of interesting papers.

The overarching topics were Flood Hazard, Consequences, Flood Risk characterization, Risk reduction, Flood Event Management and Decision making. All these topics are not only relevant to the FRM-community in general, but also to the levees and dams communities. We intend to explore the added value to the latter communities in a symposium paper for the 2017 ICOLD Annual Meeting in Prague. A brief preliminary summary can be found at <https://lfd-eurcold.irstea.fr/index.php/floodrisk-2016-conference-sessions-and-papers/>

The final plenary session included a future outlook, where increasing risk and vulnerability are likely, as well as uncertainties and financing issues. Yet the ambition for a future overarching FRM Community of Practice may help in coping with these issues together; moreover the European Commission begins to recognize the importance of Communities and Science-Policy-Interfaces, especially on Secure-Safe-Resilient Societies.

All in all the conference was highly successful. There is only one aspect about FLOODrisk that might be disappointing: those who feel inspired to soon attend the next FLOODrisk conference, will have to wait another four years. The good message is that FLOODrisk 2020 is planned to take place in Budapest: a lovely city in a country with an interesting history on floods and Flood Risk Management.

## Editor's Note

BY JUSTIN WATTS

The daunting task of becoming a newsletter editor with a civil and coastal engineering background has been a rewarding one. I would like to send an expression of thanks to Jackie Banks and Rémy Tourment for this amazing opportunity. As a graduate engineer from South Africa, it has been a remarkable experience. It is refreshing to see the commitment and engagement between countries and working group members on the common theme of levees and flood defences. I have enjoyed the challenge, learnt a lot so far and given my all in hope that you enjoy this inaugural newsletter. I am optimistic the future editions will improve with the addition of your contributions along with the progress of my own editing capacity. Enjoy!

## WEBSITE – ACCESS, UPDATES AND INSTRUCTIONS

BY BRUNO BEULLAC

The website for our Levees and Flood Defences Working Group was launched in May 2016 (<http://lfd-eurcold.irstea.fr/>).

The website, along with the newsletter, provides an additional form of communication between our members and the rest of the levee and dams community. The type of information that is accessible on the website consists of:

- Presentations from our working group
- Working group news
- Information about levees and flood defences (news, reference documents, research projects and topics, press)
- Working group documents (meeting notes, reports)
- Useful links

Most of the information on the website can be accessed by anyone on the Internet. Some information is restricted to the working group members, like draft versions of documents in the writing phase and contact details for members. Regular web pages and downloadable documents are published and managed by the website administrators. In addition to these, it is possible for members and other subscribers of the website to send potential "posts" along with comment on the existing content. Only the more recent posts and comments are prominently visible on the main page of the website. In order to have information published in the main and more permanent areas of the website; members, subscribers and unsubscribed readers need to send the information by email to the website and newsletter editorial team (<https://lfd-eurcold.irstea.fr/>).

A recent upgrade in the user management of the website allows a single list of registered users with an individual login allowing access to functions according to their status (administrators, members, subscribers). A user's guideline is being written and will soon be sent to members along with being made available on the website. Working Group members are systematically registered as members. Other users need to request to be registered as "subscribers" by sending an email to the administrators email address.

## STOP PRESS!

### SCOPING MEETING ON OUR 'DAMS-LEVEES' COMPARISON REPORT

BY RÉMY TOURMENT

A two day workshop was recently held in Lelystad (NL) for the initial scoping and planning of our future report on the comparison between dams and levees.

Five members of our group met from the 25th to the 27th of January to discuss and make decisions on the strategic aim, content and main ideas of the report, along with the working method, key dates and actions. A student from Delft Technical University joined the meeting and will be helping with the cross cutting issue of failure modes. Unfortunately we missed two members who were planning on attending but had health issues at the time of the meeting.

The main target date is the Vienna ICOLD Congress in July 2018 where we aim to present a quasi-final draft. An updated, improved and more detailed draft Table of Contents with comments has been produced and will serve as the foundation for future work. This is currently being circulated among all our WG members for feedback and contributions on the content.

## Upcoming Events

### April 03 - 08, 2017

- USD 2017 Annual Conference and Exhibition
- Anaheim, California, USA

### July 03 - 07, 2017

- 85th Annual Meeting of International Commission on Large Dams
- Prague, Czech Republic

### September 04 - 07, 2017

- 25th Meeting of the European Working Group on Internal Erosion in Embankment Dams & their Foundations
- Delft, The Netherlands

### September 27 - 28, 2017

- CFBR - Colloque Hydraulique des barrages et des digues
- Location to be confirmed

### October 16 - 17, 2017

- 11. Deichtage
- Karlsruhe, Germany

### July 01 - 07, 2018

- 26th Congress - 86th Annual Meeting of International Commission on Large Dams
- Vienna, Austria



NEWSLETTER TEAM CONTACT – [lfd-eurcold@irstea.fr](mailto:lfd-eurcold@irstea.fr)

Rémy Tourment, Marcel Bottema, Jackie Banks, Justin Watts, Bruno Beullac

