

# Rainfall, Inundation and Flooding

- undermining the foundations of the Construction market

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## Summary

*\*Wild Fires could be triggered by Natural (lightening) or Man-made (fire/explosion, arson) events*

# Firstly, some clarity on terminology ...

## Natural Catastrophe (Nat Cat):

- ▶ Earthquake
- ▶ Named Windstorm, Typhoon, Cyclone
- ▶ Storm Surge
- ▶ River Flood (Fluvial Flood)

versus

## Natural Perils = Nat Cat plus:

- ▶ Storm, Thunderstorm, Tornado, Lightening, Wild Fires\*
- ▶ Hail, Snow
- ▶ Rainfall, inundation and Pluvial Flood

## Natural Perils are not necessarily “catastrophic” but they are a significant source of attrition

- ▶ The insurance industry places a significant focus on Nat Cat (RMS/AIR modelling, limits/deductibles, aggregation/accumulation etc.)
- ▶ But do we have a blind spot to other Natural Perils?

## Out of scope:

- ▶ Wet Works (marine environment)
- ▶ “Water Damage” (burst pipes) in buildings

# Introduction

The Built Environment is very resilient to Natural Perils, and largely responds well to Nat Cat but assets under construction are inherently far more exposed ...

- ▶ Excavations, foundations, basements, shafts, trenches – water always finds the lowest point
- ▶ Temporary works are often designed to lower design standards – cofferdams, berms, retaining walls etc
- ▶ Temporary structures can increase the load on the structure – e.g. scaffolding around a building, wind drag through ‘forest’ of columns
- ▶ Fresh-cut earthworks is exposed to erosion, wash-out, settlement
- ▶ Partially complete structures are less stable – e.g. cable stayed bridge, cut & cover tunnel
- ▶ Exposure to and from plant and equipment

... and these are the exposures that the Construction market covers – not the ‘what’ but the ‘how’

# Pluvial Flood

(run-off from rainfall)



# Fluvial Flood

(river flood)

Note: Completed assets above flood levels (mostly)



## Inundation of Shafts and Tunnels

- Water finds the lowest point
- Volumes exceed pumping capacity/failure of pumps
- Tunnel network distributes the water widely
- Sensitive equipment exposed (temporary or permanent)
- TBM particularly exposed

Best Practice: 1m reinforced concrete upstands around shafts

## Inundation of pipeline trenches

- Crossing of flood plains and rivers
- Channel water over long lengths
- Flootation of the pipe
- Washing-in of material
- Destabilize the trench
- Pumping-out of flood waters (contamination?)

## Temporary cofferdams

- Design return period (1:20, 1:10 years) compared to period of exposure
- Quality of hydrological data (availability, relevance and duration)
- Local effects of diversion strategy

## Bare Earthworks

- Erosion potential until vegetation established
- Cuttings become unstable when saturated
- Fine materials washed in to drains and gulleys
- Large areas exposed and difficult to protect



## Damage to or from Plant and Equipment

- Can't always be removed or secured in time
- Sensitive equipment and difficult to repair/replace (eg TBM)
- Large/heavy equipment with potential to cause damage (eg barges)

## Partially complete structures are inherently less stable

- E.g. cable stayed bridge or cut & cover station box
- Stability calculations for each intermediate stage
- Design return periods in temporary state lower than permanent

## Scaffolding creates a larger surface area

- Wind loading during construction/renovation may be higher
- Possible drag effect through unclad building

# Of all these, water is the most destructive

Who says?

- ▶ Munich Re
- ▶ Swiss Re
- ▶ IMIA
- ▶ Liberty

... let's look at some recent commentary and loss statistics ...

Blog

## "Secondary" is not the same as "unimportant"



Victor Victorsson  
Co-Head EMEA Engineering  
26 Oct 2020

Share 

Increasingly, hailstorms, torrential rain, pluvial floods and wildfires are playing a larger role in driving up claims. In recent years, more than 60% of all natural catastrophe related insurance claims have resulted from these so-called secondary perils. This trend is expected to continue given ongoing urbanisation and other socio-economic processes in exposed and well less modeled areas. In addition, climate change is exacerbating this problem, creating conditions that are conducive to some secondary perils.

# Swiss RE: Secondary Perils

Secondary perils are of particular importance to Engineering. Many of our exposures are in less developed and often less modeled territories, and therefore at risk of not being considered in the underwriting process. Additionally, during the construction phase, the protection level of construction projects is often below what it will be once complete.

Source: [Swiss Re Internet site:](https://www.swissre.com/risk-knowledge/mitigating-climate-risk/secondary-is-not-the-same-as-unimportant.html)

<https://www.swissre.com/risk-knowledge/mitigating-climate-risk/secondary-is-not-the-same-as-unimportant.html>

# Munich RE: Natural disaster figures for 2020



NOT IF, BUT HOW

Risks Solutions Company

EN

Home > Company > Media Relations > Media Information and Corporate News > Media Information > 2021 > 2020 Natural disaster balance

## Record hurricane season and major wildfires – The natural disaster figures for 2020

2021/01/07

### Reinsurance

- Record hurricane season: More storms in the North Atlantic than ever before
- Historic wildfires in the western United States
- Worldwide, natural disasters produced losses of US\$ 210bn, with insured losses of US\$ 82bn
- Floods in China were responsible for the highest individual loss of US\$ 17bn, only around 2% of which was insured
- Five years after the Paris Climate Agreement: 2020 on the way to being the second warmest year on record

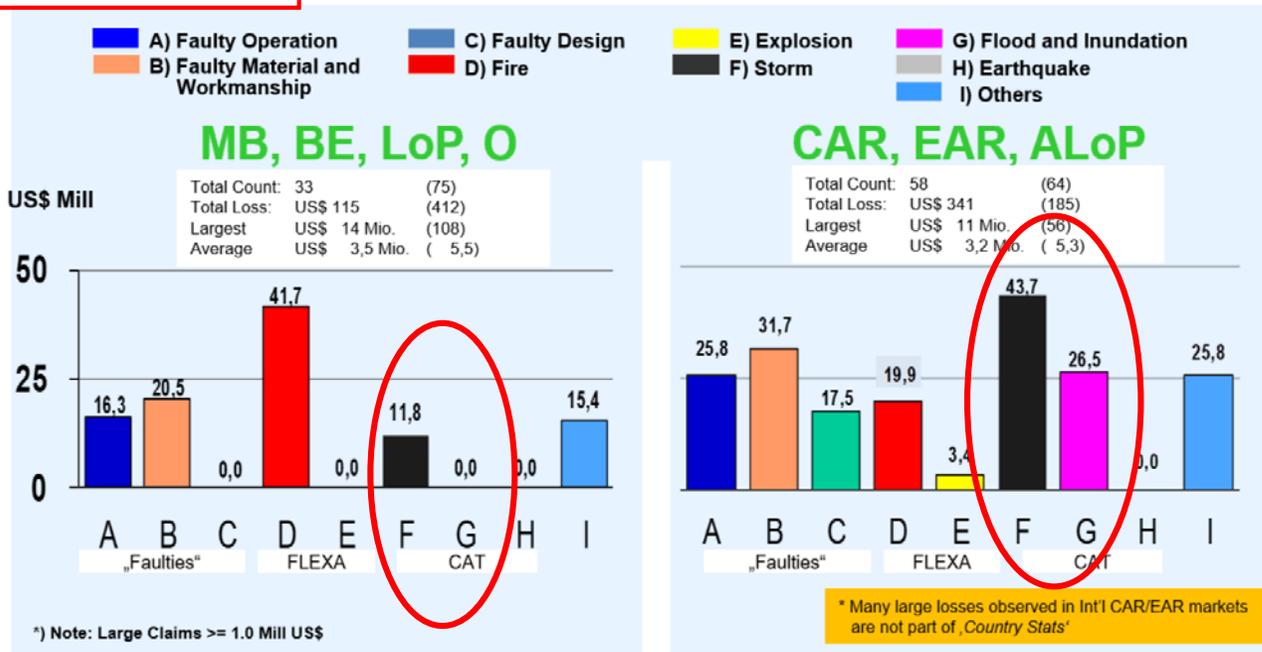
Source: Munich Re Internet site:

<https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2021/2020-natural-disasters-balance.html>

# IMIA Statistics

## Large Claims only 2019 (2018)

Cause of Loss → Operational / Projects



Storm and Flood & Inundation are a major source of Construction losses:

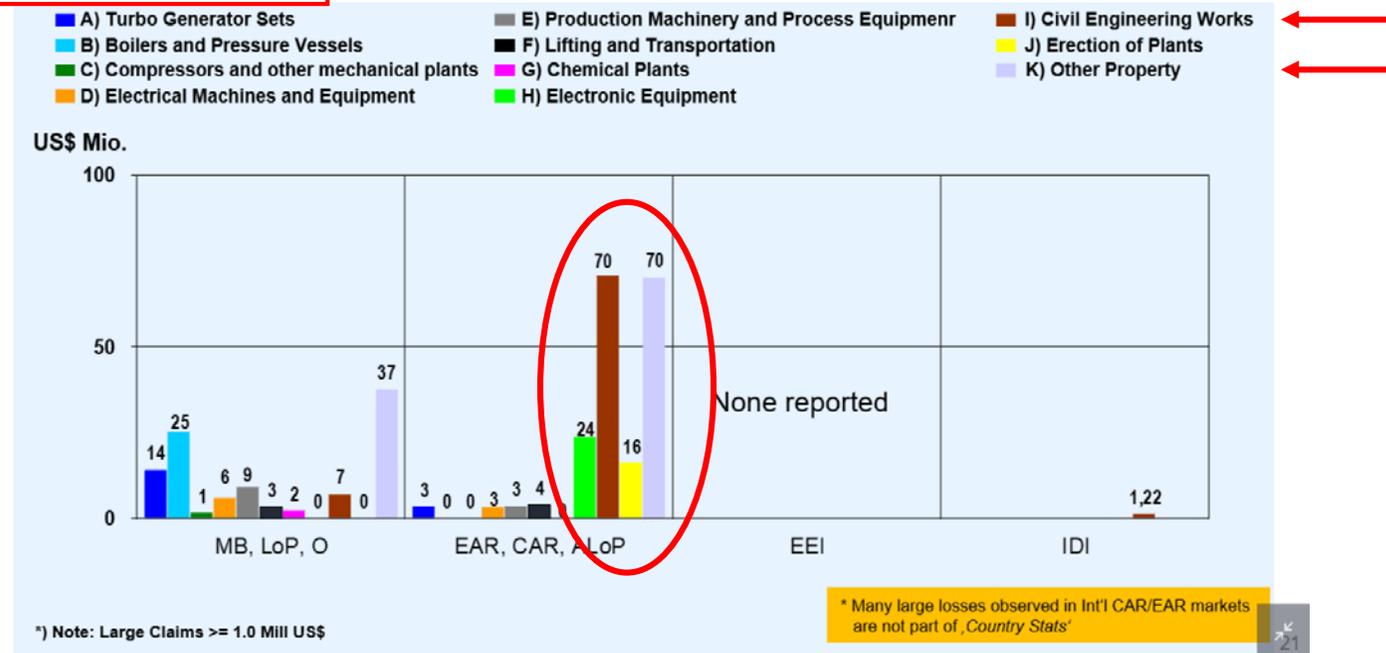
- ▶ 36% of the total
- ▶ 3 times higher than Fire and Explosion
- ▶ Limited impact in operational classes

Source: IMIA Presentation at virtual Conference  
September 2020  
Permission granted

# IMIA Statistics

## Large Claims only 2019

Main Items affected → Operational / Projects / etc.



When Construction losses do occur, Civil Engineering Works are disproportionately impacted:

- ▶ 36% of the total each
- ▶ 3 times higher than other categories
- ▶ Limited impact in operational classes (exposure of completed works versus temporary state)

Source: IMIA Presentation at virtual Conference  
September 2020  
Permission granted

# LSM Construction Portfolio Analysis Tool

## Analysis of the global construction portfolio

- ▶ Links Underwriting data to claims data
- ▶ Live system, updated quarterly

## Limitations:

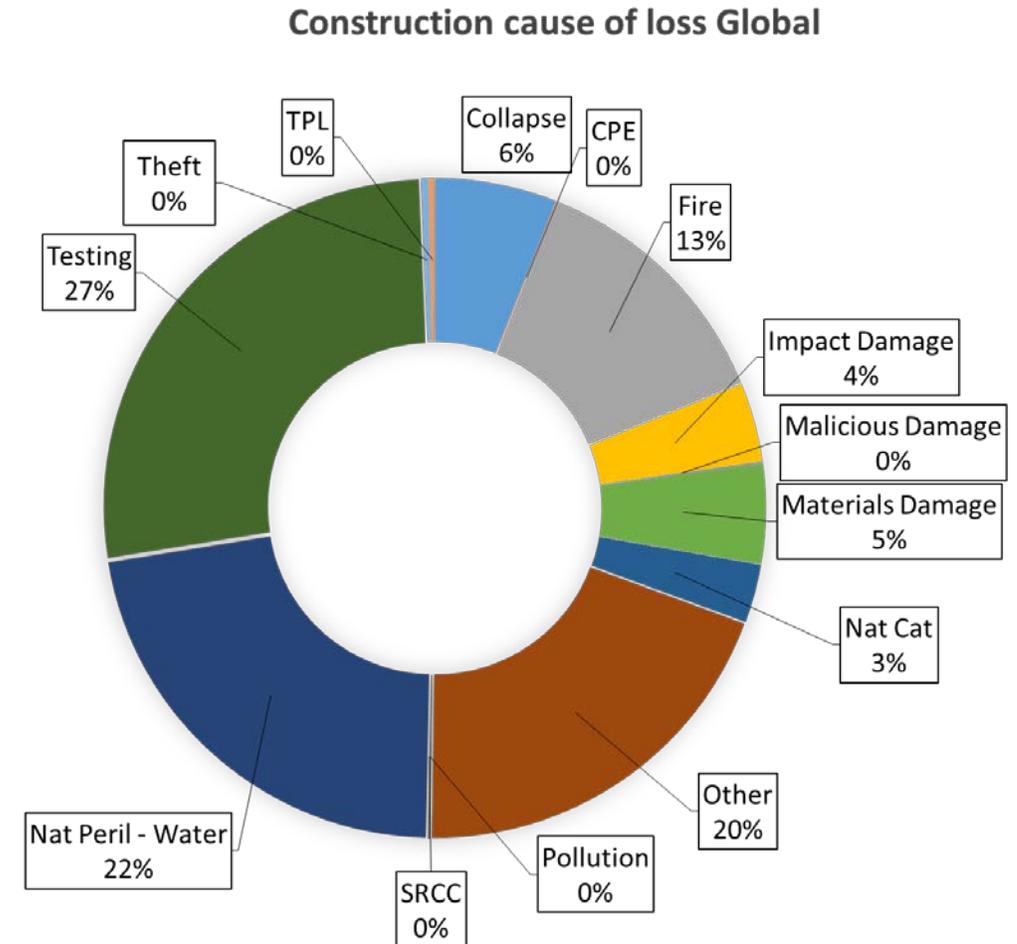
- ▶ Accuracy - rubbish in, rubbish out
- ▶ Consistency – data entered by numerous people around the world, potential for differing judgement
- ▶ Sample size - mature portfolio but still only our data

# LSM Construction Portfolio Analysis Tool

Source: LSM data

## Overview of causes of loss across our Construction portfolio

- ▶ Natural Perils – water 22%
- ▶ Testing & Commissioning – 27%
- ▶ “Other” – 20% ...

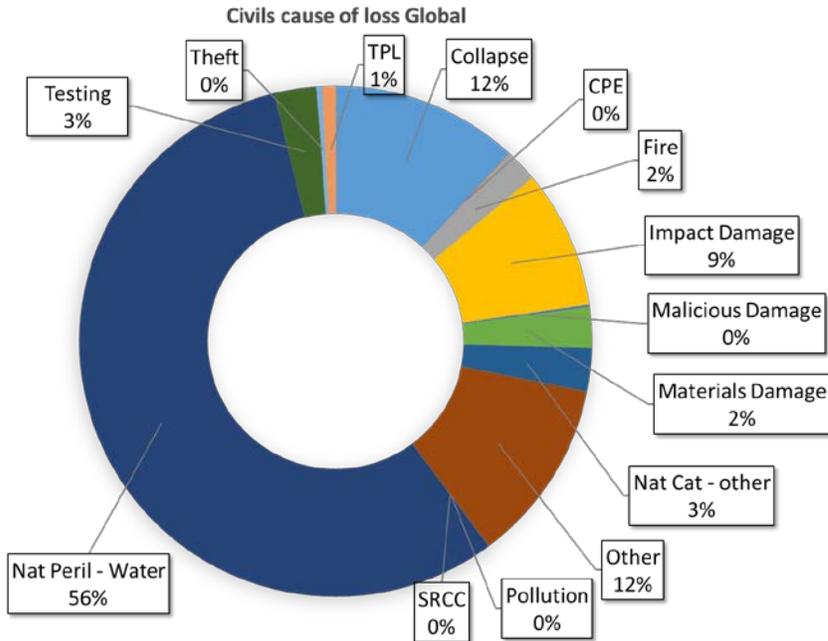


\* Important to note that the LSM portfolio has no exposure to the major hydro-power losses from recent years or the notable large flood claim in the Middle East.

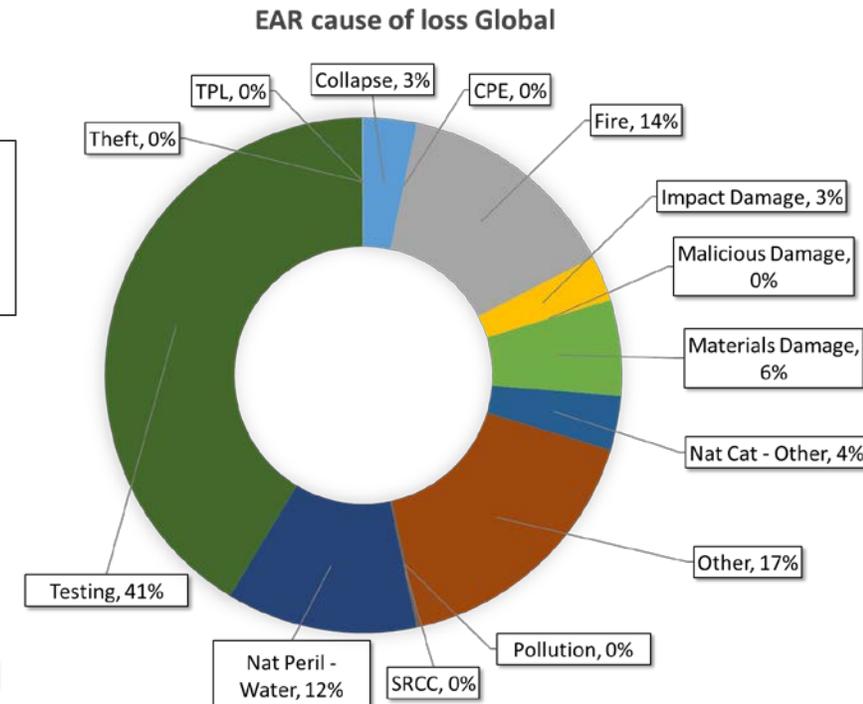
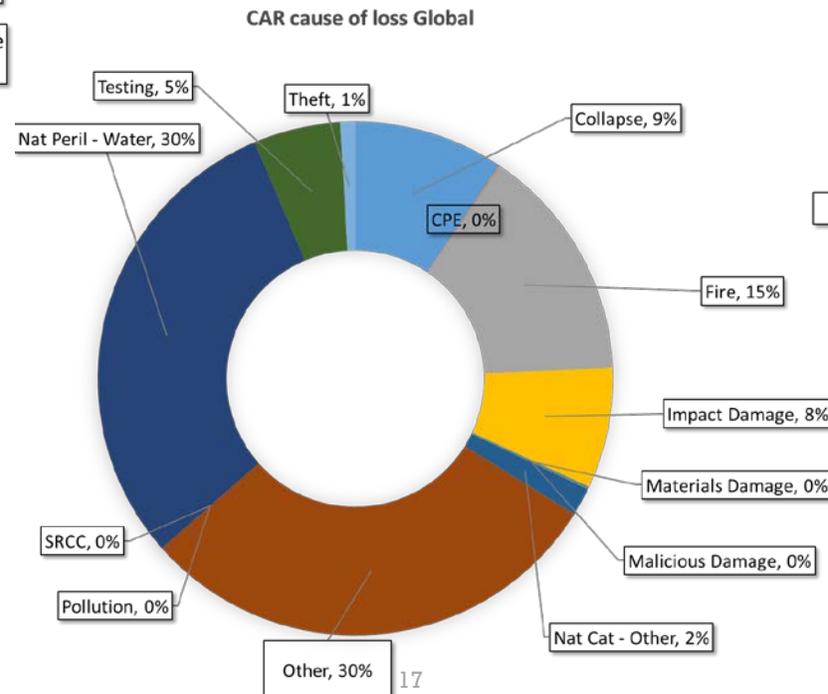
# Construction Portfolio Analysis Tool

Source: LSM data

Split across the three main sectors:



LSM Data



# Case Study - Overview

## Rural Road

- ▶ Heavy rainfall during Tropical Storm (Named but not Hurricane) – no damage due to wind or surge
- ▶ USD 12 to 15m loss

## Reservoir

- ▶ Heavy rainfall events (neither a Named/Tropical Storm)
- ▶ USD 22 to 25m loss

## On-shore Windfarm

- ▶ Heavy rainfall event (not a Named/Tropical Storm)
- ▶ Circa USD 25m loss

## Refinery

- ▶ Heavy rainfall during Tropical Cyclone – limited damage due to wind
- ▶ USD 5m loss

**Heavy rainfall events were more damaging than the Tropical Storms**

# The water cycle

## No, not a GCSE Geography lesson:

- ▶ Traditionally the insurance industry focuses on Named Windstorm, Cyclone, Typhoon etc but would be probably more concerned about the wind and surge than the rain.
- ▶ LSM also look carefully at 1:100 year flood from rivers (Fluvial Flood), eg Swiss Re Cat Net or Munich Re NATHAN.
- ▶ We are investigating analysis techniques to consider the full water cycle:
  - Rainfall, from the sky
  - Inundation, from run-off from surrounding areas
  - Flood, from rivers
  - Storm Surge, from the sea
  - ... and also from groundwater
- ▶ Particularly for long linear (rural) risks, such as pipelines, roads and railways.

At LSM, we are increasingly focussing on all stages of the water cycle and asking ourselves:

*“Is analysis of the exposure to water the most important step for a Civils project?”*

Further, in light of notable water-related losses on EAR projects and known issues on CAR, is the industry systemically underestimating the impact across the whole construction portfolio?

# Flooding & Rainfall Analysis – Available Tools

We have developed an interim approach but further research work is on-going:

- ▶ Swiss Re Cat Net Pluvial Flood Zones (newly released)
- ▶ Munich Re Nathan ...
- ▶ National Environment Agency data (UK Agency, FEMA, NOAA etc)
  
- ▶ Detailed Fluvial and Pluvial flood model data,
  - ▶ Global Vs Country/Municipality specific?
- ▶ Precipitation data
  - ▶ Global Vs Country/Municipality specific?
  - ▶ Rain gauge or gridded remotely sensed information?
- ▶ Digital elevation Modelling and watershed analysis
- ▶ In-house tool in development

# Snap-shot of the Construction Industry

## Is the exposure adequately addressed at site level?

- ▶ How well, if at all, is rainfall and inundation dealt with in Risk Registers?
- ▶ Example: Major civil engineering project heavily exposed to Windstorm
  - No reference to storm and storm surge in market presentation or Risk Register
- ▶ Response to questions on flood often reference permanent design solutions
  - Has the temporary state been over-looked?
- ▶ Risk mitigation, if offered, is often “standby pumping facilities available”.
  - Prevention better than cure? More focus needed on preventing it entering the works?
  - Bund walls, cut-off walls, temporary drainage, elevated work-sites etc
- ▶ Planned flooding, too difficult to protect so allow it to flood?
  - This is a deliberate strategy, not a ‘risk’, so cannot be transferred to Insurers.

# Snap-shot of the Construction Industry

However, some risks just are inherent:

- ▶ How can you protect earthworks from rainfall?
- ▶ Some wet works can never be protected from water, eg dredging, rip-rap, river works
- ▶ Flood plains will flood
- ▶ Water always finds the weak point and/or low point
- ▶ Planned/inevitable events

The residual risk (and risk that mitigation measures fail) that is passed to insurers:

- ▶ Sustainable risk transfer solutions are required (policy conditions, deductibles and price)

# Underwriting Considerations

## Some things to consider:

- ▶ Definitions of Nat Cat and Natural Perils
  - application of deductibles, sub-limits, other policy conditions
- ▶ Policy conditions, eg Swiss Re EPI 57 or Munich Re 110
  - Return periods, quality and reliability of data, where is the measuring station, who measures? (reverse onus?)
- ▶ Policy extensions
  - Loss Mitigation expenses versus acting as though uninsured?
- ▶ Price
  - We have to price the residual risk and the risk that mitigation measures fail  
or more simply
  - We have to charge enough to cover the losses (plus brokerage, internal costs, cost of capital, profit etc)

## EPI 57 Precipitation

It is agreed that in Section 1, Material Damage the following is added to 1.2 Exclusions to Section 1:

Insurers will not indemnify the Insured in respect of any loss or damage totally or partially resulting from precipitation unless according to data available from the meteorological service the quantity of rainfall at the Project Site is higher than the quantity corresponding to the return period stated below.

The burden will be on the Insured to demonstrate that this exclusion shall not apply.

Return period: ..... years

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### Endorsement 110 Special conditions concerning safety measures with respect to precipitation, flood and inundation

It is agreed and understood that otherwise subject to the terms, exclusions, provisions and conditions contained in the Policy or endorsed thereon, the Insurers shall only indemnify the Insured for loss, damage or liability caused directly or indirectly by precipitation, flood or inundation if adequate safety measures have been taken in designing and executing the project involved.

For the purposes of this Endorsement adequate safety measures shall mean that, at all times throughout the policy period, allowance is made for precipitation, flood and inundation up to a return period of 20 years for the location insured on the basis of the statistics prepared by the meteorological agencies.

Loss, damage or liability resulting from the Insured's not immediately removing obstructions (e.g. sand, trees) from watercourses within the construction site, whether carrying water or not, in order to maintain free waterflow shall not be indemnifiable.

Source: IMIA website:

<https://www.imia.com/category/key-categories/examples-of-standard-policies-and-clauses/>



# And what about Climate Change?

Perhaps what we are seeing is because of climate change?

Either way, things are going to get harder:

- ▶ Increased development adds more hard surfaces (rapid run-off)
- ▶ Seasons and patterns disrupted and less predictable
- ▶ Existing drainage infrastructure may become overwhelmed
- ▶ Local knowledge/expertise and design codes may not address the new normal
- ▶ Historical data (return periods) is less relevant and unreliable

Munich Re report number of Nat Cat events has been growing at a rate of 3% per annum since 1980\*

- ▶ We must do something just to standstill ... but even more if we are to address the problem

# Summary

## Water, water, water:

- ▶ Construction projects more exposed to wet perils than completed/operational assets (Ref. Swiss Re and IMIA)
- ▶ Significant source of loss activity in recent years (Ref. Swiss Re, IMIA, LSM) and only likely to increase due to climate change (Ref. Munich Re)
- ▶ Civil works particularly exposed (working in the ground) whether a civil project or the ground works associated with EAR and buildings
- ▶ Tools are available to analyse but do we know what to do with them yet?
- ▶ Construction industry may have a blind spot here too, is the exposure recognised in the temporary state?
- ▶ Climate change is only going to make the challenge even harder
- ▶ Residual risk remains high, can only be treated by Terms & Conditions and price

## Appears to be a market-wide issue:

- ▶ requires a dialogue between insurance and construction industries to find sustainable solutions