

# Impact Based Forecasting & Early Warning System

adopted from Elizabeth Webster (SAWS)

By Nhlanhla Sithole  
(RTC)

# What is Impact-Based Forecasting (IBF)?

- Forecasting of weather hazards and the **IMPACTS** they will have on society
- Warning levels are based on the **VULNERABILITY** of certain areas
- Communicating these warnings in plain, simple language to stakeholders and the public

# Why Impact based forecasting (IBF)?

Hydro-meteorological events cause havoc across the globe, resulting in adverse impacts. Good forecasts are issued with increased accuracy and lead-times; however, **lives are still lost.**



# Why?!

It is becoming urgent for more countries to make the transition from focusing only on the accuracy of hazard-based forecasting to also outlining the potential impacts of a forecast – an evolution from “***what the weather will be***” to “***what the weather will do***.”

## Moving from:

What the weather will be:  
(Meteorological thresholds)

- 50mm in 24 hours
- 35 knots winds



## To:

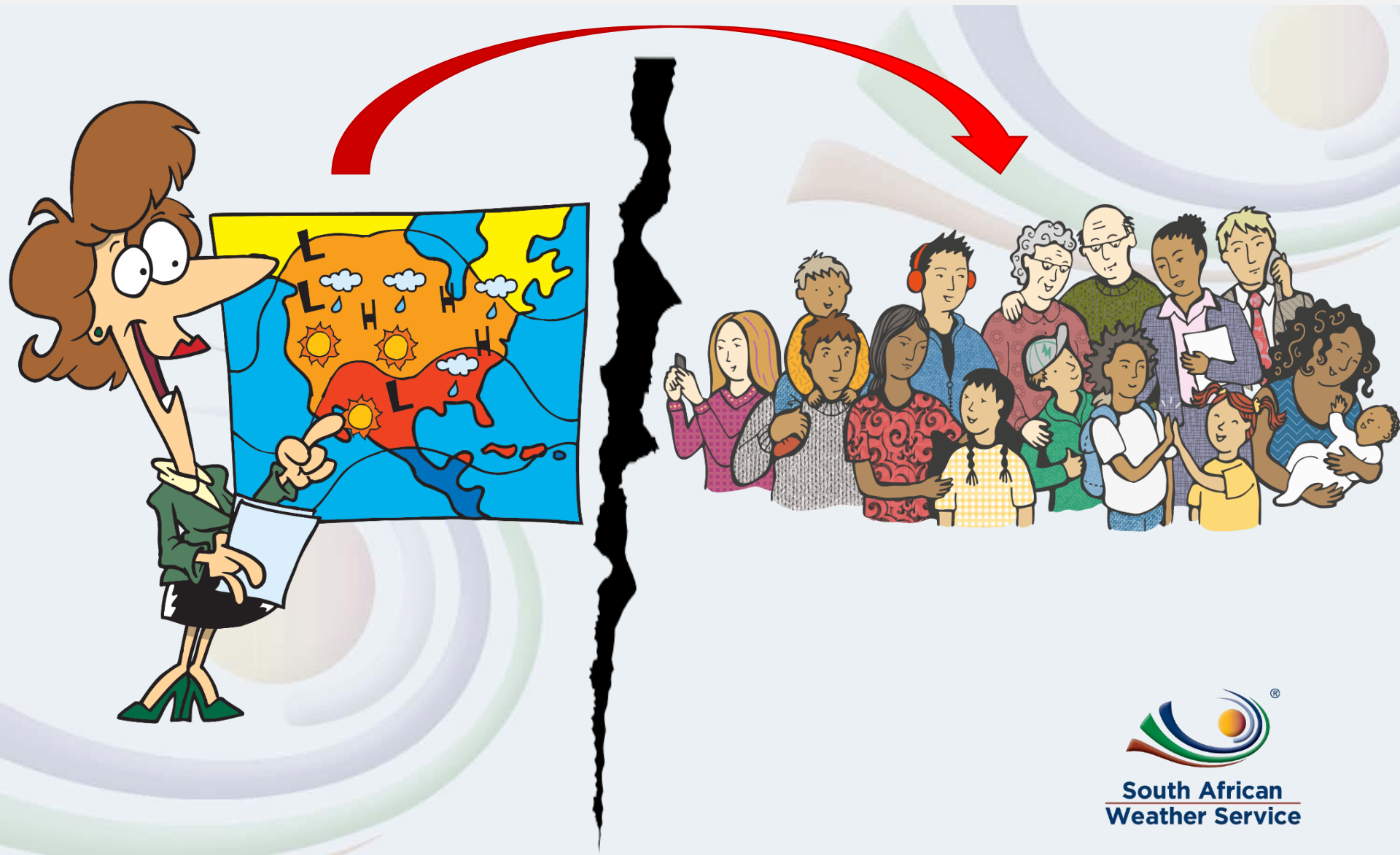
What the weather will do:  
(Impact Warnings)

- Roads flooded
- Communities cut off





# Why Impact-Based Forecasting?



# Bridging the gap



# Bridging the gap



# Key Ideas in IBF and Warning Services

- Warnings are issued only when the hazardous weather is expected to have an **impact**
  - Conditions that are common in certain areas will not necessarily result into warnings (resilient and business as usual)
- Warnings consider **vulnerabilities** of certain areas
  - Communities living on floodplains
- Warnings consider **sensitivities** of certain areas
  - “Here today and gone tomorrow” e.g., Roadworks

Information from: Paul Kucera

Hazard

Exposure



Vulnerability



# Sensitivities and vulnerabilities

Forecaster now considers the following (paradigm shift):

- What area is the rainfall expected to affect?
  - Mainly farmlands?
  - Densely populated cities?
  - Area prone to these conditions?
- What time is the heaviest rain expected?
  - During rush hour?
- Any pre-existing weather conditions?
  - Recent rainfall
- Any major events expected to take place?
  - Concerts
  - Sporting events
  - Elections
  - Initiation



# Sensitivities and vulnerabilities

Comparison of two communities with differing levels of vulnerability to the risk of flooding



<b>Likelihood</b>	High >80%		2	6	10
	Medium 50-80%		1	5	9
	Low 30-50%			4	8
	Very Low 10-30%			3	7
		Minimal	Minor	Significant	Severe
<b>Impact</b>					



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# Impact Level

<b>Likelihood</b>	High		2	6	10
	Medium		1	5	9
	Low			4	8
	Very Low			3	7
		Minimal	Minor	Significant	Severe
		<b>Impact</b>			

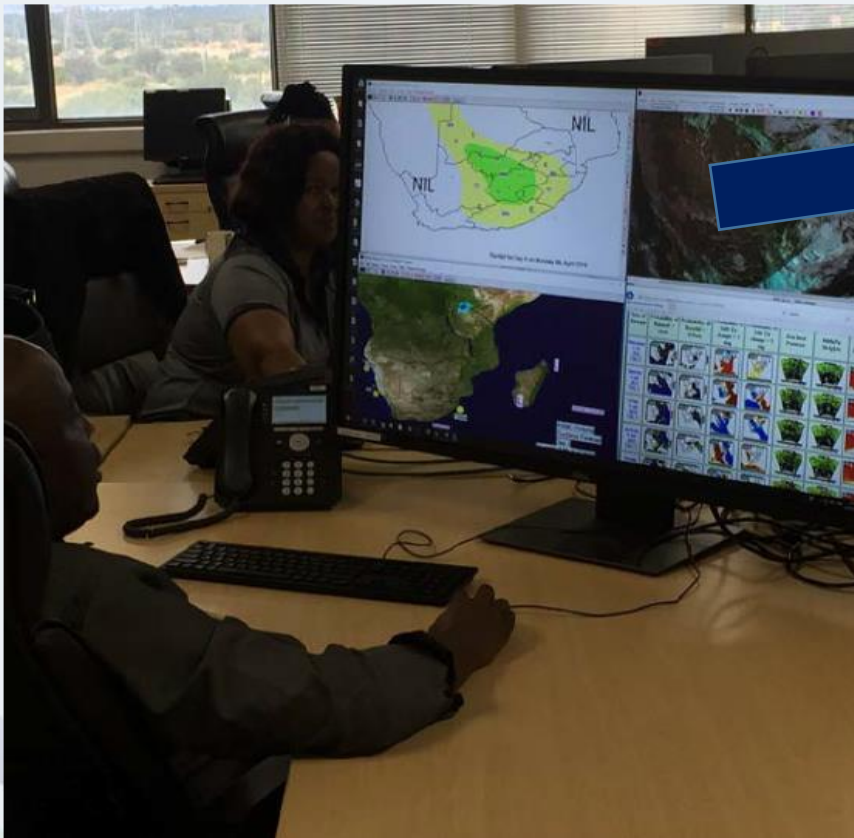
- Impact tables determine the impact level
- Impact tables developed with the disaster managers

Minimal	Minor	Significant	Severe
Business as usual	Localised Business as usual	Localised Short term strain on emergency personnel	Widespread Prolonged strain on emergency personnel
<ul style="list-style-type: none"> <li>• Some <b>pooling</b> of water on roads or in formal/informal settlements</li> <li>• Day to day activities not disturbed</li> <li>• Wet roads and reduced visibility</li> <li>• Minimal traffic congestion</li> <li>• Isolated mudslides and rockfalls</li> </ul>	<ul style="list-style-type: none"> <li>• Localised flooding of susceptible formal/informal settlements or roads, low-lying areas and bridges</li> <li>• Major roads affected but can be used, increased travel times</li> <li>• Difficult driving conditions on dirt roads</li> <li>• Minor motor vehicle accidents due to slippery roads and/ reduced visibility</li> <li>• Closure of roads crossing low water bridges</li> </ul>	<ul style="list-style-type: none"> <li>• Flooding of roads and settlements (formal and informal)</li> <li>• Danger to life (fast flowing streams / deep water)</li> <li>• Displacement of affected communities</li> <li>• Some communities temporarily not accessible/cut-off</li> <li>• Damage to property, infrastructure, loss of livelihood and livestock</li> <li>• Major disruption of traffic flow due to major roads being flooded or closed</li> </ul>	<ul style="list-style-type: none"> <li>• Widespread flooding of roads and settlements</li> <li>• Danger to life (fast flowing streams / deep water)</li> <li>• Large communities not accessible/cut-off for a prolonged period</li> <li>• Widespread displacement of affected communities</li> <li>• Widespread damage to property, buildings and loss of livelihoods and livestock</li> <li>• Widespread transport routes and travel services severely affected</li> <li>• Major roads and bridges damaged or washed away</li> </ul>



# Impact Level

- Likelihood level is determined by the forecaster



Likelihood	High	2	6	10	
	Medium	1	5	9	
	Low		4	8	
	Very Low		3	7	
		Minimal	Minor	Significant	Severe
		Impact			

# Factors affecting impact and likelihood

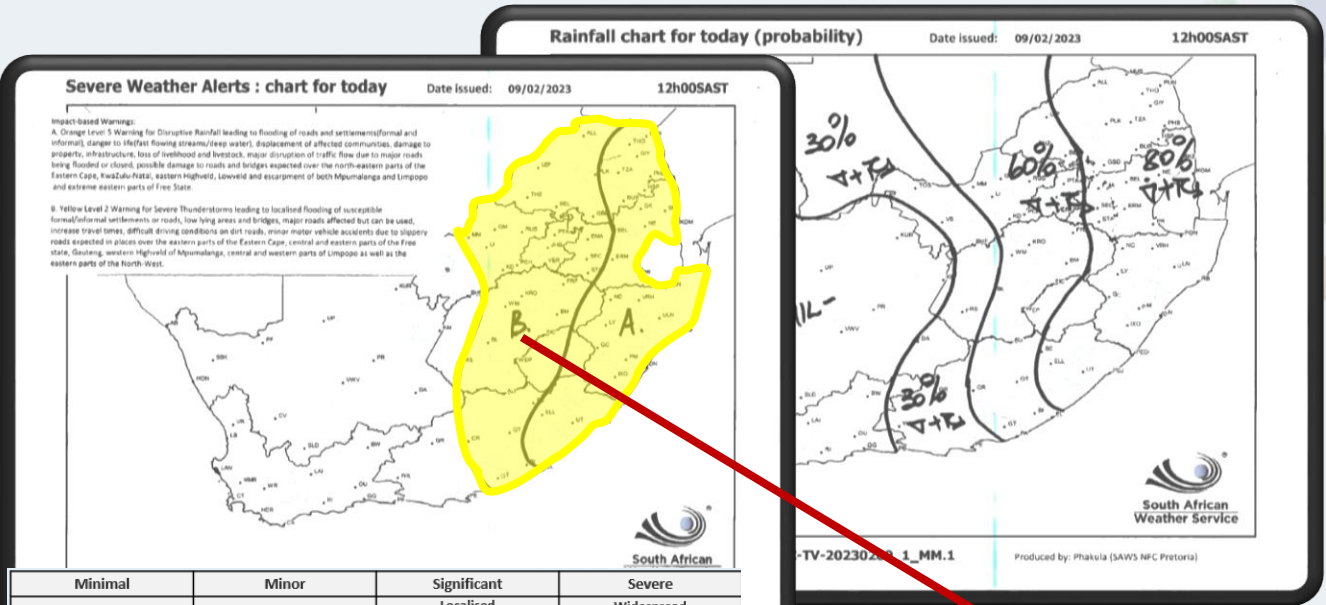
## Impact

- Time of the day
- Time of the year
- Antecedent conditions
- Rural vs Urban
- Non-weather factors

## Likelihood

- Forecast uncertainty
- Most likely scenario
- Reasonable worst-case scenario

# How does it work?



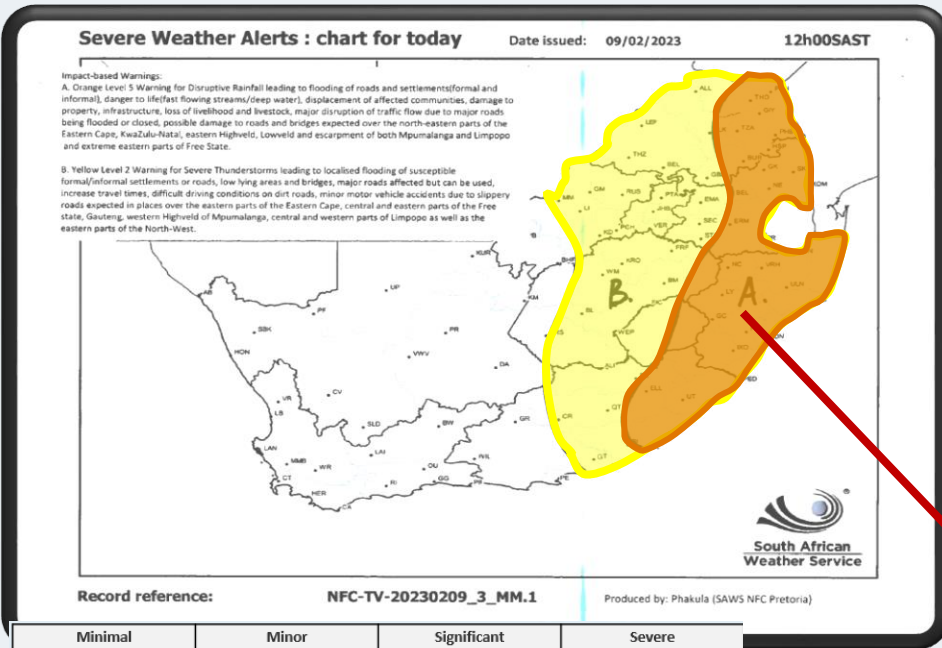
- Forecasters identify a region where rainfall could result in adverse impacts
- Based on the *Impact tables*, the most appropriate *impact level* is identified for an area
- The expected *likelihood* of these impacts to occur is determined
- Then the appropriate *warning risk level* is established

Minimal	Minor	Significant	Severe
Business as usual	<u>Localised</u> Business as usual	<u>Localised</u> Short term strain on emergency personnel	Widespread Prolonged strain on emergency personnel
<ul style="list-style-type: none"> <li>• Some pooling of water on roads or in formal/informal settlements</li> <li>• Day to day activities not disturbed</li> <li>• Wet roads and reduced visibility</li> <li>• Minimal traffic congestion</li> <li>• Isolated mudslides and rockfalls</li> </ul>	<ul style="list-style-type: none"> <li>• Localised flooding of susceptible formal/informal settlements or roads, low-lying areas and bridges</li> <li>• Major roads affected but can be used, increased travel times</li> <li>• Difficult driving conditions on dirt roads</li> <li>• Minor motor vehicle accidents due to slippery roads and/ reduced visibility</li> <li>• Closure of roads crossing low water bridges</li> </ul>	<ul style="list-style-type: none"> <li>• Flooding of roads and settlements (formal and informal)</li> <li>• Danger to life (fast flowing streams / deep water)</li> <li>• Displacement of affected communities</li> <li>• Some communities temporarily not accessible/cut-off</li> <li>• Damage to property, infrastructure, loss of livelihood and livestock</li> <li>• Major disruption of traffic flow due to major roads being flooded or closed</li> </ul>	<ul style="list-style-type: none"> <li>• Widespread flooding of roads and settlements</li> <li>• Danger to life (fast flowing streams / deep water)</li> <li>• Large communities not accessible/cut-off for a prolonged period</li> <li>• Widespread displacement of affected communities</li> <li>• Widespread damage to property, buildings and loss of livelihoods and livestock</li> <li>• Widespread transport routes and travel services severely affected</li> <li>• Major roads and bridges damaged or washed away</li> </ul>

Likelihood	High	✓	6	10	
	Medium	1	5	9	
	Low		4	8	
	Very Low		3	7	
		Minimal	Minor	Significant	Severe
		Impact			

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# How does it work?



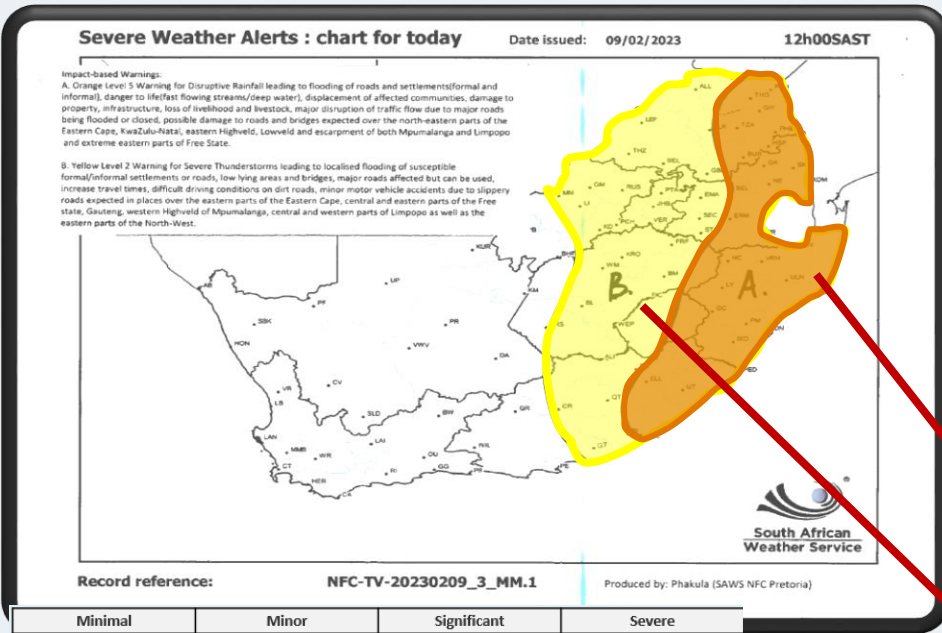
Minimal	Minor	Significant <u>Localised</u>	Severe Widespread
Business as usual	<u>Localised</u> Business as usual	Short term strain on emergency personnel	Prolonged strain on emergency personnel
<ul style="list-style-type: none"> <li>Some pooling of water on roads or in formal/informal settlements</li> <li>Day to day activities not disturbed</li> <li>Wet roads and reduced visibility</li> <li>Minimal traffic congestion</li> <li>Isolated mudslides and rockfalls</li> </ul>	<ul style="list-style-type: none"> <li>Localised flooding of susceptible formal/informal settlements or roads, low-lying areas and bridges</li> <li>Major roads affected but can be used, increased travel times</li> <li>Difficult driving conditions on dirt roads</li> <li>Minor motor vehicle accidents due to slippery roads and/ reduced visibility</li> <li>Closure of roads crossing low water bridges</li> </ul>	<ul style="list-style-type: none"> <li>Flooding of roads and settlements (formal and informal)</li> <li>Danger to life (fast flowing streams / deep water)</li> <li>Displacement of affected communities</li> <li>Some communities temporarily not accessible/cut-off</li> <li>Damage to property, infrastructure, loss of livelihood and livestock</li> <li>Major disruption of traffic flow due to major roads being flooded or closed</li> </ul>	<ul style="list-style-type: none"> <li>Widespread flooding of roads and settlements</li> <li>Danger to life (fast flowing streams / deep water)</li> <li>Large communities not accessible/cut-off for a prolonged period</li> <li>Widespread displacement of affected communities</li> <li>Widespread damage to property, buildings and loss of livelihoods and livestock</li> <li>Widespread transport routes and travel services severely affected</li> <li>Major roads and bridges damaged or washed away</li> </ul>

		High	2	6	10
Likelihood	High		2	6	10
	Medium		1	5 ✓	9
	Low			4	8
	Very Low			3	7
		Minimal	Minor	Significant	Severe
		<b>Impact</b>			

- Forecasters identify a region where rainfall could result in adverse impacts
- Based on the *Impact tables*, the most appropriate *impact level* is identified for an area
- The expected *likelihood* of these impacts to occur is determined
- Then the appropriate *warning risk level* is established
- The same is done for areas with higher vulnerability



# How does it work?



Minimal	Minor	Significant	Severe
Business as usual	Localised Business as usual	Localised Short term strain on emergency personnel	Widespread Prolonged strain on emergency personnel
<ul style="list-style-type: none"> <li>Some pooling of water on roads or in formal/informal settlements</li> <li>Day to day activities not disturbed</li> <li>Wet roads and reduced visibility</li> <li>Minimal traffic congestion</li> <li>Isolated mudslides and rockfalls</li> </ul>	<ul style="list-style-type: none"> <li>Localised flooding of susceptible formal/informal settlements or roads, low-lying areas and bridges</li> <li>Major roads affected but can be used, increased travel times</li> <li>Difficult driving conditions on dirt roads</li> <li>Minor motor vehicle accidents due to slippery roads and/ reduced visibility</li> <li>Closure of roads crossing low water bridges</li> </ul>	<ul style="list-style-type: none"> <li>Flooding of roads and settlements (formal and informal)</li> <li>Danger to life (fast flowing streams / deep water)</li> <li>Displacement of affected communities</li> <li>Some communities temporarily not accessible/cut-off</li> <li>Damage to property, infrastructure, loss of livelihood and livestock</li> <li>Major disruption of traffic flow due to major roads being flooded or closed</li> </ul>	<ul style="list-style-type: none"> <li>Widespread flooding of roads and settlements</li> <li>Danger to life (fast flowing streams / deep water)</li> <li>Large communities not accessible/cut-off for a prolonged period</li> <li>Widespread displacement of affected communities</li> <li>Widespread damage to property, buildings and loss of livelihoods and livestock</li> <li>Widespread transport routes and travel services severely affected</li> <li>Major roads and bridges damaged or washed away</li> </ul>

Likelihood	High	6	10	
	Medium	1	9	
Low	4	8		
Very Low	3	7		
	Minimal	Minor	Significant	Severe
<b>Impact</b>				

- Coordination with disaster management is important for **orange** and **red** warnings.
- Important to note the difference in impact and likelihood of the yellow and orange warnings
- These warnings require a different response from disaster management depending on its **impact** and **likelihood** levels


# Examples of Impact-based warnings

Bloemfontein Weather Office  
Bram Fischer Int. Airport  
Mazelspoort Road  
Bloemfontein  
9300

E-Mail: fablfc@weathersa.co.za  
Tel: 051 433 2301

Likelihood	High	2			
	Medium				
	Low				
	Very Low				
	Minimal	Minor	Significant	Severe	

**Impact**



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IMPACT BASED WARNING issue :10:05 on Thu 09 Feb 2023

**LEVEL 2 for Disruptive Rain**

WARNING valid Thu 09 Feb 01:00 Until Thu 09 Feb 18:00

Affected DM / LM / Metro area
City of Matlosana, Dihlabeng, Ditsobotla, Kgetlengrivier, Local Municipality of Madibeng, Mafube, Mahikeng, Maluti a Phofung, Mantsopa, Metsimaholo, Mohokare, Moqhaka, Moretele, Moses Kotane, Naledi, Ngwathe, Nketoana, Phumelela, Ramotshere Moiloa, Rustenburg, Setsoto, Ventersdorp, Ventersdorp
Short Message
leading to flooding over the east of both North-West and Free State, as well as along the Lesotho border today.
Discussion
Cut-off low becoming an upper trough and moving out of the region resulting in disruptive rain in the east and along the Lesotho border.
Impacts
Flooding of potholes, settlements and low-lying bridges. Difficult driving conditions on dirt roads. Motor vehicle accidents due to slippery roads and reduced visibility. Localised and short term disruption to essential services (water, electricity, communication network, etc).
Instruction
If possible stay indoors and off the roads, avoid crossing rivers and swollen streams where water is above your ankles. If trapped in a vehicle during a flood, abandon it and climb to higher ground. In buildings, move valuables to a safe place above the expected flood level.


Public Document: IBF v1.0

National Forecast Centre  
01 EcoPark, EcoGlades, Block B  
Cnr Olievenhoutbosch &  
Ribbon Grass St  
Centurion, 0157

nfcfcast@weathersa.co.za  
Tel: 012 367 6041

Likelihood	High		5		
	Medium				
	Low				
	Very Low				
	Minimal	Minor	Significant	Severe	

**Impact**



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IMPACT BASED WARNING issue :12:21 on Thu 09 Feb 2023

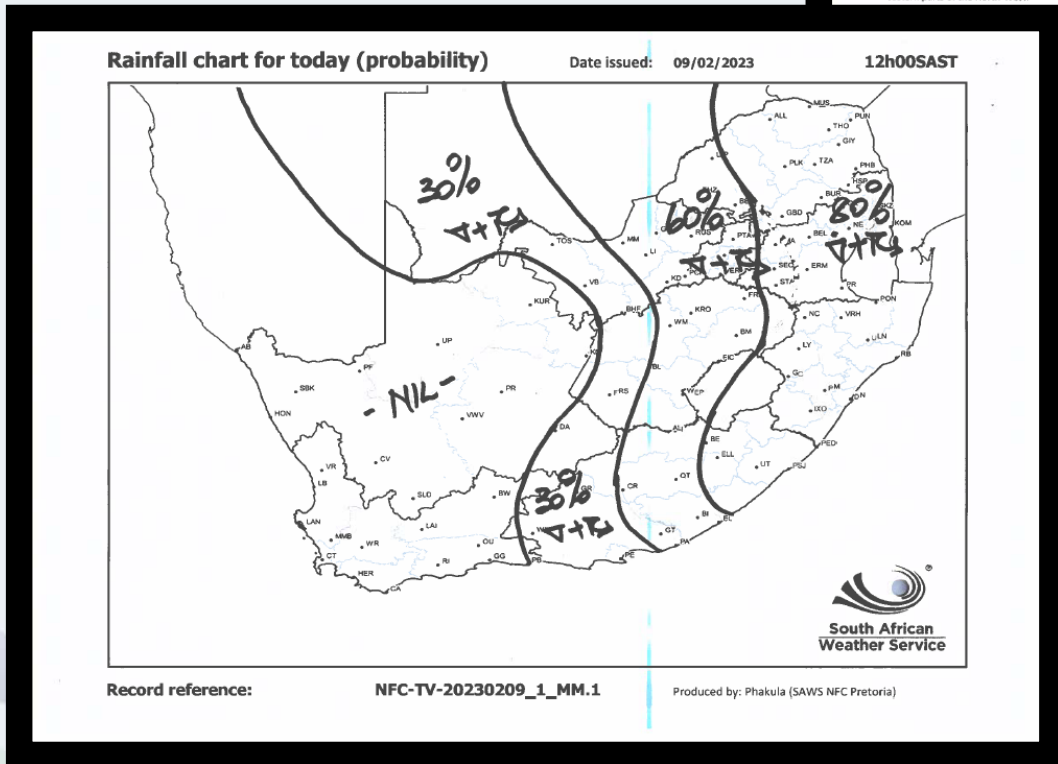
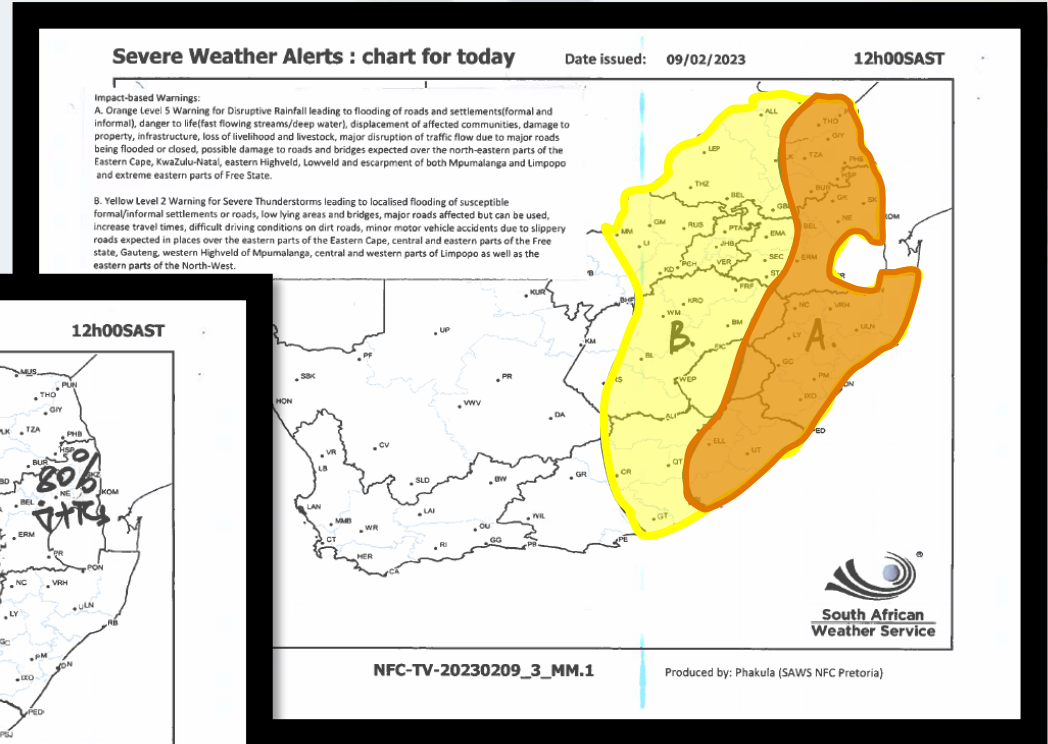
**LEVEL 5 for Disruptive Rain**

WARNING valid Thu 09 Feb 15:00 Until Thu 09 Feb 23:00

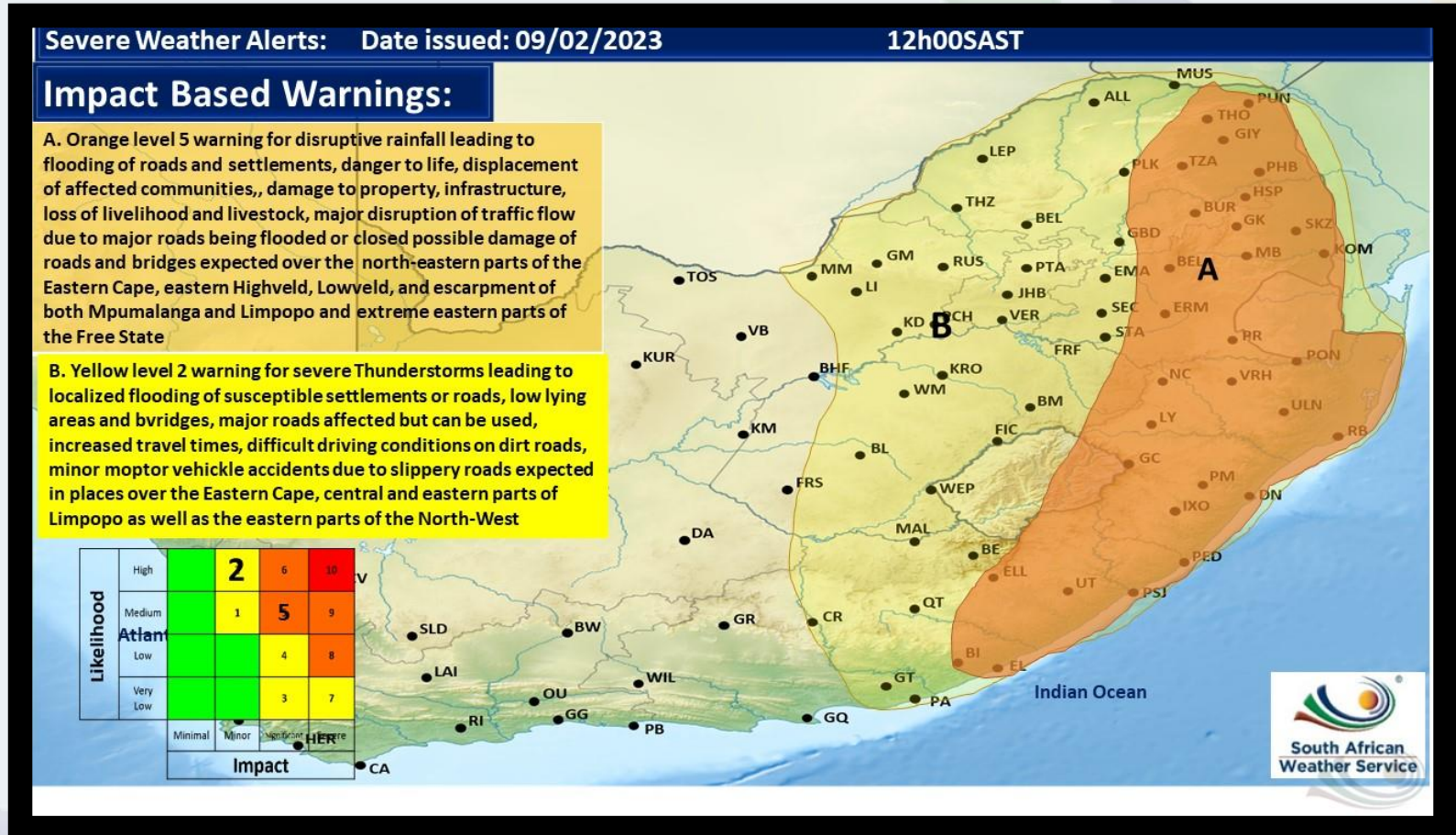
Affected DM / LM / Metro area
Albert Luthuli, Ba-Phalaborwa, Bushbuckridge, Collins Chabane, Emakhazeni, Fetakgomo, Greater Giyani, Maruleng, Mbombela - Barberton, Mbombela - Sabie, Mkhondo, Msukaligwa, Musina, Nkomazi, Pixley Ka Seme, Thaba Chweu, Thulamela
Short Message
is expected along the escarpment and in the Lowveld of both Mpumalanga and Limpopo as well as the Limpopo Valley today.
Discussion
Thundershowers are expected to continue over parts of Limpopo and Mpumalanga on Thursday and may also continue into Friday (10 Feb 2023). These thundershowers are expected to be slow moving in nature and may produce heavy rainfall (50-80mm/3h), which may lead to flooding and possible significant impacts.
Impacts
<ol style="list-style-type: none"> <li>1. Flooding of roads and settlements (formal and informal).</li> <li>2. Disruptions to traffic flow due to major roads being flooded or closed.</li> <li>3. Danger to life due to fast flowing streams.</li> <li>4. Some communities may be temporarily not accessible/cut-off.</li> <li>5. Damage to property, bridges and roads.</li> </ol>
Instruction
<p>Instruction: If possible stay indoors and off the roads, avoid crossing rivers and swollen streams where water is above your ankles. If trapped in a vehicle during a flood, abandon it and climb to higher ground. In buildings, move valuables to a safe place above the expected flood level.</p> <p>Load WeatherSmart APP, scroll to last page and use two fingers to navigate storm tracking application.</p>

Public Document: IBF v1.0

# How will the SABC receive these warnings?



# How do the social media warning charts look?





# As a result

Yellow  
warning

Orange  
warning

Red  
Warning

1. Easy to understand
  - Colour coded
  - Easy to translate
2. It is a user oriented, risk-based Early Warning System, **adapted** for **specific country conditions**.
3. Combines level of **impact** with **likelihood** of the impact occurring
4. Warnings are unique to hazard and area
5. Joint ownership of warnings with disaster management
6. Supports and guides the decision-making process in the Disaster Management Centres.



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